

ArcWorld[®] II-6000 Series SYSTEM MANUAL

for ArcWorld II-6000 and II-6000HD Systems

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

MOTOMAN INSTRUCTIONS

MOTOMAN XXXXXXXX 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: 156983-1CD

Revision: 0



YASKAWA

MANUAL NO.

156983-1CD 



MANDATORY

- This system manual provides an overview of the Motoman ArcWorld® II-6000 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-6000 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 revision 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-6000 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 front door of the DX100 controller and on the 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.

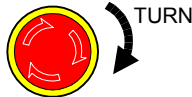
Figure 1: EMERGENCY STOP Button



- 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 immediately if there is a problem. The EMERGENCY STOP buttons are located on the right of the front door of the DX100 controller 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-6000 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

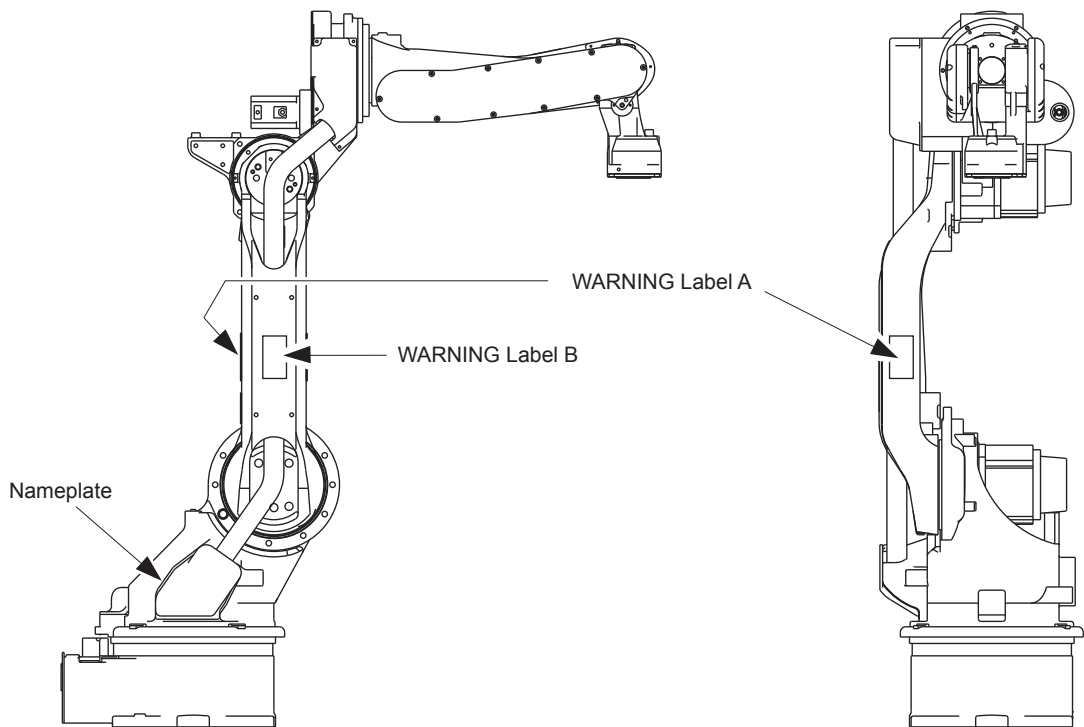
Explanation of Warning Labels

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:

MOTOMAN	
TYPE □□□□□	
PAYLOAD □□ kg	MASS □□□ kg
ORDER NO. □□□□□□	DATE □□
SERIAL NO. □□□□□□	
 YASKAWA ELECTRIC CORPORATION JAPAN	

WARNING Label A:



WARNING Label B:



1	Introduction	1-1
1.1	About This Document	1-1
1.2	System Overview	1-2
1.2.1	System Layout	1-3
1.2.2	Major Components	1-3
1.2.3	Optional Equipment	1-4
1.3	Reference Documentation	1-4
1.4	Customer Support Information	1-5
2	Equipment Description	2-1
2.1	Robot Description	2-1
2.2	DX100 Controller	2-1
2.3	Programming Pendant	2-3
2.4	Operator Station	2-4
2.4.1	Cycle Start/Cycle Latched	2-4
2.4.2	Emergency Stop (E-STOP)	2-5
2.5	RM2-250 STN and RM2-500 STN Positioner	2-5
2.6	Welding Equipment	2-6
2.6.1	Welding Power Sources	2-6
2.6.2	Wire Feeder	2-6
2.6.3	GMAW Torch	2-6
2.7	Safety Features	2-7
2.7.1	Welding Arc Protection	2-7
2.7.2	Safety Fencing	2-7
2.7.3	Safety Light Curtains	2-8
2.7.4	Emergency Stops (E-STOPS)	2-8
2.7.5	Programming Pendant's Enable Switch	2-8
2.7.6	Emergency Braking System	2-8
2.7.7	Interlocked Work-cell Doors	2-9
3	Installation	3-1
3.1	Required Materials	3-1
3.1.1	Customer-supplied Items	3-1
3.1.2	Recommended List of Hand Tools and Equipment	3-2
3.2	Site Preparation	3-2

3.3	Removal of System Components from Shipping Skids	3-4
3.4	Component Installation	3-5
3.4.1	Place System Components	3-5
3.4.2	Level and Secure System Components	3-6
3.4.3	Door Latch Alignment	3-7
3.5	Installation — Arc Curtains	3-8
3.6	Light Curtain Alignment	3-9
3.7	Cable Connections	3-9
3.7.1	Connection to Earth Ground	3-9
3.7.2	Connecting the Robot Cables	3-10
3.7.3	Connection to Local Electrical Service	3-12
3.7.3.1	DX100 Controller	3-13
3.7.3.2	Welding Power Source	3-13
3.8	Safety/Operation Check	3-13
3.9	Installation of Tooling and Fixtures	3-14
4	Operation	4-1
4.1	Programming	4-1
4.2	Sweeping the Positioner	4-2
4.3	Daily Operation	4-2
4.3.1	Start-up Procedure	4-2
4.3.2	Robot HOME Position	4-3
4.3.3	Control Master Job	4-3
4.3.4	Operation Cycle	4-4
4.3.5	Shutdown Procedure	4-4
4.4	System Recovery	4-4
4.4.1	Alarms and Errors	4-4
4.4.1.1	Error Messages	4-5
4.4.1.2	Minor Alarms	4-5
4.4.1.3	Major Alarms	4-5
4.4.2	E-STOP Recovery	4-5
4.4.3	Shock Sensor Recovery	4-6
4.4.4	Brake Release	4-6
5	Maintenance	5-1
6	Anchor Requirements	6-1

1 Introduction

1.1 About This Document

This system manual is delivered with both the ArcWorld II-6000 and ArcWorld II-6000HD systems to provide a “first look” and overview of the complete Motoman ArcWorld® II-6000 Series systems. You should read and understand this system manual before moving on to the more detailed documentation that is included with your ArcWorld® II-6000 Series system. Although basic in content, the system manual is intended for personnel who have received operator training from Motoman and who are familiar with the operation of this particular Motoman system. For more detailed information on any specific component or peripheral of the ArcWorld® II-6000 Series system, please review the full documentation package that is included with your ArcWorld® II-6000 Series system (refer to *Section 1.3*).



This manual documents a **standard** Motoman system. If your system is custom or modified, please use this manual in conjunction with the drawings, schematics, and parts listing (Bill of Material) for your specific system. The drawings, schematics, and parts listing are included in the documentation package supplied with your ArcWorld® II-6000 Series system.

This system manual contains the following sections:

Section 1 – Introduction

This section provides general information about the ArcWorld® II-6000 Series and its components, a list of reference documents, and customer service contact information.

Section 2 – Equipment Description

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

Section 3 – Installation

This section provides installation procedures for the ArcWorld® II-6000 Series system.

Section 4 – Operation

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

Section 5 – Maintenance

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

Section 6 – Anchor Requirements

This section gives recommended anchoring hardware specifications and foundation requirements for all the equipment that is part of the ArcWorld® II-6000 Series system.

ArcWorld® II-6000 Series	1	Introduction
	1.2	System Overview

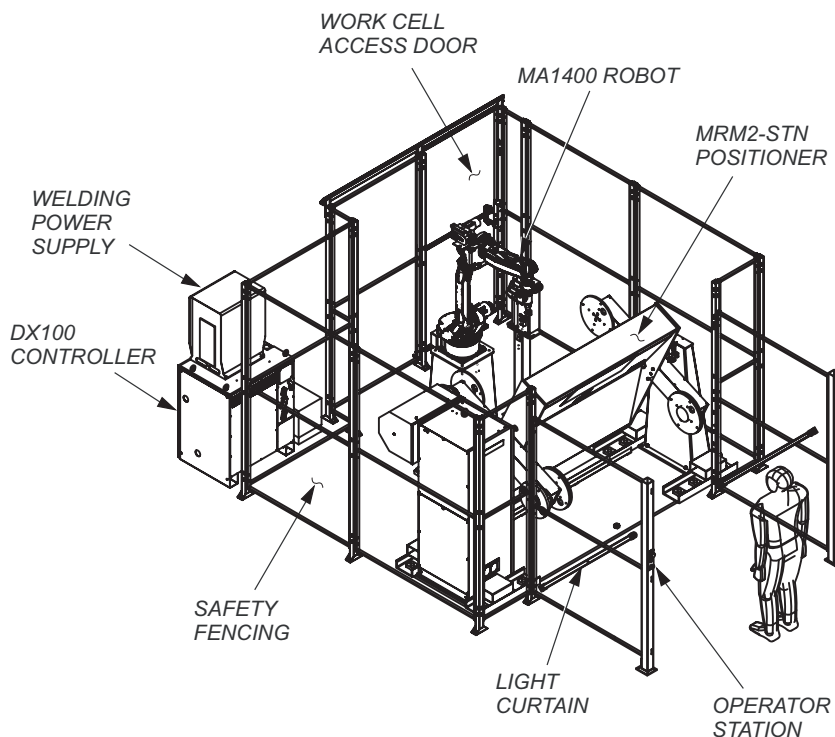
1.2 System Overview

The ArcWorld® II-6000 Series system provides a complete arc-welding solution in a standardized configuration. The system is designed around the Motoman MA-series six-axis, arc-welding robot; DX100 controller; MRM2-250 STN or MRM2-500 STN positioner; and a complete welding package. The MRM2-250STN positioner (AWII-6000) features 250-kg capacity per side, a 1,170-mm maximum part diameter and a 2-second indexing time. Two spans are available: 2.6-m or 1.6-m. The MRM2-500STN positioner (AWII-6000HD) features 500-kg capacity per side, a 1,350-mm maximum part diameter and a 5-second indexing time. The MRM2-STN positioner is an AC servo-driven headstock/tailstock (HS/TS) positioner that allows an operator to prepare and set up parts on one side of the positioner while the robot welds previously loaded parts on the other side of the positioner. Control of an external axis is provided by a kit installed in the cabinet of the DX100 controller.

The ArcWorld® II-6000 Series system features a total safety environment that meets or exceeds the requirements of the ANSI/RIA R15.06-1999 Robot Safety standard, as well as the CAN/CSA-Z434-94 Canadian standard. Heavy-gauge, wire-mesh safety fencing encloses the robot side of the ArcWorld® II-6000 Series work cell to prevent unintended entry of personnel while the robot is performing a welding task. Arc curtains cover the wire-mesh fencing to reduce the levels of arc radiation that escape the interior of the work cell during welding operations. A sliding access door is part of the safety fence assembly and provides access to the work cell (see *Figure*). The access door incorporates a dual-channel (redundant circuitry), tamper-proof safety interlock to disable all equipment should the access door be opened while the robot is active. A dual-channel (redundant circuitry) safety light curtain system protects the operator from positioner movement by establishing an infrared light field between the Send unit and the Receive unit in front of the positioner (see *Figure*). In effect, the light field defines a protected zone in front of the positioner. Positioner movement is prevented (or stopped) whenever a person or object interrupts (breaks) the light field.

Figure 1-1 illustrates the layout of the ArcWorld® II-6000 Series system and the location of its components.

Fig. 1-1: Overview and Component Location (ArcWorld II-6000 shown)



1.2.1 System Layout

All components of the ArcWorld® II-6000 Series work cell are mounted individually to the floor. This system does not use common equipment bases. Heavy-gauge, wire-mesh safety fencing is installed at the customer's site to completely surround the work cell. One safety-interlocked access door at the rear of the work cell is part of the safety fencing and provides access to the work cell for programming and maintenance personnel. Both the DX100 controller and the welding power source are located outside of and to the side of the work cell. All system controls, including those on the Programming Pendant, DX100 controller, welding power supply, and Operator Station, are safely accessible from outside the ArcWorld® II-6000HD work cell.

1.2.2 Major Components

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

- MA1400 (or optional MA1900) robot
- DX100 controller (with external axis kit installed)
- One MRM2-250 STN positioner; 2.6-m or 1.6-m span (AWII-6000)
or
One MRM2-500 STN positioner, 3.0-m span (AWII-6000HD)
- One Programming Pendant (located on the DX100 controller)
- One fence-mounted Operator Station
- Welding equipment:
 - Welding power supply
 - Welding torch (water-cooled or air-cooled)
 - Wire feeder

ArcWorld® II-6000 Series	1	Introduction
	1.3	Reference Documentation

- Applicable welding interface
- Torch mount
- Safety equipment:
 - Heavy gauge, wire-mesh safety fencing
 - Arc curtains (covering 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® II-6000 Series system:

- Torch cleaner
- Wire cutter
- Water circulator
- Touch Sense™ (starting point detection unit)
- ComArc™ (seam tracking)

1.3 Reference Documentation

For additional information on individual components of the ArcWorld® II-6000 Series system, refer to the following documentation that is included with your delivered system:

- Motoman *MA1400 Manipulator Manual* (P/N 155557-1CD)
- Motoman *MA1900 Manipulator Manual* (P/N 156226-1CD)
- 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 *RM2-250 STN Positioner Manual* (P/N 155092-1CD)
- Motoman *RM2-500 STN Positioner Manual* (P/N 155229-1CD)
- Motoman *DX100 Independent/Coordinated Control Function Manual*
- Motoman *INFORM User's Manual* (P/N 155493-1CD)
- Vendor manuals for system components not manufactured by Motoman

ArcWorld® II-6000 Series	1	Introduction
	1.4	Customer Support Information

1.4 Customer Support Information

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

(937) 847-3200

Please have the following information ready before you call:

- | | |
|----------------------------|--|
| • System | ArcWorld® II-6000 Series, DX-Series |
| • Robot | MA1400, MA1900 |
| • Positioner | RM2-250 STN or RM2-500 STN |
| • Primary Application | Welding |
| • Controller | DX100 |
| • Software Version | Access this information on the Programming Pendant display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION} |
| • Robot Serial Number | Located on a data plate on the rear of each robot arm |
| • Robot Sales Order Number | Located on a data plate on the front door of the DX100 controller |

ArcWorld® II-6000 Series	2	Equipment Description
	2.1	Robot Description

2 Equipment Description

2.1 Robot Description

The ArcWorld® II-6000 Series system is equipped with a Motoman MA1400 or optional MA1900 robot (depending upon the customer's order and preference). Both robot models are six-axis units that are specifically designed for arc-welding applications.

Each robot model has a payload capability of 3 kg. The MA1400 robot has a horizontal reach of 1434 mm, while the MA1900 robot has a horizontal reach of 1904 mm. Each robot has a relative positioning accuracy of ± 0.08 mm.

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

The robot's B-axis (Pitch/Yaw) features a large range of motion that allows full circumferential welding on cylindrical work pieces. The welding torch cable connects to a torch mount in the center of the hollow wrist flange (T-axis). This feature allows the robot to rotate the welding torch $\pm 360^\circ$ without cable interference or cable stress.

For additional information on the Motoman MA-series robots, please refer to the *MA1400 Manipulator Manual* or the *MA1900 Manipulator Manual* that is included with your ArcWorld® II-6000 Series system documentation package (see *Section 1.3*).

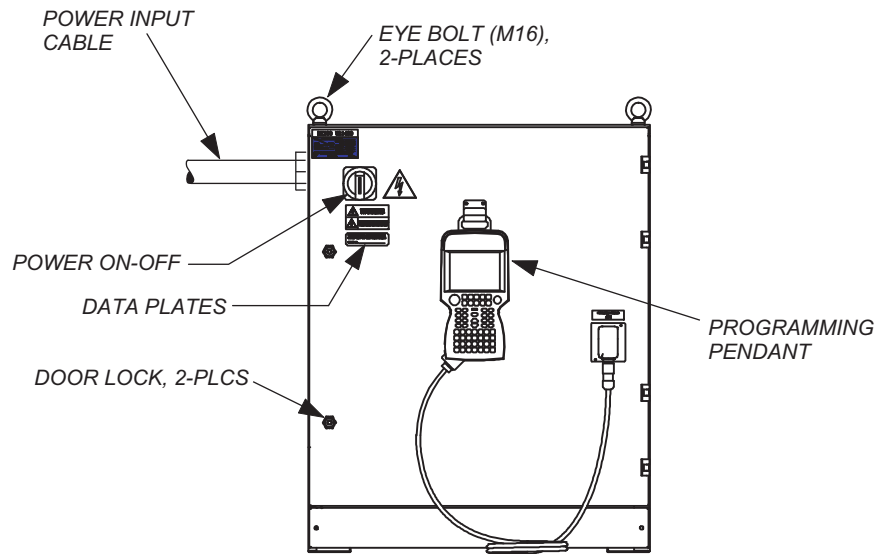
2.2 DX100 Controller

The ArcWorld® II-6000 Series system features a DX100 controller (see *Figure 2-2*). The DX100 controls the movement of the single or multiple robots. It also controls the welding power source(s) and the positioner and provide the signals necessary to operate the welding system.

The DX100 controllers feature a real-time operating system (RTOS) and is programmed with the Motoman INFORM programming language. For more detailed information on the DX100 controller, refer to the *DX100 Controller Manual* that is included with your ArcWorld® II-6000 Series system (see *Section 1.3*).

ArcWorld® II-6000 Series 2 Equipment Description
2.2 DX100 Controller

Figure 2-2: DX100 Controller

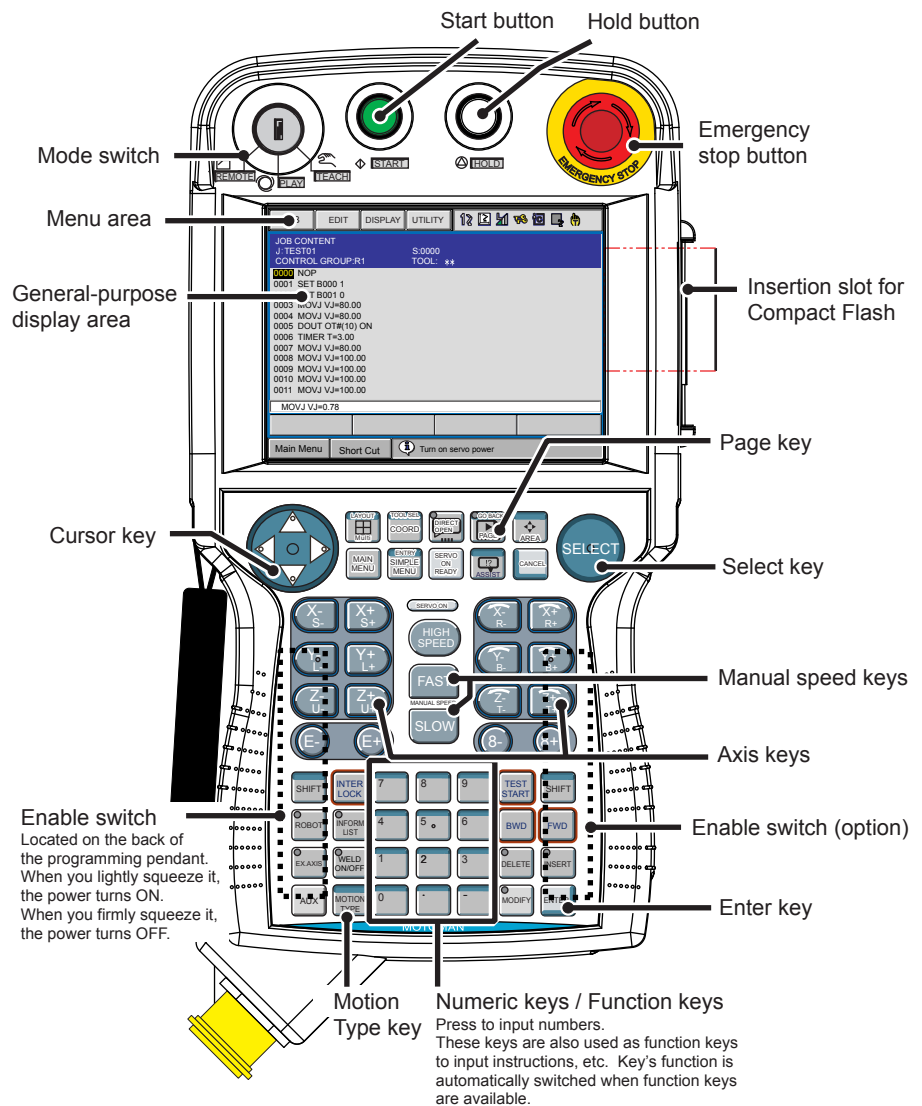


2.3 Programming Pendant

The Programming Pendant (see *Figure 2-3*) provides the primary means of programmer/operator interaction with the ArcWorld® II-6000 Series system. The pendant features the Windows® CE operating system and displays information on a 6½ -inch, color LCD, touch-screen display (640 X 480 VGA). The pendant also incorporates a Compact Flash card and USB port for program backups.

The 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 the DX100 controller cabinet to be mounted remotely. By using the pendant, the operator can teach the robots motion; perform programming, editing, maintenance, and diagnostic functions; and transfer control of the ArcWorld® II-6000 Series system to or from the Operator Station. For detailed information on the pendant programming keys, programming functions, and display functions, please refer to the DX100 *Operator's Manual for Arc Welding* that is included with your ArcWorld® II-6000 Series system (see *Section 1.3*).

Figure 2-3: DX100 Programming Pendant



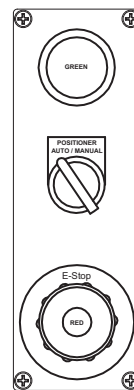


- The Programming Pendant's LCD display goes dark after a few minutes of inactivity. Press any key to restore the screen.
- Operator Station "enable" or "disable" is accomplished with the Programming Pendant's Mode Select Switch. To transfer control of the ArcWorld® II-6000 Series system to the Operator Station, set the Programming Pendant's Mode Select Switch to REMOTE. The Operator Station enable/disable function cannot be selected at the Operator Station.

2.4 Operator Station

The standard Operator Station includes a NEMA enclosure and is mounted on the ArcWorld system fence post. The standard Operator Station includes the Positioner Auto/Manual, Cycle Start, and E-Stop buttons.

Figure 2-4: Operator Station



2.4.1 Cycle Start/Cycle Latched

The operation of the Cycle Start/Cycle Latched button depends upon the structure of the Control Master job.

The green Cycle Start/Cycle Latched button, located on the Operator Station, initiates a positioner sweep cycle if 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 and the positioner does not sweep until the robot returns to Home position.

The green 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 weld cycle is complete and the robot has returned to Home position. 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 to sweep the positioner. Pressing the Cycle Start/Cycle Latched button while the robot is still in motion latches the Cycle Start command into the controller. If a person or object enters the safety zone created by the safety light curtain system, the Cycle Start command will unlatch and the positioner will not sweep.

ArcWorld® II-6000 Series	2	Equipment Description
	2.5	RM2-250 STN and RM2-500 STN Positioner

2.4.2 Emergency Stop (E-STOP)

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

2.5 RM2-250 STN and RM2-500 STN Positioner

The Motoman RM2-series positioners are AC servo-driven headstock/tailstock (HS/TS) positioners. This type of positioner is often referred to as a “Ferris wheel” positioner because of its operational dynamics. All the RM2-series positioners have three axes. Since the RM2-series positioners use only a single servo motor, however, only one of the three axes can be driven at any time.

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

The MRM2-250 STN positioner has a load capacity of 250 kg per side, a 1,170-mm maximum part diameter, and a “Side A-to-Side B sweep time” of 2 seconds. The standard distance between the headstock/tailstock face plates is 2600 mm, with 1600 mm available as an option (see *Figure 3-5*). Positioning accuracy for the RM2-250 STN is ± 0.1 mm.

The MRM2-500 STN positioner has a load capacity of 500 kg per side, a 1350-mm maximum tooling diameter, and a “Side A-to-Side B sweep time” of 5 seconds. The standard distance between the headstock/tailstock face plates is 3000 mm. Positioning accuracy for the MRM2-500 STN is ± 0.1 mm.

The MRM2-series positioners are capable of synchronized motion between various components depending on the job configuration. Synchronized components move at the same time during welding operations. The robot can be synchronized with the MRM2-series positioner. The MRM2-series positioners are also capable of true coordinated motion, where linear, circular, or spline motion can be coordinated between the robot and the positioner. Coordinated motion allows the robot to weld while the positioner rotates the parts.

The MRM2-series positioner is equipped with fixture-locking pins that prevent the headstock and tailstock face plates from turning when the servo motor disengages. The fixture-locking pins are spring-loaded to ensure pin engagement when the servo motor retracts. Each headstock face plate incorporates two locking pins.

For additional information on coordinated motion, refer to the *DX100 Independent/Coordinated Control Function Manual* included with your ArcWorld® II-6000 Series system documentation (see *Section 1.3*).

For detailed positioner information, including illustrated parts lists, load capabilities, and dimensions, refer to the *RM2-250 STN Positioner Manual* or *RM2-500 STN Positioner Manual* included with your ArcWorld® II-6000 Series system documentation (see *Section 1.3*).



- The customer shall supply all tooling and fixtures for the positioner.
- Motoman recommends application of a corrosion/rust preventive compound to tooling and fixtures located in a high-humidity environment.

2.6 Welding Equipment

In its standard configuration, the ArcWorld® II-6000 Series system includes a welding power source, wire feeder, torch, and torch mount for the robot. Optional equipment — water-cooled torch, water circulators, ComArc™ seam tracking units, and torch tenders — may also be included with your ArcWorld® II-6000 Series system.

2.6.1 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® II-6000 Series system depends on the customer's specific application and preference. For specific information on the welding power sources supplied with your ArcWorld® II-6000 Series system, refer to the welding power source vendor manual that is included with your system (see *Section 1.3*).

2.6.2 Wire Feeder

A welding wire feeder is mounted on the upper arm (U-Axis) of the MA1400 robot. The wire feeder is the "4-roll" type and provides reliable wire feeding at rates up to 750 inches per minute (ipm). An integral gas valve provides fast shielding gas response time. Interchangeable feed rolls are used to accommodate different wire gauges and wire types. For additional information on how the wire feeder is mounted to the robot's upper arm, including allowable load and installation position, refer to the *MA1400 Manipulator Manual* that is included with your ArcWorld® II-6000 Series system (see *Section 1.3*).

2.6.3 GMAW Torch

The ArcWorld® II-6000 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 flange. The torch mount provides multi-dimensional impact (collision) detection to protect the robot, torch, fixture, positioner, and work piece from damage in the event of a collision. Any torch impact (collision) triggers an emergency stop condition (refer to *Section 4.4.2*).

For applications that use the optional water-cooled torch, the ArcWorld® II-6000 Series system includes a water circulator kit for each robot. For additional information on the torches that are supplied with your system, refer to the documentation that is included with your ArcWorld® II-6000 Series system (see *Section 1.3*).

2.7 Safety Features

The ArcWorld® II-6000 Series 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.



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

ArcWorld® II-6000 Series	2	Equipment Description
	2.7	Safety Features

2.7.1 Welding Arc Protection

Three forms of welding arc protection are part of the ArcWorld® II-6000 Series system:

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

The positioner's arc screen and the additional shield panels protect the operator from arc radiation and sparks that result from the welding operation (see *Figure 1-1* and *Figure 3-5*).



WARNING

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

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

2.7.2 Safety Fencing

A heavy-gauge, steel-mesh safety fence assembly provided with the system encloses the robot side of the work cell (see *Figure 1-1*). It forms a physical barrier that prevents the unintentional movement of personnel or objects into the work cell during automatic operation. A dual-channel, interlocked sliding door at the rear of the work cell provides a work cell point-of-entry for programming and maintenance personnel (refer to *Section 2.7.7*).

2.7.3 Safety Light Curtains

The safety light curtain system consist of two units (a Send unit and a Receive unit) that emit and receive infrared light pulses to create an invisible protective field. The infrared light pulses, coded by the Send unit, are sent to the Receive unit, which evaluates them. If an object or person penetrates the protective field created by the infrared light, outputs of the safety light curtain system change state to stop all machine motion. The safety light curtain system incorporates a dual-channel safety feature. The dual-channel feature provides redundant operation to ensure a continuous field of coverage for the area protected by the light curtain units.

With the ArcWorld® II-6000 Series system, the safety light curtains are set up to protect personnel who might unintentionally enter the positioner area during the positioner sweeping process. In Play mode, if the positioner is sweeping and the operator steps into the safety zone (defined by the light curtain Send and Receive units), servo power is removed from the ArcWorld® II-6000 Series system, and all positioner motion stops. Servo power can be reapplied and operation resumed (after the operator is clear of the protected area) by pressing SERVO ON and START on the Operator Station panel. For additional information on the safety light curtain system, refer to the vendor documentation that is included with your ArcWorld® II-6000 Series system (see *Section 1.3*).

2.7.4 Emergency Stops (E-STOPS)

In addition to the safety features described above, the ArcWorld® II-6000 Series system incorporates large, red Emergency Stop (E-STOP) push buttons that are placed in accessible locations. When any E-STOP push button is activated (pushed in), the E-STOP circuitry immediately stops all system operation and robot movement.

E-STOP push buttons are found in the following locations:

- The door of DX100 controller
- The Programming Pendant
- The Operator Station pedestal

2.7.5 Programming Pendant's Enable Switch

The Enable switch is a three-position switch located on the left rear of the Programming Pendant (see *Figure 2-3*). It is a safety feature that controls servo power while the system is in Teach mode. When pressed in, this switch allows the operator to turn servo power ON. Should the operator release the switch or grasp it too tightly, however, servo power is immediately removed, thus preventing further robot movement. For detailed information about the operation of the Enable switch, refer to the *Operator's Manual* included with your ArcWorld® II-6000 Series system (see *Section 1.3*).

2.7.6 Emergency Braking System

The MA1400 manipulator incorporates a series of brakes that are designed to protect the robot and other system components from damage in the event of a software or hardware robot control failure. Upon activation, the brake system stops all robot motion. The brake system incorporates a feature that allows the operator to release the brake of a specific robot axis when drive power has been removed from the system. Use the Programming Pendant to access the brake release function. Refer to *Section 4.4.4* for brake release procedures.

2.7.7 Interlocked Work-cell Doors

A dual-redundant safety interlock is installed on each work-cell access door. If either one of the work-cell doors is opened while the robots are in PLAY mode, the robot emergency braking system activates, all servo power is removed from the system, and all positioner motion stops.

3 Installation



CAUTION

- The ArcWorld® II-6000 Series system should be installed by qualified personnel who are familiar with the installation and setup of a robotic system.
- The ArcWorld® II-6000 Series system is not extremely fragile. It is, however, a sophisticated robotic system that can be damaged by rough handling. Be sure to handle all system components with care.

The ArcWorld® II-6000 Series system can be installed in a short amount of time by two to three qualified technicians. Always comply with the established safety instructions and precautions given throughout this manual throughout the installation process.

The instructions given in this section are general guidelines for installing the ArcWorld® II-6000 Series system. Refer to your system drawings and relevant system component manuals for specific installation information (see *Section 1.3*).

3.1 Required Materials

All system components and most hardware required for installation of the ArcWorld® II-6000 Series system are included with your shipment. There are, however, some required items that the customer must supply (hand tools, special anchor bolts, etc.). These are not included with your shipment.

3.1.1 Customer-supplied Items

- Shielding gas for the welding torches
- Local electrical service
- Earth ground wires for the MA1400 robot, DX100 controller, and peripheral equipment
- Ground rods and/or buried copper sheeting (quantity as required to achieve a specified resistance-to-ground reading of 100 ohms or less)
- Chemical (optional) to increase the conductivity of soil in the vicinity of the ground system
- Welding wire
- Clean, dry air supply (15 scfm @ 90 psig) for torch tender or wire cutter options
- Stepladder
- Forklift and/or overhead crane

ArcWorld® II-6000 Series	3	Installation
	3.2	Site Preparation

3.1.2 Recommended List of Hand Tools and Equipment

- Safety glasses
- Face shield
- Gloves (protective, leather)
- Levels (short and long)
- Ratchet handle (with 3/4-inch hex socket)
- Adjustable wrench
- Hammer drill with appropriate concrete bits
- Phillips and flat-blade screwdrivers
- Hammers (dead-blow and steel)
- Hammer (non-marring)
- Socket sets (SAE and Metric)
- Air-impact gun (with 3/4-inch hex socket)
- Open-end wrench sets (SAE and Metric)
- Socket head wrench sets (Allen®, Bondhaus®, etc.)



The customer must supply all anchoring hardware for the ArcWorld® II-6000 Series system. Please refer to *Section 6* of this document for suggested anchoring hardware and foundation specifications.

3.2 Site Preparation



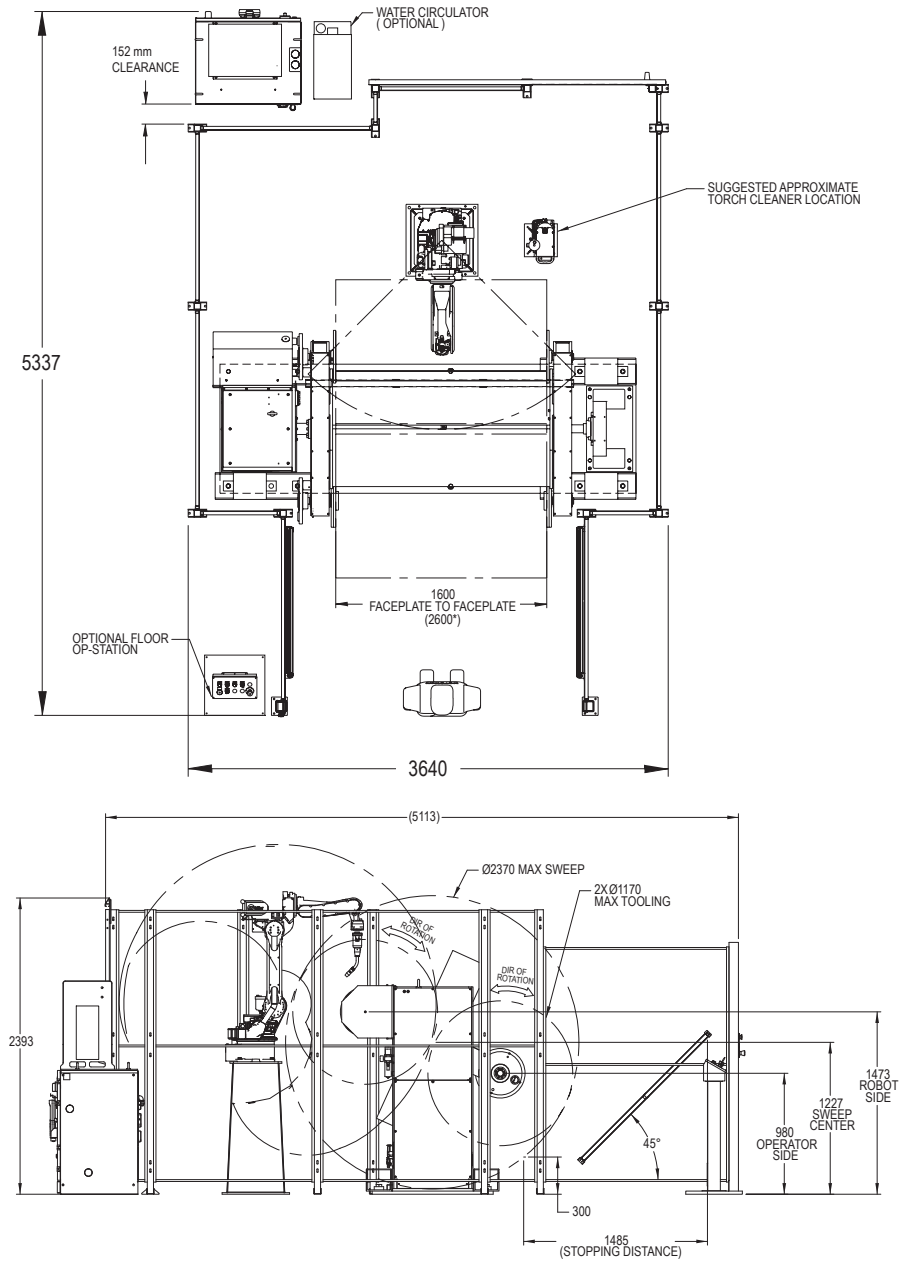
WARNING

During installation planning, allow sufficient room for access to the work-cell door and system components that are exterior to the work cell. Failure to observe this warning could result in injury to personnel during system operation and maintenance.

To prepare your site, proceed as follows:

1. Clear the floor space and overhead area needed for the ArcWorld® II-6000 Series system (see *Figure 3-5*). Allow an additional 1.2 to 1.5 m (4 to 5 ft) on all sides of the work cell to facilitate installation.
2. Gather all customer-supplied items and required tools (refer to *Section 3.1*).

Figure 3-5: Installation Dimensions for the ArcWorld® II-6000 Series System (ArcWorld II-6000 shown)



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 them for shipping damage. The following are general guidelines for removing the system components. Refer to your system drawings and the relevant manuals for more detailed information (see *Section 1.3*).



CAUTION

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



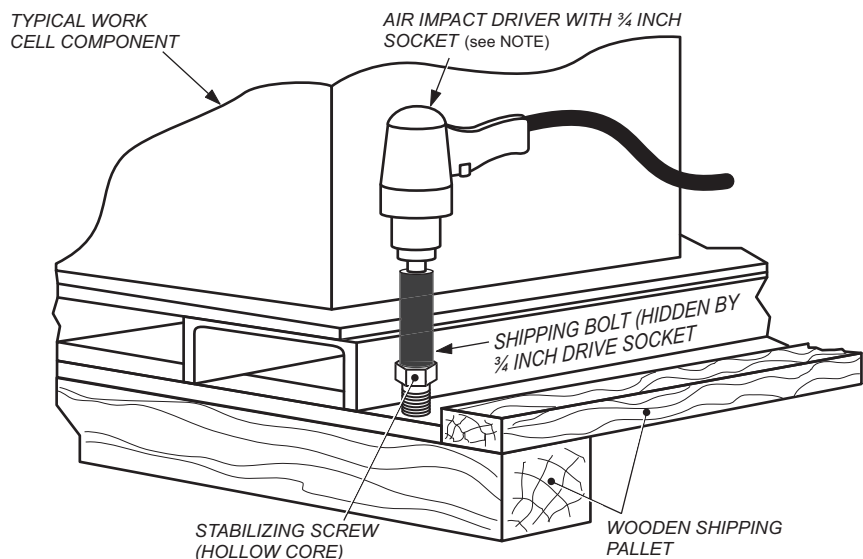
If you notice any equipment damage, notify your shipping contractor as soon as possible.

Remove system components from the shipping skids as follows:

1. Unbolt each component from its shipping skid using a 3/4-inch socket (see *Figure 3-6*).
2. Use a forklift or overhead crane to lift each component away from its shipping skid.
3. Discard or recycle the shipping skids and other shipping materials.

Figure 3-6: 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.



3.4 Component Installation

To make sure that the ArcWorld® II-6000 Series work cell is complete and to verify the correct amount of floor space needed for the installation, Motoman recommends that all system components (except the safety arc curtains) be set in place prior to anchoring the components to the foundation. See *Figure 3-5* and refer to the system drawings and relevant manuals supplied with your ArcWorld® II-6000 Series system to correctly place and install the system components (see *Section 1.3*).



The safety arc curtains are attached to the work-cell fence panels after the fencing has been assembled and anchored to the foundation (refer to *Section 3.5*).

3.4.1 Place System Components

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

1. Place the positioner to define the front of the cell (see *Figure 3-5*).
2. Place the robot (with riser) in the specified location relative to the positioner (see *Figure 3-5*).
3. Assemble and place the safety fencing around the work cell (see *Figure 3-5* and refer to the fence installation documentation that is supplied with your ArcWorld® II-6000 Series system).



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

4. Ensure that the final placement of the assembled safety fence conforms to the placement dimensions shown in *Figure 3-5*.
5. Install the work-cell sliding door (refer to *Figure 3-5* and *Section 3.4.3*, as well as the safety fencing documentation that is supplied with the ArcWorld® II-6000 Series system).
6. Remove both safety light curtain fence panels from their shipping position and attach each to the safety fence with the supplied hardware. The light curtains are oriented properly when the status lights are located near the base of the positioner (see *Figure 1-1*).



The light curtain components — the Send unit and Receive unit — are each pre-attached to a safety fence panel at the factory (see *Figure 1-1*).

7. Place the DX100 controller and welding power source (see *Figure 3-5* and the ArcWorld® II-6000 Series system drawings for the correct location for these components).



Do not place the DX100 controller or welding power source any closer than 152.4 mm to the work-cell safety fencing.

3.4.2 Level and Secure System Components

When all ArcWorld® II-6000 Series system components are in the correct position, refer to the relevant system drawings and component manuals before proceeding with the following steps to level the system components (if required) and anchor them to the foundation (see *Section 1.3*).

**CAUTION**

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

**WARNING**

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

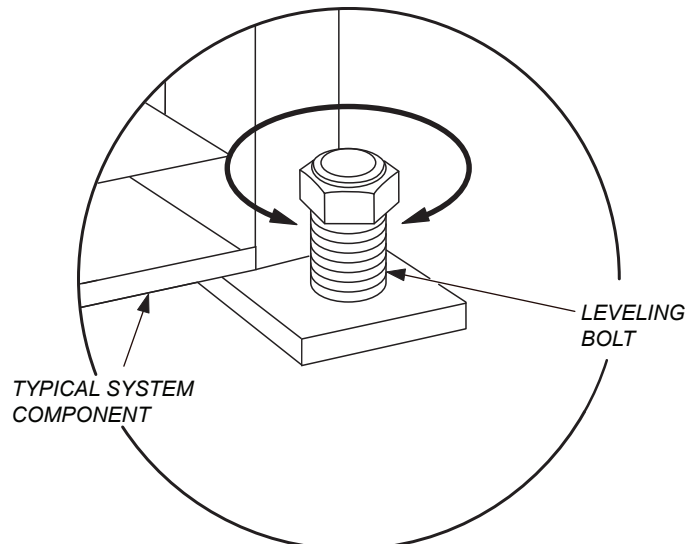
1. If required, level a system component by adjusting the leveling bolts (see *Figure 3-7*).



Refer to the *Positioner Manuals* for detailed leveling and anchoring information for the positioner (refer to *Section 1.3*).

2. After positioning and leveling (if required) a system component, insert a drill bit through the center of each leveling bolt for that component and drill a hole into the foundation to accept an anchor bolt (refer to *Section 6* for foundation and anchoring suggestions).
3. Use compressed air to remove all concrete dust from each drilled hole.
4. Anchor the system component to the foundation with suitable anchor bolts (refer to *Section 6* for foundation and anchoring suggestions).
5. Repeat all steps in this section for each system component that requires anchoring to the foundation.

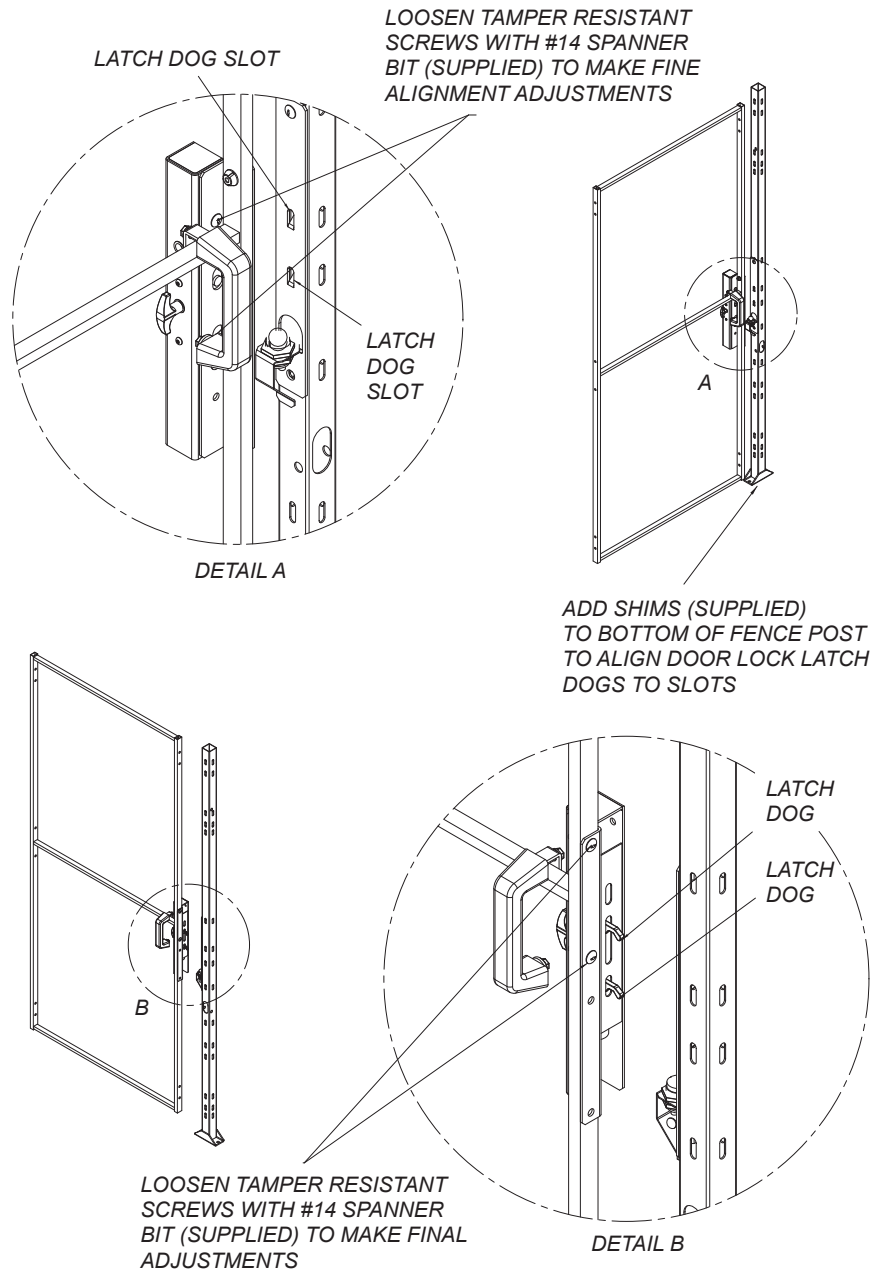
Figure 3-7: Typical Leveling Bolt



3.4.3 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 3-8*.

Figure 3-8: Door Latch Alignment



3.5 Installation — Arc Curtains

The arc curtains are packaged in an accessories box that is shipped with the ArcWorld® II-6000 Series system.



WARNING

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

Install the arc curtains as follows:

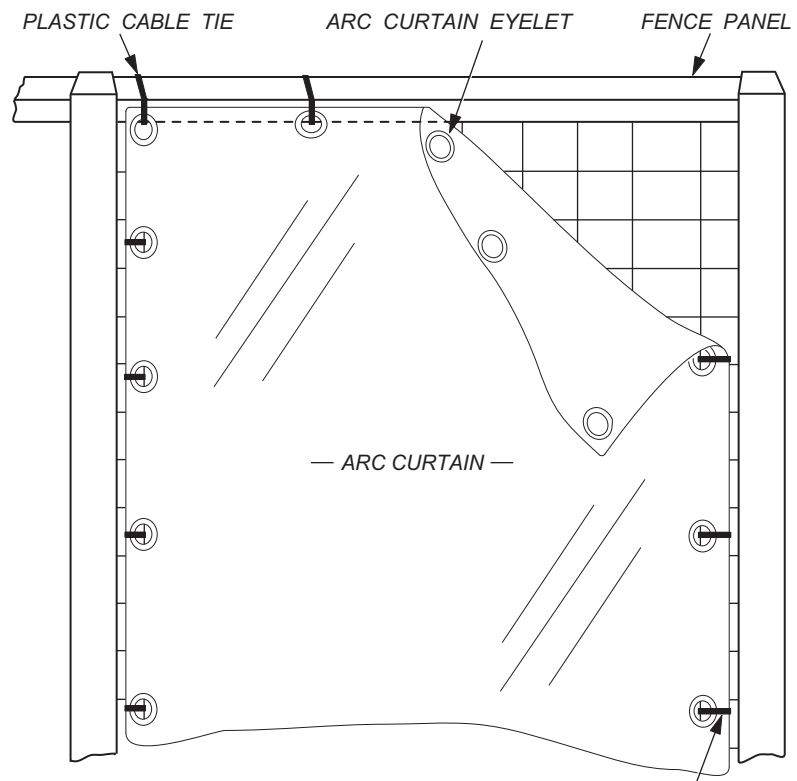
1. Unfold each arc curtain and install one on the **inside** of each work-cell safety fence panel using the supplied plastic cable ties and the eyelets in each arc curtain (see *Figure 3-9*).



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 3-9*).

Figure 3-9: 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

ArcWorld® II-6000 Series	3	Installation
	3.6	Light Curtain Alignment

3.6 Light Curtain Alignment

The light curtain Send unit and Receive unit must be accurately positioned, relative to each other, to ensure correct operation. Complete alignment procedures are included in the light curtain documentation that is included with your ArcWorld® II-6000 Series system (refer to *Section 1.3*).

3.7 Cable Connections

After the ArcWorld® II-6000 Series components and peripherals are secured in their correct locations, unwrap the cables from around the equipment and route them according to the cable diagrams included in the documentation supplied with your ArcWorld® II-6000 Series system. All cables and connectors are labelled for ease of installation.



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

3.7.1 Connection to Earth Ground



WARNING

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

Each robot and DX100 controller must be connected to an earth ground. If a ground stake is used, it should be driven at least 2.43 m (8 ft) into the soil. The soil surrounding the driven ground stake should be treated with a chemical that increases the soil conductivity in the vicinity of the driven ground stake. This is often referred to as a “low-resistance earth ground” and may require quite a bit more than a single driven ground rod, depending on soil conditions. Multiple ground stakes (bonded together) or even a bonded network of buried copper sheeting (plus conduction-enhancing chemicals) may be required, depending on local soil condition. In any event, the “low-resistance earth ground” must indicate a resistance of **100 ohms or less** (when measured directly between grounded equipment and the earth ground system). Be advised that specialized measuring equipment is usually required to get an accurate “resistance-to-ground” reading. Consult a specialist in this field, if required.

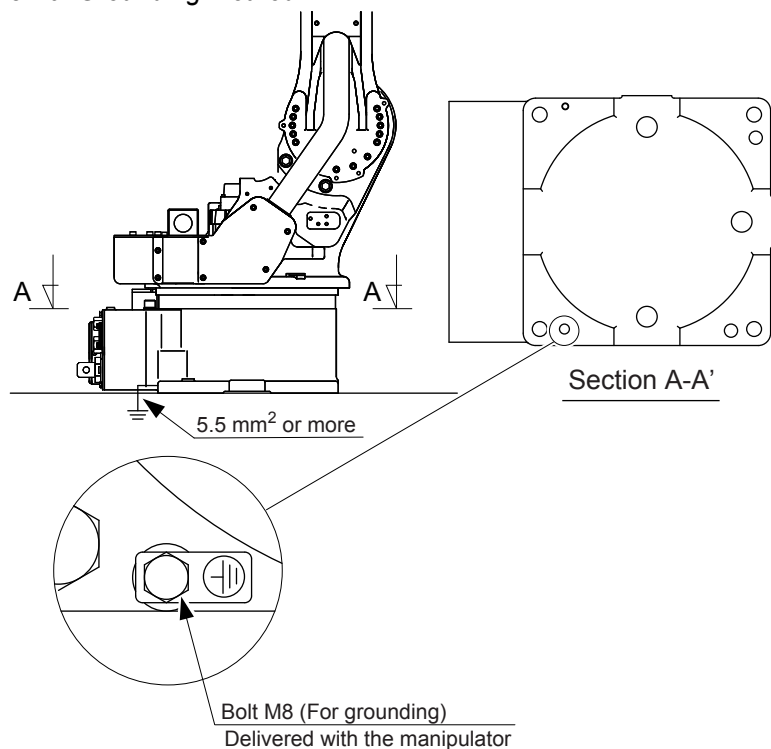
NOTE

The customer must supply all wires associated with the earth ground. The customer is responsible for establishing and maintaining an adequate earth ground (must maintain a resistance of 100 ohms or less).

Connect both robots and DX100 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 MA1400 robot. Connect the other end of the earth ground wire to the low-resistance earth ground.
2. Connect one end of an earth ground wire to the Common Ground Bus Bar located inside DX100 controller. Connect the other end of the earth ground wire to the low-resistance earth ground.

Fig. 3-10: Grounding Method



3.7.2 Connecting the Robot Cables

Two cables, 1BC and 2BC, connect each 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 large black manipulator cables and route one end 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 each robot (see *Figure 3-11*). Connect the other ends of the 1BC and 2BC cables to the 1BC and 2BC connections on the side of the controller.

Fig. 3-11: Manipulator Cables

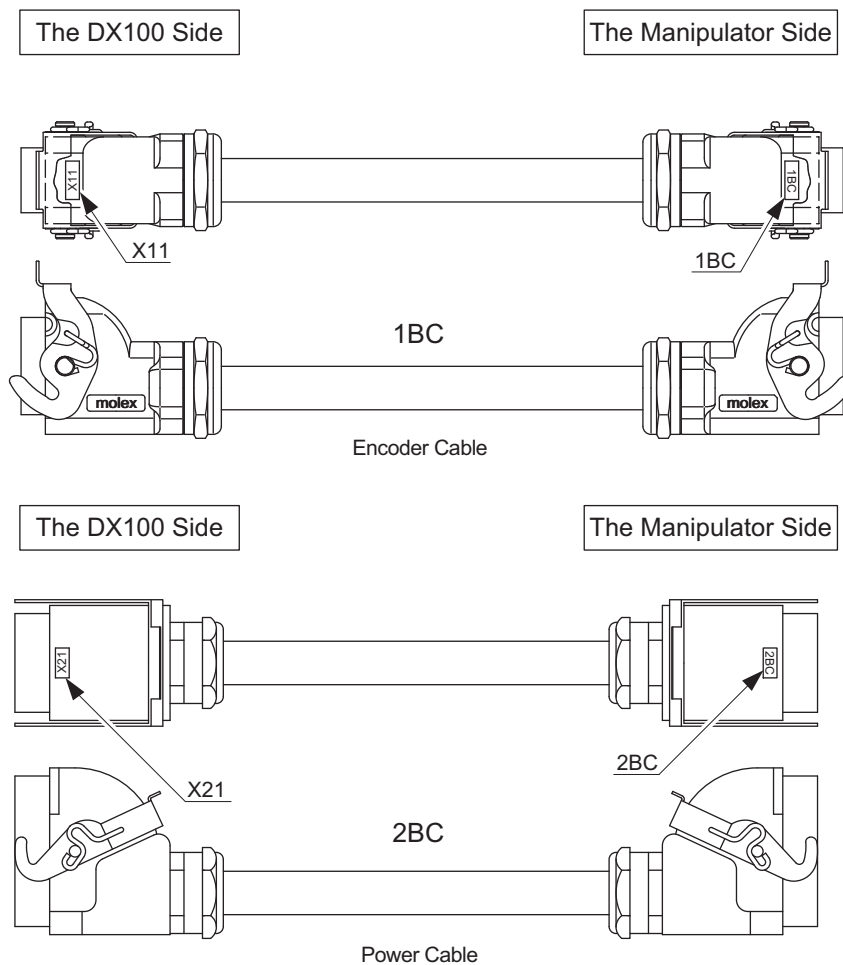


Fig. 3-12(a): Manipulator Cable Connectors (Manipulator Side)

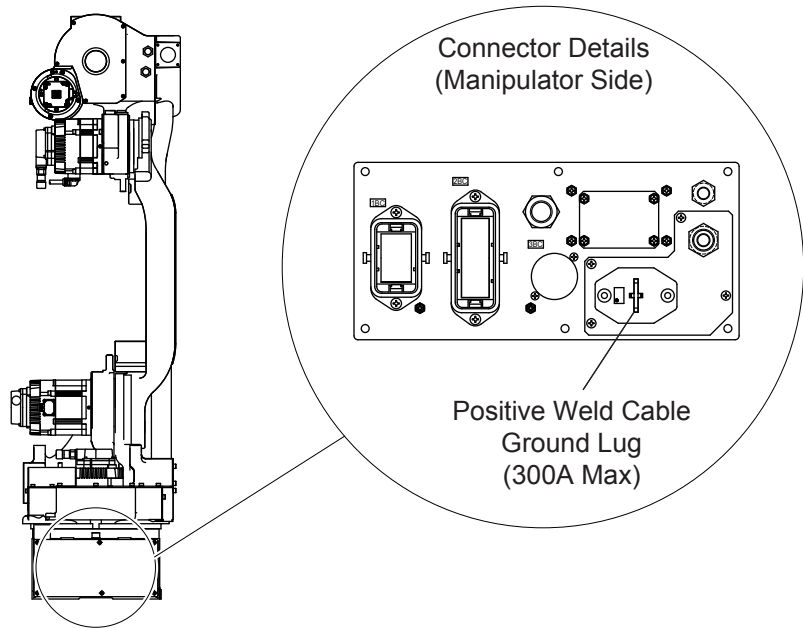
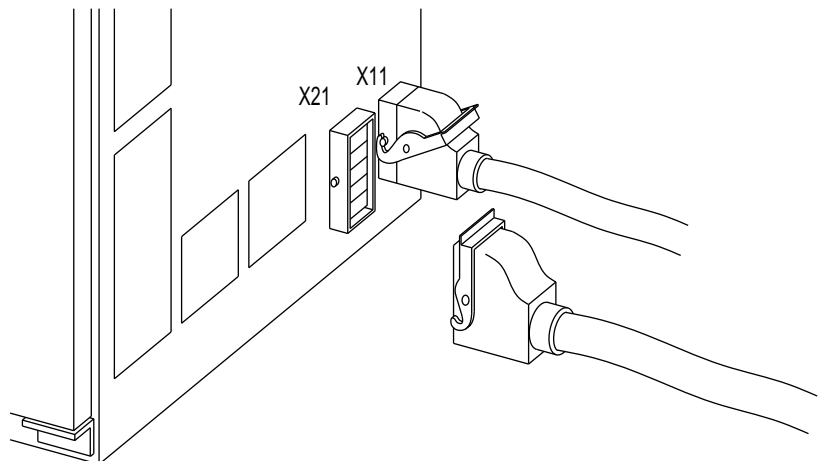


Fig. 3-12(b): Manipulator Cable Connection to the DX100



3.7.3 Connection to Local Electrical Service



WARNING

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



The ArcWorld® II-6000 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).

ArcWorld® II-6000 Series	3	Installation
	3.8	Safety/Operation Check

After all the system components have been properly installed and interconnected, connect local electrical service to the DX100 controller and welding power source (see *Figure* and *Figure 2-2*).

3.7.3.1 DX100 Controller

For detailed electrical service interconnect procedures for the DX100 controller, refer to the *DX100 Controller Manual* and ArcWorld® II-6000 Series system drawings and schematics that are included with your system documentation package (see *Section 1.3*).

3.7.3.2 Welding Power Source

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

3.8 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 correct alignment and operation of the safety light curtain Send and Receive units.
2. Ensure that the work-cell access door is closed and latched and door interlocks engaged.
3. Check the torque and security of all cable connections.
4. Ensure the correct setting of the welding power source (refer to the welding power source documentation that is included with your ArcWorld® II-6000 Series system).
5. Verify that the local electrical service line voltage and phase comply with the voltage and phase requirements for your ArcWorld® II-6000 Series system.



CAUTION

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

6. Switch ON the electrical service disconnect box (see *Figure 2-2*).
7. Set the power ON-OFF switch on DX100 controller to ON (see *Figure 2-2*).



WARNING

Before operating the robots, check each E-STOP push button to verify that servo power can be disabled by activation of the E-STOP. Injury to personnel or equipment damage can result from an E-STOP circuit defect. The E-STOP push buttons must be able to positively stop robot and positioner movement during an emergency situation.

ArcWorld® II-6000 Series	3	Installation
	3.9	Installation of Tooling and Fixtures

8. Check for correct operation of system E-STOP push buttons.
9. Check for correct operation of the system HOLD buttons on the Programming Pendant and Operation Station (ROBOT HOLD). Refer to the *Operator's Manual for Arc Welding* for more information on the pendant's HOLD button (see *Section 1.3*). Refer to *Section 2.4* for more information on the Operator Station's ROBOT HOLD button.
10. Ensure correct action of the safety interlocks on both work-cell access doors.

3.9 Installation of Tooling and Fixtures

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



- All tooling and fixtures for the RM2-250 STN 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



CAUTION

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

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

The ArcWorld® II-6000 Series system is a fully integrated robotic GMAW welding cell. One Motoman MA-series robot welds parts on one side of the positioner while the operator loads the opposite side with parts to be welded. When the robot completes the parts-welding process, it returns to HOME position. The operator can then initiate another positioner sweep cycle from the Operator Station. This moves the previously loaded parts into the robot work area, where the robot then moves from HOME position to complete another parts-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 and operator documentation that is included with your ArcWorld® II-6000 Series system (refer to *Section 1.3*).

Any changes made to your system configuration and/or job structure will alter the operation of the system. Motoman recommends that you **do not** modify the original jobs and system configuration of your ArcWorld® II-6000 Series system.

If you determine a need to modify the original jobs and system configuration, make any modifications to a copy of the original. Keep the original as a backup. Do not modify the original.

Modifications must be performed by trained and experienced personnel who are familiar with the operation of the ArcWorld® II-6000 Series system. If you have questions concerning the configuration of your ArcWorld® II-6000 Series system, please contact Motoman 24-hour Customer Support (refer to *Section 1.4*).

4.2 Sweeping the Positioner



The robot must be in HOME position before you can sweep the positioner.

MANUAL mode allows you to sweep the positioner without activating the robot. Parts can be loaded onto the fixture to achieve the most efficient configuration and then swept into the welding zone before teaching the robot a series of moves. To sweep Side A or Side B of the positioner into the robot's welding zone, proceed as follows:

1. Place the robot in HOME position (refer to *Section 4.3.2*).
2. Make sure that the Operator Station is enabled (Programming Pendant's Mode Select Switch set to REMOTE).
3. Set the Operator Station's POSITIONER AUTO/MANUAL switch to MANUAL mode and start the Control Master job (see *Section 4.3.3*). Normally, the robot(s) will not move out of HOME position when the POSITIONER AUTO/MANUAL switch is set to MANUAL. (This depends on the job structure.)



Cycle Start latching is not operative in Manual mode.

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

4.3 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 the start-up procedure (refer to *Section 4.3.1*).
- Move the robot to HOME position (refer to *Section 4.3.2*).
- Select the Control Master job (refer to *Section 4.3.3*).
- Perform the operation cycle (refer to *Section 4.3.4*).
- Perform the shutdown procedure (refer to *Section 4.3.5*).

4.3.1 Start-up Procedure

To start up the ArcWorld® II-6000 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-6000 Series system shipment.

2. Set the power ON-OFF switch on DX100 controller to ON (see *Figure 2-2*).
3. Switch the welding power source electrical service disconnect boxes to ON.
4. Set the Power ON-OFF switch on the welding power source to ON (the ON-OFF indicator lamp on the welding power source will illuminate).
5. Open the regulator valve for the welding gas supply.
6. Make sure that the work-cell access door is closed and operating properly and the door safety interlock is engaged.
7. Make sure that all E-STOP buttons are released. E-STOP buttons are installed at the following locations:
 - Programming Pendant
 - Door of DX100 controller
 - Operator Station pedestal
8. Select TEACH mode on the Programming Pendant.
9. Place the robot in HOME position (refer to *Section 4.3.2*).

4.3.2 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 touch screen.
3. Select JOB on the Programming Pendant touch screen.
4. Select SELECT JOB on the Programming Pendant touch screen (a job list appears on the screen).
5. Use the navigation cursor key to move the cursor to 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 the Programming Pendant to move robot(s) to HOME position.

4.3.3 Control Master Job

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

1. Select JOB on the Programming Pendant touch screen.
2. Select CTRL MASTER on the Programming Pendant touch screen.
3. Press SELECT twice to activate the Control Master job.
4. Select PLAY mode on the Programming Pendant and press the PLAY MODE ENABLE button on the door of DX100 controller (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).

ArcWorld® II-6000 Series	4	Operation
	4.4	System Recovery

7. Transfer control to the Operator Station by selecting REMOTE on the Programming Pendant's Mode Select Switch.

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

4.3.4 Operation Cycle

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

1. The operator loads the fixture (on the operator side of the positioner) with parts to be welded.
2. The operator steps out of the safety zone created by the safety light curtain system and moves to the front of the Operator Station.
3. The operator presses the green CYCLE START/CYCLE LATCHED button on the Operator Station. The positioner sweeps 180°, placing parts to be welded into the robot work area. The robot then begins to weld the parts (Operator Station's POSITIONER AUTO/MANUAL switch must be set to AUTO).
4. While the robot is welding, the operator loads the operator side of the positioner with the next group of parts to be welded.
5. The operator again moves to the Operator Station and presses the green CYCLE START/CYCLE LATCHED button. When the robot is finished welding, it returns to HOME position. The positioner then sweeps 180° to return completed, welded parts to the operator position while moving the next group of parts into the robot work area.
6. The operator moves back to the operator side of the positioner and unloads the completed, welded parts.

4.3.5 Shutdown Procedure

Use the following procedure to perform a normal shutdown of the ArcWorld® II-6000 Series system:

1. Make sure that the robot is in HOME position.
2. Turn off system 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's power ON-OFF switch to the OFF position.
5. Set welding power source power ON-OFF switches to the OFF position.
6. Close the regulator valve for the welding gas supply.
7. Switch all electrical service disconnect boxes to OFF.

The ArcWorld® II-6000 Series system is now shut down.

4.4 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 might encounter and how to clear them.

4.4.1 Alarms and Errors

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

ArcWorld® II-6000 Series	4	Operation
	4.4	System Recovery

- Error messages
- Minor alarms
- Major alarms

For more detailed information on alarm and error recovery, refer to the DX100 controller and MA1400 robot documentation that is included with your ArcWorld® II-6000 Series system (refer to *Section 1.3*).

4.4.1.1 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.

4.4.1.2 Minor Alarms

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

4.4.1.3 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 (switch the Power ON-OFF switch on each controller to OFF, then back to ON).

4.4.2 E-STOP Recovery

An E-STOP (emergency stop) will occur under any of the following conditions:

- An E-STOP button is pushed in (activated).
- A work-cell access door is opened while the robot is not in TEACH mode.
- The safety light curtain system is triggered while the positioner is sweeping.
- A collision triggers a shock sensor output.

To restart the ArcWorld® II-6000 Series system after an E-STOP condition occurs, follow the procedures below.

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(s).
 - Clear the area (in front of the positioner) that is protected by the safety light curtain system.
 - Clear the shock sensor condition (refer to *Section 4.4.3*).



CAUTION

If an emergency stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when the ArcWorld® II-6000 Series system is restarted.

2. Press the SERVO ON button on the Operator Station or Programming Pendant.
3. Ensure that the Programming Pendant is in REMOTE mode (Programming Pendant's Mode Select Switch set to REMOTE).
4. Press the green START button on the Operator Station.

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

4.4.3 Shock Sensor Recovery

The MA1400 robot includes a Motoman gun mount. This mount is designed to protect the torch from damage in case of a crash. A slight deflection of the torch activates a SHOCK SENSOR signal that triggers an E-STOP condition. To clear the E-STOP condition, you must override the shock sensor and move the affected robot clear of the impact. To override the shock sensor, proceed as follows:

1. Select MAIN MENU on the Programming Pendant touch screen.
2. Select ROBOT on the Programming Pendant touch screen.
3. Select OVERRUN-S.SENSOR on the Programming Pendant 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 affected robot clear of the impact position.

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

4.4.4 Brake Release

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, a loss of drive power, or any other occurrence that activates the brakes. It is then necessary to release the brakes on the robot in order to move it. To release the brakes, proceed as follows:



WARNING

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

1. On the Programming Pendant, select TEACH mode.
2. Select ROBOT on the Programming Pendant touch screen.
3. Select the BRAKE RELEASE option.

ArcWorld® II-6000 Series	4	Operation
	4.4	System Recovery

4. Select the control group (R1, R2, S1).
5. While pressing in on the pendant's ENABLE switch, hold down the minus key for the axis to be released (S-, L-, U-, etc.). The brake for the selected axis releases.

5 Maintenance

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

Be advised that 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-6000 Series system, refer to the documentation that is included with your ArcWorld® II-6000 Series system (refer to *Section 1.3*).



CAUTION

If your system uses a water-cooled torch, use only Motoman-specified antifreeze. Typical automotive antifreeze contains additives that can clog the small cooling ports in the torch and damage sealing gaskets in the water circulator pump.

Table 5-1: Periodic Maintenance

FREQUENCY	COMPONENT	PROCEDURE
Daily (or on condition)	Water Circulator (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 the 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 the safeguard item is working correctly.
Monthly (or on condition)	ArcWorld® II-6000 Series Work Cell	Remove accumulated dirt, grease, and debris from inside and outside the work cell.

6 Anchor Requirements

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
<p>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.</p>

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 (<i>Note 1</i>)	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 (<i>Note 1</i>)	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 (<i>Note 1</i>)	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.			

ArcWorld® II-6000 Series SYSTEM MANUAL

for ArcWorld II-6000 and II-6000HD Systems

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