ArcWorld® III-1000 Series SYSTEM MANUAL
For ArcWorld III-1000 and ArcWorld III-1200

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

MOTOMAN INSTRUCTIONS
- MOTOMAN XXXXXXX 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: 156549-1CD
Revision: 1
MANDATORY

- This system manual provides an overview of the Motoman ArcWorld® III-1000 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® III-1000 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® III-1000 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.

*NOTE*
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.
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:

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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.

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1 Introduction

1.1 About This Document

This system manual is delivered with both the ArcWorld III-1000 and ArcWorld III-1200 systems to provide a “first look” and overview of the complete Motoman ArcWorld® III-1000 Series systems. You should read and understand this system manual before moving on to the more detailed documentation that is included with your ArcWorld® III-1000 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® III-1000 Series system, please review the full documentation package that is included with your ArcWorld® III-1000 Series system (refer to Section 1.3).

This system manual contains the following sections:

Section 1 – Introduction

This section provides general information about the ArcWorld® III-1000 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® III-1000 Series system.

Section 3 – Installation

This section provides installation procedures for the ArcWorld® III-1000 Series system.

Section 4 – Operation

This section provides an overview of ArcWorld® III-1000 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® III-1000 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® III-1000 Series system.

1.2 System Overview

The ArcWorld® III-1000 Series system provides a complete arc-welding solution in a standardized configuration. The ArcWorld III-1000 system is designed around a single Motoman MA1400 robot, a DX100 controller, and welding power source. The ArcWorld III-1200 system is designed around two Motoman MA1400 robots, a DX100 DRC controller, and welding power sources.

The ArcWorld® III-1000 Series family uses the MSR500 rotary positioner. The rotary positioner allows an operator to prepare and set up parts on
one side of the positioner while the robots weld on the other side of the positioner.

The ArcWorld® III-1000 Series system features a total safety environment that meets or exceeds the requirements of the ANSI/RIA R15.06 standard and is designed to safeguard both personnel and equipment. Heavy-gauge, wire-mesh safety fencing prevents unintended entry of personnel into the work cell while it is in operation.

Arc curtains cover the wire-mesh fencing to attenuate the amount of arc radiation that escapes the work cell during the welding operations. Dual-interlocked access doors on each side of the work cell provide convenient access to equipment while providing a safety interlock to disable all equipment should these doors be opened while the robots are active.

A dual-channel safety light curtain system provides a “sensing field” in front of the rotary positioner through use of an infrared light beam. Rotary positioner motion is prevented whenever an operator is in a position to disrupt the sensing field of the light curtain system. In addition, maximum robot travel is physically limited by an S-axis “hard stop” at the base of each robot. Figure 1-1 illustrates the layout and component locations for the ArcWorld® III-1000 Series system.

**Fig. 1-1: System Layout — ArcWorld III-1200 Shown**

1.2.1 System Layout

The MA1400 manipulator(s) (robots), an MSR500 180° rotary positioner, and heavy-gauge, wire-mesh safety fencing all share a common steel base for ease of installation and assurance of proper alignment between the robot(s) and rotary positioner. The wire-mesh safety fencing completely surrounds the ArcWorld® III-1000 Series work cell. The DX100 controller shares a common platform with the welding power source(s).

The equipment platform is located outside and to the rear of the work cell. This arrangement allows most of the component wiring interconnects to be pre-wired at the factory, thus reducing the amount of point-to-point wiring required of the customer. All operator controls, including those on
1 Introduction

1.3 Reference Documentation

the Programming Pendant, DX100 controller, welding power supplies, and Operator Station, are accessible from outside the ArcWorld® III-1000 Series work cell.

1.2.2 Major Components

The ArcWorld® III-1000 Series system includes the following major components:

• Motoman MA1400 manipulator(s) (robots)
• DX100 controller (AWIII-1200-DRC configuration)
• One MSR500 180° rotary positioner
• One Programming Pendant (located on the DX100 controller)
• Operator Station
• Welding equipment (for each robot):
  • Welding power supply
  • Welding torch (water-cooled or air-cooled)
  • Wire feeder
  • 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 doors
  • Steel arc screen on the MSR500 rotary positioner

1.2.3 Optional Equipment

The following optional equipment is available for use with the ArcWorld® III-1000 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® III-1000 Series system, refer to the following documentation that is included with your delivered system:

• Motoman MA1400 Manipulator Manual (P/N 155557-1CD)
• 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)
1.4 Customer Support Information

If you need technical assistance with any aspect of your ArcWorld® III-1000 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® III-1000 Series, DX-Series
- Robot: MA1400
- Positioner: MSR500
- 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
2 Equipment Description

2.1 Robot Description

The ArcWorld® III-1000 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® III-1000 Series system (refer to Section 1.3).

2.2 DX100 Controller

The ArcWorld® III-1000 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 MSR500 rotary 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® III-1000 Series system (see Section 1.3).

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® III-1000 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® III-1000 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® III-1000 Series system (see Section 1.3).

Figure 2-3: DX100 Programming Pendant
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

The optional Pedestal Operator Station (see Figure 2-5) includes a NEMA enclosure on a stand-alone pedestal. See for the location of the Operator Station pedestal in relation to other components of the ArcWorld® III-1000 Series system.

Figure 2-5: Optional Pedestal Operator Station

The following paragraphs describe the Operator Station controls:

- 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® III-1000 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.
2.4.1 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 robots are in Home position. If the Cycle Start/Cycle Latched button is pressed while the robots are outside Home position, the Cycle Start command does not execute and the positioner does not sweep until the robots return 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 robots will begin to weld immediately after the current weld cycle is complete and the robots have returned to Home position. It is not necessary to wait for the robots 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 robots are 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.

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 robots, and all positioner motion is stopped.

2.4.3 Robot Hold

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

2.4.4 Alarm

A red Alarm lamp illuminates to indicate that a DX100 controller has encountered an alarm condition.

2.4.5 Positioner Auto/Manual

The Positioner Auto/Manual switch is used to select automatic or manual mode for the MSR500 rotary 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 robots do not immediately start to weld after the positioner sweeps and remain in Home position.

The Positioner Auto/Manual signal depends upon the structure of the Control Master job.

2.4.6 Start

Pressing the green Start button starts the current, active job. The Operator Station must be enabled and servo power must be ON for the Start button to function.
2.4.7 Reset

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

2.4.8 Servo On

The green Servo On push button turns servo power ON when the robot is in Play mode and the Operator Station is enabled.

2.5 MSR500 Positioner

The MSR500 positioner is part of the ArcWorld® III-1000 Series system. It is mounted on the same common equipment base as the MA1400 robot(s) and the wire-mesh safety fencing. The MSR500 is a high-speed rotary positioner that features controlled rotary motion and a 500 kg payload capacity per side. The standard configuration utilizes a brushless AC drive motor plus gear reducer, a 1525 mm (60-inch) circular table top, and housing. A steel arc screen divides the table top, providing two semicircular work areas (Side A and Side B). The steel arc screen creates a barrier that safeguards the operator from arc radiation and sparks produced during the welding operation. The MSR500 uses a rotary motion to sweep each side of the circular turntable 180° from the operator’s loading zone, into the robots’ work zone and back to the operator again. The positioner can accept optional external axis control for coordinated motion between the positioner and the robots. See Figure 1-1 for a general view of the MSR500 positioner.

WARNING

Do not operate the MSR500 positioner unless the arc screen is in place. Operation of the positioner without the arc screen in place can result in burns or serious eye damage for the operator.

For detailed positioner information, including illustrated parts lists, load capabilities, and dimensions, refer to the MSR Series Positioner Manual that is included with your ArcWorld® III-1000 Series system (see Section 1.3).

- All tooling and fixtures for the MSR500 rotary positioner are supplied by the customer.
- In high humidity areas, use surface protection to prevent corrosion of the tooling plates.
2.6 Welding Equipment

In its standard configuration, the ArcWorld® III-1000 Series system includes a welding power source, wire feeder, torch, and torch mount for each MA1400 robot. Optional equipment — water-cooled torch, water circulators, ComArc™ seam tracking units, and torch tenders — may also be included with your ArcWorld® III-1000 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® III-1000 Series system depends on the customer's specific application and preference. For specific information on the welding power sources supplied with your ArcWorld® III-1000 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 each 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® III-1000 Series system (see Section 1.3).

2.6.3 GMAW Torch

The ArcWorld® III-1000 Series system uses either an air-cooled or water-cooled robotic/automatic GMAW torch for each robot. 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® III-1000 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® III-1000 Series system (see Section 1.3).

2.7 Safety Features

The ArcWorld® III-1000 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® III-1000 Series system are adequate for their plant conditions. Users must also ensure that all safeguards are maintained in working order.
2.7  Safety Features

2.7.1 Welding Arc Protection

Two forms of welding arc protection are part of the ArcWorld® III-1000 Series system:

- a steel arc screen on the MSR500 rotary positioner
- arc curtains that are attached to the steel-mesh safety fencing

The steel arc screen on the MSR500 rotary positioner protects the operator from arc radiation and sparks that result from the welding operation (see Figure 1-1).

2.7.2 Safety Fencing

The heavy-gauge, steel-mesh safety fencing that is provided with the ArcWorld® III-1000 Series system attaches to the common base and encloses the entire work cell. It forms a physical barrier that prevents personnel from entering the work cell during automatic operation.

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® III-1000 Series system, the safety light curtains are set up to protect personnel who might unintentionally enter the MSR500 rotary 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® III-1000 Series system, and all MSR500 positioner motion stops. Servo power can be reapplied and the operation resumed (after the operator is clear of the protected area) by pressing SERVO ON and START on the Operator Station panel. Refer to Section 3.6 for the alignment of the safety light curtains in the ArcWorld® III-1000 Series system.
2.7.4 Emergency Stops (E-STOPS)

In addition to the safety features described above, the ArcWorld® III-1000 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® III-1000 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

3.1 Required Materials

The ArcWorld® III-1000 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® III-1000 Series system. Refer to your system drawings and relevant system component manuals for specific installation information (see Section 1.3).

3.1.1 Customer-supplied Items

- Shielding gas for the welding torches
- Local electrical service
- Earth ground wires for the MA1400 robots, DX100 controllers, 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

CAUTION

- The ArcWorld® III-1000 Series system should be installed by qualified personnel who are familiar with the installation and setup of a robotic system.
- The ArcWorld® III-1000 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.
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.)

**NOTE**

Special anchor bolts (lag bolts) are supplied by the customer. Refer to Section 6 for a listing of special bolts that are required for anchoring the common equipment bases and other components of the ArcWorld® III-1000 Series system.

3.2 Site Preparation

**WARNING**

Be sure to allow for sufficient room for maintenance on the robots, DX100 controllers, and other peripheral equipment. Failure to observe this precaution could result in injury to personnel during system maintenance.

To prepare your site, proceed as follows:

1. Clear the floor space needed for the ArcWorld® III-1000 Series system (see Figure 3-1). 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).
Installation dimensions are identical for both the AWIII-1000 and AWIII-1200 Systems.
3.3 Installing and Leveling the Common Base

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.

*Figure 3-2: Stabilizing and Lag Points*

**WARNING**

As shipped, the robot/positioner common base (with equipment) weighs approximately 2200 kg (4409 lbs). 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).
3 Installation
3.3 Installing and Leveling the Common Base

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.

NOTE
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.
3.4 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 3-3.

Figure 3-3: Door Latch Alignment
3.5 Installing the Operator Station Pedestal (Option)

To install the Operator Station pedestal, proceed as follows:

1. Locate the Operator Station pedestal.
2. Carefully remove the protective plastic wrapping from the Operator Station pedestal.
3. Inspect the Operator Station pedestal for shipping damage.
4. Place the Operator Station pedestal outside the light curtain fence panels (see Figure 3-1 for the recommended location).

**CAUTION**

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

5. Secure the Operator Station pedestal 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.

3.6 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® III-1000 Series system (refer to Section 1.3).

3.7 Cable Connections

After the ArcWorld® III-1000 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® III-1000 Series system. All cables and connectors are labelled for ease of installation.

**NOTE**

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® III-1000 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.

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.

3.7.2 Connection to Local Electrical Service

**WARNING**

Connection of the ArcWorld® III-1000 Series system to local electrical service must be done by a qualified, licensed electrician. Electrical and grounding connections must comply with the National Electrical Code (NEC), as well as local electrical codes.
After all the system components have been properly installed and interconnected, connect local electrical service to the fused electrical service disconnect boxes. The boxes are located on the DX100 controller common base (see Figure 1-1 and Figure 2-2).

**NOTE**

The ArcWorld® III-1000 Series is configured for three-phase 460/480V AC primary power. For additional information, please refer to the electrical drawings and schematics that are included with your ArcWorld® III-1000 Series system.
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:

3. Ensure correct alignment and operation of the safety light curtain Send and Receive units.

4. Ensure that both work-cell access doors are closed and latched and door interlocks engaged.

5. Check the torque and security of all cable connections.

6. Ensure the correct setting of the welding power sources (refer to the welding power source documentation that is included with your ArcWorld® III-1000 Series system).

7. Verify that local electrical service is correctly wired into the fused disconnect boxes on the DX100 controller common base (refer to Section 3.7.2).

8. Verify that the local electrical service line voltage and phase comply with the voltage and phase requirements for your ArcWorld® III-1000 Series system.

**CAUTION**
The ArcWorld® III-1000 Series system is now ready for power-up. Ensure that qualified, trained operators who are familiar with the ArcWorld® III-1000 Series system perform this power-up sequence.

9. Switch ON the electrical service disconnect box located on the DX100 controller common base (see Figure 2-2).

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

11. Switch ON the electrical service disconnect boxes located on the controller common base (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.

12. Check for correct operation of system E-STOP push buttons.

13. 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.

14. Ensure correct action of the safety interlocks on both work-cell access doors.
3.9 Installation of Tooling and Fixtures

Your ArcWorld® III-1000 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® III-1000 Series system should do the installation. After the installation, test the MSR500 positioner for correct operation.

**NOTE** All tooling and fixtures for the MSR500 rotary positioner are supplied by the customer.
The ArcWorld® III-1000 Series system is a fully integrated robotic GMAW welding cell. Motoman MA1400 robot(s) weld on one side of the MSR500 rotary positioner while the operator loads the opposite side with a part to be welded. Once the robot(s) are finished, they return to HOME (Safe) position. The operator then enables the positioner sweep, allowing the robot(s) to start welding on the next part. This section provides operation instructions for the ArcWorld® III-1000 Series system.

### 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® III-1000 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® III-1000 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® III-1000 Series system. If you have questions concerning the configuration of your ArcWorld® III-1000 Series system, please contact Motoman 24-hour Customer Support (refer to Section 1.4).

### 4.2 Sweeping the Positioner

**NOTE** The robots must be in HOME position before you can sweep the positioner.

MANUAL mode allows you to sweep the MSR500 positioner without activating the robot(s). Parts can be loaded onto the fixture to achieve the most efficient configuration and then swept into the welding zone before teaching the robot(s) 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(s) 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. (Optional Pedestal Operator Station) 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 switch is set to MANUAL. (This depends on the job structure.)
4. Press the CYCLE START/CYCLE LATCHED button on the Operator Station (the MSR500 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 robots 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® III-1000 Series work cell from a power-off condition, proceed as follows:

1. Switch the DX100 controller’s electrical service disconnect box to ON (see Figure 1-1).
2. Set the power ON-OFF switch on DX100 controller to ON (see Figure 2-2).
3. Switch both welding power source electrical service disconnect boxes to ON.
4. Set the Power ON-OFF switch on each welding power source to ON (the ON-OFF indicator lamp on each welding power source will illuminate).
5. Open the regulator valve for the welding gas supply.
6. Make sure that both work-cell doors are closed and operating properly and the door safety interlocks are 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(s) in HOME position (refer to Section 4.3.2).

Note: Cycle Start latching is not operative in Manual mode.
4.3.2 Robot HOME Position

To move the robot(s) to HOME position:

1. Select TEACH mode on the Programming Pendant.
2. Select MAIN MENU 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).
7. Transfer control to the Operator Station by selecting REMOTE on the Programming Pendant’s Mode Select Switch.

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

4.3.4 Operation Cycle

The following is the typical sequence of operation for the ArcWorld® III-1000 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 MSR500 positioner sweeps 180°, placing parts to be welded into the robot work area. The robot(s) then begin to weld the parts (Optional Pedestal Operator Station’s POSITIONER AUTO/MANUAL switch must be set to AUTO).
4. While the robot(s) are welding, the operator loads the operator side of the positioner with the next group of parts to be welded.
5. The operator again moves to the Operator Station pedestal and presses the green CYCLE START/CYCLE LATCHED button. When the robot(s) are finished welding, they return to HOME position. The MSR500 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 MSR500 positioner and unloads the completed, welded parts.

4.3.5 Shutdown Procedure

Use the following procedure to perform a normal shutdown of the ArcWorld® III-1000 Series system:

1. Make sure that the robot(s) are in HOME position.
2. Turn off system servo power by pressing the E-STOP button on the Operator Station pedestal 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® III-1000 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:

- 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® III-1000 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 robots are not in TEACH mode.
- The safety light curtain system is triggered while the MSR500 positioner is sweeping.
- A collision triggers a shock sensor output.

To restart the ArcWorld® III-1000 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 MSR500 positioner) that is protected by the safety light curtain system.
   - Clear the shock sensor condition (refer to Section 4.4.3).

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® III-1000 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.

---

**CAUTION**

If an emergency stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when the ArcWorld® III-1000 Series system is restarted.
2. Select ROBOT 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® III-1000 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:

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always support the robot axis to be released <strong>before</strong> you release it. Without adequate robot axis support, brake release could cause personal injury or machine damage.</td>
</tr>
</tbody>
</table>

1. On the Programming Pendant, select TEACH mode.
2. Select ROBOT on the Programming Pendant touch screen.
3. Select the BRAKE RELEASE option.
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.
Maintenance of the ArcWorld® III-1000 Series system and components must be performed by authorized personnel who are familiar with the ArcWorld® III-1000 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® III-1000 Series system, refer to the documentation that is included with your ArcWorld® III-1000 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**

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>COMPONENT</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily (or on condition)</td>
<td>Water Circulator (water-cooled torch application only)</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>All safeguard items – work-cell door interlocks, E-STOP push buttons, safety light curtains, arc curtains, etc.</td>
<td>Check the physical condition of the safeguard item and ensure that the safeguard item is working correctly.</td>
</tr>
<tr>
<td>Monthly (or on condition)</td>
<td>ArcWorld® III-1000 Series Work Cell</td>
<td>Remove accumulated dirt, grease, and debris from inside and outside the work cell.</td>
</tr>
</tbody>
</table>
6 Anchor Requirements

The purchaser must determine all anchoring and foundation requirements and supply the appropriate anchoring hardware for a particular installation. Before installing the ArcWorld® III-1000 Series, refer to Table 6-1 to determine special anchor and foundation 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

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>MINIMUM HILTI® ANCHOR ROD DIAMETER/TYP</th>
<th>MINIMUM FLOOR-PLATE REQUIREMENTS</th>
<th>MINIMUM FOUNDATION REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ROBOTS</strong> UP6, UP20, UP20-6, EA1400, EA1900</td>
<td>5/8-inch HVA Chemical Style Anchor (Note 3)</td>
<td>600mm (24 in.) Length 600mm (24 in.) Width 38.1mm (1.5 in.) Thick</td>
<td>30 in. x 30 in. x 7 in. Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td><strong>ROBOTS</strong> UP20M, UP50, SP80 (Note 2)</td>
<td>7/8-inch HVA Chemical Style Anchor (Note 3)</td>
<td>900mm (35 in.) Length 900mm (35 in.) Width 50.8mm (2 in.) Thick</td>
<td>60 in. x 60 in. x 9 in. Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td><strong>ROBOTS</strong> UP120, UP130, UP165, SP100, SP160, SP250, SP400 (Note 2)</td>
<td>7/8-inch HVA Chemical Style Anchor (Note 3)</td>
<td>1200mm (47 in.) Length 1200mm (47 in.) Width 50.8mm (2 in.) Thick</td>
<td>72 in. x 72 in. x 9 in. Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td><strong>ROBOTS</strong> UP200</td>
<td>7/8-inch HVA Chemical Style Anchor (Note 3)</td>
<td>1200mm (47 in.) Length 1200mm (47 in.) Width 50.8mm (2 in.) Thick</td>
<td>72 in. x 72 in. x 9 in. Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td><strong>ROBOTS</strong> UP350, UP500, SK300X</td>
<td>7/8-inch HVA Chemical Style Anchor (Note 3)</td>
<td>1500mm (59 in.) Length 1500mm (59 in.) Width 50.8mm (2 in.) Thick</td>
<td>72 in. x 72 in. x 9 in. Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td><strong>POSITIONER</strong> Rotary Style</td>
<td>5/8-inch HVA Chemical Style Anchor (Note 3)</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td><strong>POSITIONER</strong> Trunnion Style</td>
<td>7/8-inch HVA Chemical Style Anchor (Note 3)</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td><strong>PERIPHERAL EQUIPMENT</strong> 1/2-inch Kwik Bolt II Style Anchor (Note 4)</td>
<td>Not Applicable</td>
<td>3-inch minimum thickness or 1.3 embedment depth (whichever is larger) 4000 psi Reinforced Concrete</td>
<td></td>
</tr>
</tbody>
</table>
### Table 6-1: Minimum Recommended Equipment Anchor Requirements

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>MINIMUM HILTI® ANCHOR ROD DIAMETER/TYPE</th>
<th>MINIMUM FLOOR-PLATE REQUIREMENTS</th>
<th>MINIMUM FOUNDATION REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORK-CELL FENCE POSTS</td>
<td>3/8-inch Kwik Bolt II Style Anchor</td>
<td>Not Applicable</td>
<td>3-inch minimum thickness or 1.3 embedment depth (whichever is larger)</td>
</tr>
<tr>
<td></td>
<td>(Note 4)</td>
<td></td>
<td>4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>OPERATOR STATION PEDESTAL</td>
<td>1/4-inch Kwik Bolt II Style Anchor</td>
<td>Not Applicable</td>
<td>3-inch minimum thickness or 1.3 embedment depth (whichever is larger)</td>
</tr>
<tr>
<td></td>
<td>(Note 4)</td>
<td></td>
<td>4000 psi Reinforced Concrete</td>
</tr>
</tbody>
</table>

**NOTES:**

1. Minimum robot lagging requirements are based on maximum repulsion forces and the *Hilti® Anchor Design Program* (v3.3b).
2. SP-series robots require base plates and/or risers to be level within ± 2°. Grout if necessary.
3. Reference source: *Hilti® Product Technical Guide* (Section 4.2.1) for hardware specifications or equivalent.
4. Reference source: *Hilti® Product Technical Guide* (Section 4.3.3) for hardware specifications or equivalent.
5. Robot manual requirements calling for cast-in anchors may be substituted with the recommendations listed.

Refer to [http://us.hilti.com](http://us.hilti.com) or [http://ca.hilti.com](http://ca.hilti.com) for further information.