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Chapter 1

Introduction

1.1 About This Document

This System Manual provides an overview of the Motoman ArcWorld® V–6300M TRC system. For detailed information on any system component listed in this document, please refer to the ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

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

This System Manual contains the following chapters –

CHAPTER 1 – INTRODUCTION
This chapter provides general information about the ArcWorld® V–6300M TRC system and its components, a list of reference documents, and customer support contact information.

CHAPTER 2 – SAFETY
This chapter provides general information regarding the safe installation, maintenance, and operation of the ArcWorld® V–6300M TRC system.

CHAPTER 3 – DESCRIPTION OF EQUIPMENT
This chapter provides a description of the major components of the ArcWorld® V–6300M TRC system.

CHAPTER 4 – INSTALLATION
This chapter provides ArcWorld® V–6300M TRC system installation information.

CHAPTER 5 – OPERATION
This chapter provides an overview of ArcWorld® V–6300M TRC system operation, including start-up, loading, normal operations, fault recovery, and system shutdown.

CHAPTER 6 – MAINTENANCE
This chapter provides preventive maintenance requirements for certain components of the ArcWorld® V–6300M TRC system.

APPENDIX A – ANCHORING
Appendix A gives foundation and anchoring suggestions for ArcWorld® V–6300M TRC system components that require anchoring.
1.2 System Overview

The ArcWorld® V–6300M TRC system provides a complete arc welding solution in a standardized configuration (see Figure 1). The system is designed around three Motoman EA1400TN robots, one NX100-TRC controller assembly, three welding power sources, and one MRM2-1200 M3X positioner.

Refer to Section 3.2 for features and advantages of the TRC controller configuration.
Refer to Section 3.5 for a description of the MRM2-1200 M3X positioner.

The ArcWorld® V–6300M TRC system features a safety environment that meets or exceeds the requirements of the ANSI/RIA R15.06 Robot Safety standard. Heavy-gauge wire mesh safety fencing prevents entry of personnel into the work cell while it is in operation. Arc curtains cover the wire mesh fencing to block ultraviolet light that would otherwise escape the work cell during welding operations. An interlocked access door, at the rear of the work cell, provides convenient access to equipment while providing a safety interlock to disable all equipment should the access door be opened while the robots are active. A 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 1). Positioner movement is prevented (or stopped) whenever a person or object interrupts (breaks) the light field. In addition, maximum robot S-axis rotation is physically limited by mechanical hard stops in the base of each robot.

![Figure 1](image-url) Overview and Component Location — ArcWorld® V–6300M TRC System
1.2.1 System Layout

Three EA1400TN robots are mounted to an overhead frame weldment that is attached to the MRM2-1200 M3X positioner (see Figure 1). This configuration places the robots directly over the positioner to provide improved reach. This mounting position also reduces required work cell floor space by approximately 39% when compared to systems that use floor-mounted robots.

One NX100-TRC controller assembly is mounted to a Common Equipment Base. Two welding power sources are also mounted to a Common Equipment Base (see Figure 1). This arrangement allows most of the component interconnects to be pre-wired at the factory, thus reducing the amount of point-to-point wiring required of the customer. Both Common Equipment Bases are located outside of the work cell.

Wire mesh safety fencing encloses the robot-side of the ArcWorld® V–6300M TRC work cell. The safety fencing is anchored to the floor during system installation (refer to Section 4.6). All programming and operation controls are accessible from outside the ArcWorld® V–6300M TRC work cell.

1.2.2 Major Components

The ArcWorld® V–6300M TRC system includes the following major components –

- Three Motoman EA1400TN manipulators (robots)
- One NX100-TRC controller assembly
- One MRM2-1000 M3X positioner
- One Programming Pendant (located on NX100-TRC R1 controller)
- One Operator Station
- Welding equipment (for each robot) –
  - Welding power supply
  - Welding torch (air-cooled)
  - Wire feeder
  - Applicable welding interface
  - Torch mount
- Safety equipment –
  - Heavy-gauge, wire-mesh safety fencing
  - Arc curtains (cover the safety fencing)
  - Interlocked light curtain system
  - Interlocked work cell entry door
  - Positioner arc screen
1.2.3 Optional Welding Equipment

The following optional welding equipment is available for use with the ArcWorld® V–6300M TRC system –

- Torch cleaner
- Wire cutter
- Water-cooled torch (w / coolant circulator)
- Bulk wire dereeler, 454 kg (1000 lbs)
- ComArc™ (seam tracking)
- TouchSense™ (starting point detection)
- ToolSight® (auto verification of correct torch alignment)

1.3 Reference Documentation

For additional information on individual components of the ArcWorld® V–6300M TRC system, refer to the following documentation that is included with your system –

- Motoman EA1400N Manipulator Manual (P/N 149208-1)
- Motoman NX100 Controller Manual (P/N 149201-1)
- Motoman NX100 Maintenance Manual (P/N 150133-1)
- Motoman NX100 Operator’s Manual for Arc Welding (P/N 149235-1)
- Motoman NX100 Concurrent I/O Manual (P/N 149230-1)
- Motoman MRM2-1000 / 1200 M3X Positioner Manual (P/N 149286-1)
- Motoman NX100 Independent / Coordinated Control Function Manual (P/N 149648-1)
- Motoman INFORM User’s Manual (P/N 150078-1)
- Vendor manuals for system components and assemblies not manufactured by Motoman

1.4 Customer Support Information

If you need assistance with any aspect of your ArcWorld® V–6300M TRC system, please contact Motoman Customer Support at the following 24-hour telephone number –

**937. 847. 3200**

For routine technical inquiries, you can also contact Motoman Customer Support at the following e-mail address –

[techsupport@motoman.com](mailto:techsupport@motoman.com)

When using e-mail to contact Motoman Customer Support, please provide a detailed description of your issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response to your inquiry.
Note: Please use e-mail for routine inquiries, only. If you have an urgent or emergency need for service, replacement parts, or information, you must contact Motoman Customer Support at the telephone number shown above.

Please have the following information ready before you contact Motoman Customer Support –

- **System**  ArcWorld® V–6300M TRC
- **Robots** Three EA1400TN
- **Positioner** MRM2-1200 M3X
- **Primary Application** Arc Welding
- **Controller** NX100-TRC
- **Software Version** Access this information on the Programming Pendant LCD display screen by accessing **MAIN MENU ➤ SYSTEM INFO ➤ VERSION**
- **Robot Serial Number** Located on robot data plate
- **Robot Sales Order Number** Located on NX100-TRC controller (R1) data plate
NOTES
Chapter 2

Safety

2.1 Introduction

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

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

RoboticIndustriesAssociation
900VictorsWay
P.O.Box3724
AnnArbor,Michigan48106
TEL:(734)994-6088
FAX:(734)994-3338
www.roboticsonline.com

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. THE ROBOT MUST NOT BE OPERATED BY PERSONNEL WHO HAVE NOT BEEN TRAINED!

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.
This safety chapter addresses the following –

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

### 2.2 Standard Conventions

This manual includes the following alerts – in descending order of severity – that are essential to the safety of personnel and equipment. As you read this manual, pay close attention to these alerts to insure safety when installing, operating, programming, and maintaining this equipment.

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

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

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

*Note: Information appearing in a Note provides additional information which is helpful in understanding the item being explained.*

### 2.3 General Safeguarding Tips

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

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).

The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.

In accordance with ANSI/RIA R15.06-1999, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 Mechanical Safety Devices

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

The following safety equipment is provided as standard –

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

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

2.5 Installation Safety

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

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

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

- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Do not enter the robot cell while it is in automatic operation. Be sure that only the person holding the programming pendant enters the workcell.
- Check the E-Stop button on the programming pendant for proper operation before programming. The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- Back up all programs and jobs onto suitable media before program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- Any modifications to PART 1, System Section, of the robot controller concurrent I/O program can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1, System Section. Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!
- Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.
- The robot controller allows modifications of PART 2, User Section, of the concurrent I/O program and modifications to controller parameters for maximum robot performance. Great care must be taken when making these modifications. All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot and other parts of the system. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations.
- Check and test any new or modified program at low speed for at least one full cycle.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Use proper replacement parts.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
Chapter 3

Equipment Description

3.1 EA1400TN Robots

The ArcWorld® V–6300M TRC system is equipped with three Motoman EA1400TN robots. The EA1400TN robot is a 6-axis unit that is specifically designed for arc welding applications. The (T) designator in the robot model number indicates that the robot is configured for horizontal mounting.

Both robots are secured to an overhead robot mounting frame. The mounting frame is a weldment that is attached to and supported by the headstock housing and tailstock housing of the MRM2-1200 M3X positioner (see Figure 1). This configuration places the robots directly over the positioner to provide improved reach. This configuration also significantly reduces required work cell floor space, compared to systems that use floor-mounted robots.

Each EA1400TN robot features a payload capability of 3 kg (6.6 lbs), and a horizontal reach of 1390 mm (54.7 inches). Each robot features a relative positioning accuracy of ±0.08 mm (±0.003 in).

Each EA1400TN robot incorporates 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.

Robot 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 each robot to rotate the welding torch ±360 degrees without cable interference or cable stress.

Mechanical hard stops in the base of each EA1400TN robot are factory-set to limit robot S-axis rotation to ± 30 degrees. This is a safety feature that accommodates the unique overhead robot mounting.

For additional information on the Motoman EA1400TN robot, please refer to the EA1400N Manipulator Manual that is included with your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).
3.2 NX100-TRC Controller

The ArcWorld® V–6300M TRC system features the NX100-TRC controller assembly. The NX100-TRC assembly consists of one “full size” NX100 controller plus two, smaller, expansion cabinets (see Figure 2). This combination provides the functionality of three full-size controllers, while significantly reducing required installation area. The TRC configuration also reduces the cost to the customer by eliminating redundant components and assemblies inside the controller.

Through specific internal cable interconnections, the NX100-TRC is configured as controller R1, R2, and R3 (see Figure 2). This configuration allows the three robots to operate as a triple system that takes advantage of all the unique functions available only in a triple system configuration. With the ArcWorld® V–6300M TRC system, the full-size NX100 controller cabinet is designated R1, while the smaller, expansion cabinets are designated R2 and R3.

In addition to controlling the movement of the three robots, the NX100-TRC also controls the three welding power sources, the positioner, and provides the signals necessary to operate the three welding systems. In addition to controlling the movement of the three robots, the NX100-TRC also controls the three welding power sources, the MRM2-1200 M3X positioner, and provides the signals necessary to operate the three welding systems.

The NX100-TRC controller features an embedded real-time operating system (RTOS) and is programmed with the Motoman INFORM programming language.

Figure 2 NX100-TRC Controller
3.3 Programming Pendant

The Programming Pendant (see Figure 3) provides the primary means of programmer/operator interaction with the ArcWorld® V–6300M TRC 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 CompactFlash® card slot for program backups.

![Programming Pendant Diagram](image)

**Figure 3** NX100-TRC Programming Pendant

The Programming Pendant provides icon-driven system programming. It also features a menu-driven interface to simplify operator interaction with the robots. Most operator controls are located on the Programming Pendant. This allows remote installation of the NX100-TRC
controller. By using the Programming Pendant, the operator can teach robot motion; perform programming, editing, maintenance, and diagnostic functions; and enable / disable Operator Station control of the ArcWorld® V–6300M TRC system. For detailed information on the pendant programming keys, programming functions, and display functions, please refer to the NX100 Operator’s Manual for Arc Welding that is included with your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

Note: The Programming Pendant LCD display goes dark after a few minutes of inactivity. Press any key to restore screen.

Note: Operator Station ENABLE/DISABLE is accomplished with the Programming Pendant MODE SELECT SWITCH. To transfer control of the ArcWorld® V–6300M TRC system to the Operator Station, set the Programming Pendant MODE SELECT SWITCH to REMOTE.

3.4 Operator Station

The Operator Station (see Figure 4) includes a NEMA enclosure on a stand-alone pedestal. See Figure 1 and Figure 6 for location of the Operator Station pedestal in relation to other components of the ArcWorld® V–6300M TRC system.

![Operator Station Controls](image)

Figure 4 Operator Station Controls
3.4.1 **Operator Station Function – Cycle Start/Cycle Latched**

**WARNING!**

The operation of the CYCLE START button is dependent on the structure of the Master Job. Any alteration of the Master Job could result in injury to personnel or damage to equipment.

Pushing the green CYCLE START/CYCLE LATCHED push button, located on the Operator Station, initiates a positioner sweep cycle if the robot is in the HOME (Safe) position. If the CYCLE START/CYCLE LATCHED push button is pressed while the robot is still welding, or otherwise not in the HOME (Safe) position, the CYCLE START command is “latched” into (stored in) the NX100-TRC controller circuitry. When the robot returns to the HOME (Safe) position, the “latched” CYCLE START command is executed and the positioner sweeps. Circuitry in the NX100-TRC controller prevents the positioner from continuously cycling, should the operator depress and hold the CYCLE START/CYCLE LATCHED push button.

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

Pressing the Operator Station E-Stop push button initiates an emergency stop (E-Stop). Refer to Section 3.7.4 for a discussion of the E-Stop function, and procedures for recovering the ArcWorld® V–6300M TRC system from the emergency stop (E-Stop) condition.

3.4.3 **Operator Station Function – Robot Hold**

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

3.4.4 **Operator Station Function – Alarm**

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

3.4.5 **Operator Station Function – Positioner Auto / Manual**

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

*Note: The POSITIONER AUTO / MANUAL signal depends upon the structure of the Master Job.*
### 3.4.6 Operator Station Function – Start

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

### 3.4.7 Operator Station Function – Reset

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

### 3.4.8 Operator Station Function – Servo ON

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

### 3.4.9 Operator Station Function – Joystick Control of Orbital Axis Rotation

The MRM2-1200 M3X positioner has the ability to position the operator load axis (orbital axis) ±360° in 2.5° increments for better part loading / unloading ergonomics. This rotation of the orbital axis in 2.5° increments (also known as "jogging") is accomplished with a "joystick" control located on the Operator Station (see Figure 4).

### 3.5 MRM2-1200 M3X Positioner

The MRM2-1200 M3X positioner is a high-speed three-axis AC servo-controlled "Ferris-wheel" type positioner. The MRM2-1200 M3X positioner features a 1,200 kg (2646 lb) capacity per side, and three servo axes for high-speed positioning. One external axis is used to rotate the trunnion (swing arm) axis, while the two additional servomotors are used to rotate the two orbital (parts fixture) axes independently of the trunnion (swing arm) axis. The positioner uses a reciprocating motion that sweeps each side of the “Ferris-wheel” type positioner from the operator’s loading zone, into the robot work zone, and back to the operator again. A metal arc screen divides the positioner into two work areas: Side A and Side B. When Side A is in the robot welding zone, Side B is facing the operator and ready to be loaded or unloaded. Tooling fixtures shall be supplied by the customer.

The ArcWorld® V–6300M TRC system is capable of synchronized motion between various components depending on the job configuration. Synchronized robots move at the same time during operation. R1, R2, and R3 can be synchronized with the positioner, and R1 can be synchronized with R2 and R3. All three robots can work simultaneously on a rotating work piece. For additional information on independent control and coordinated motion, refer to the NX100 Independent / Coordinated Control Function Manual that is included in the ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

For additional positioner information, including specifications, illustrated parts lists, load capabilities, and dimensions, refer to the MRM2-1000/1200 M3X Positioner Manual that is
Note: The customer shall supply all tooling and fixtures for the positioner.

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

3.6 Welding Equipment

In its standard configuration, the ArcWorld® V–6300M TRC system includes a welding power source, wire feeder, torch, and torch mount for each of the three EA1400TN robots. Optional welding equipment is available for the ArcWorld® V–6300M TRC system (refer to Section 1.2.3). Optional welding equipment may be included with your ArcWorld® V–6300M TRC system shipment.

3.6.1 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® V–6300M TRC system depends on the customer’s specific application and preference. For specific information on the welding power sources supplied with your ArcWorld® V–6300M TRC system, refer to the welding power source manual that is included with your system documentation package (refer to Section 1.3).

3.6.2 Wire Feeder

A welding wire feeder is mounted on the upper arm (U-Axis) of each EA1400TN robot. The wire feeder is the “4-roll” type and provides reliable wire feeding at rates up to 750 inches per minute (ipm). Interchangeable feed rolls are used to accommodate different wire gauges and wire types. For additional information on how the wire feeder is mounted to a robot upper arm, including allowable load and installation position, refer to the EA1400N Manipulator Manual that is included with your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

3.6.3 GMAW Torch

The ArcWorld® V–6300M TRC system uses either an air-cooled or a water-cooled robotic / automatic GMAW torch for each robot. These are heavy-duty torches designed for quick replacement and minimum robot reprogramming. The GMAW torch is installed at the end of the robot wrist flange. For applications that use the optional water-cooled torch, the ArcWorld® V–6300M TRC system includes a water circulator kit for each robot. For additional information on the torches that are supplied with your system, refer to the vendor documentation that is included with your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).
3.7 Safety Features

The ArcWorld® V–6300M TRC system features Motoman’s Total Safety Environment. The system incorporates a practical level of safeguarding to satisfy most plant conditions. If the customer complies with all standard safety precautions, the safety equipment helps to ensure safe operation of the robot work cell.

Note: ArcWorld® V–6300M TRC safety features are independent of program logic. All safeguards are “hard wired” and provide protection that is independent of any software program. System safeguards do not depend upon a programmer correctly inputting an instruction in the operating program.

Note: ArcWorld® V–6300M TRC system safeguards are interfaced with normally closed (NC) “fail-to-safe” switch contacts. These components will stop work cell operation if they are disconnected or damaged.

Note: Users are responsible for determining that the safeguards provided with the ArcWorld® V–6300M TRC system are adequate for their plant conditions. Users must also ensure that all safeguards are maintained in working order.

3.7.1 Welding Arc Protection

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

Two forms of welding arc protection are part of the ArcWorld® V–6300M TRC system –
• a steel arc screen on the positioner
• arc curtains (attached to the steel mesh safety fencing)

The steel arc screen on the positioner is always positioned between the welding arc and the operator. This protects the operator from intense ultraviolet light, radiation and sparks that result from the welding operation (see Figure 1).

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

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

3.7.2 Safety Fencing

The heavy-gauge steel mesh safety fencing that is provided with the ArcWorld® V–6300M TRC system encloses the entire work cell. It forms a physical barrier that prevents personnel from entering the work cell during automatic operation.
3.7.3 **Light Curtain System**

The main function of the Light Curtain System is to protect an operator from positioner movement. The Light Curtain System consists of a SEND unit, RECEIVE unit, and associated wiring (see Figure 1). The Light Curtain System establishes an infrared light path between the SEND and RECEIVE units to define a protected zone in front of the positioner. The positioner will not initiate a sweep if an operator (or an object) is in a location that interrupts (breaks) the established light path. Interruption of the established light path during a positioner sweep immediately triggers an E-Stop condition (refer to Section 3.7.4).

For additional information on the safety light curtain system, refer to the vendor documentation that is included with your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

3.7.4 **Emergency Stop (E-Stop)**

E-Stop is a primary safety feature of the ArcWorld® V–6300M TRC system. A work cell access door interlock, a light curtain system, robot welding torch impact (collision) detection circuitry (refer to Section 3.6.3), and E-Stop activation push buttons can all trigger an E-Stop condition. An E-Stop condition immediately de-energizes the control system and activates the robot braking system (refer to Section 3.7.6). The E-Stop activation push buttons are used for an intentional shutdown of the ArcWorld® V–6300M TRC system, and are installed at the following locations –

- Programming Pendant
- NX100 controller (R1)
- Operator Station

To resume operation after an E-Stop system shutdown, the operator must clear and reset the action that caused the E-Stop condition (refer to Section 5.4.2).

3.7.5 **Programming Pendant ENABLE Switch**

The ENABLE switch is part of the Programming Pendant, and provides a safety feature that controls servo power while the system is in TEACH mode (see Figure 5). When pressed in, this switch allows the operator to turn servo power ON. However, should the operator release the switch or grasp it too tightly, servo power is immediately removed, thus preventing further robot movement.

For detailed information about the operation of the ENABLE switch, refer to the thNX100 Operator's Manual for Arc Welding that is included with your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).
3.7.6 Emergency Braking System

The robot incorporates a braking system that protects personnel from injury and prevents equipment damage if servo power is removed. Upon loss of servo power, the brake system activates to hold all robot axes in place. The brake system incorporates a feature that allows the operator to release the brake of a specific robot axis when drive power has been removed from the system. Brake release is accomplished with the Programming Pendant (refer to Section 5.4.4).

3.7.7 Interlocked Work Cell Door

A redundant circuit safety interlock is installed on the sliding work cell access door (see Figure 1). Opening the work cell access door while the robots are in PLAY mode triggers an E-Stop condition (refer to Section 3.7.4).
CAUTION! The ArcWorld® V–6300M TRC system should be installed by qualified personnel who are familiar with the installation and set-up of a robotic system.

CAUTION! Do NOT remove the positioner shipping bracket assembly until the MRM2-1200 M3X positioner is securely anchored to the foundation. The shipping bracket assembly retains the headstock and tailstock in correct alignment during shipping and installation. Do not discard shipping bracket assembly after removal.

Note: The customer must supply all anchoring hardware for the ArcWorld® V–6300M TRC system. Please refer to Appendix A of this document for suggested anchoring hardware and foundation specifications.

Two to three qualified technicians can install the ArcWorld® V–6300M TRC system in a reasonable amount of time. Always comply with established safety procedures throughout the installation process (refer to Chapter 2).

4.1 Required Materials

All system components and most of the hardware items required for installation of the ArcWorld® V–6300M TRC system are included with your shipment. There are, however, some required items that the customer must supply, such as typical installation and maintenance tools (refer to Section 4.1.2) and special anchor bolts (refer to Appendix A).

4.1.1 Customer-Supplied Items

- Shielding gas for the welding torches
- Local electrical service
- Earth ground wires for the robots and the NX100-TRC controller
- Earth ground rods and/or buried copper sheeting (quantity and placement depth as required to achieve specified resistance-to-ground reading of 100 ohms or less)
• Chemical (optional) to increase conductivity of soil in the vicinity of the earth ground system
• Welding wire
• Clean, dry air supply (for torch tender or wire cutter options) –
  • Flow Rate  0.425 m$^3$/min (15 cfm)
  • Pressure  620 kPa (gage) [90 psi (gage)]
• Forklift(s) and/or overhead crane
• Special anchor bolts and drill bits (refer to Appendix A for suggested anchoring hardware)

### 4.1.2 Recommended List of Hand Tools and Equipment

• Safety glasses
• Face shield
• Gloves (heavy-duty leather recommended)
• Levels (short and long)
• Adjustable wrench (large and small)
• Air impact wrench / hammer drill with concrete drill bits (refer to Appendix A)
• Phillips and flat-blade screwdrivers
• Hammers (“dead-blow”, standard, and non-marring)
• Ratchet handle and breaker bar (3/8-inch and 1/2-inch drive)
• Socket set, 3/8-inch and 1/2-inch drive (SAE and Metric)
• Open-end wrench set (SAE and Metric)
• Wrench set, Allen® (SAE and metric)

### 4.2 Site Preparation

**WARNING!**

Be sure to provide sufficient room for access to the work cell door, Operator Station, and system components that are exterior to the work cell. Failure to observe this precaution could result in injury to personnel during system operation and maintenance.

To prepare your site, proceed as follows –

1. Clear floor and overhead space needed for the ArcWorld® V–6300M TRC system (see Figure 6 and Figure 7). Allow an additional 1.2 – 1.5 m (4 – 5 ft) on all sides of the work cell to provide the clearances needed for installation.

2. Gather all customer-supplied items and required tools (refer to Section 4.1)
Figure 6  ArcWorld® V–6300M TRC System — Plan View

Figure 7  ArcWorld® V–6300M TRC System — Elevation View
4.3 Removal of System Components from Shipping Skids

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

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

**CAUTION!**
Do NOT remove the positioner shipping bracket assembly until the positioner is securely anchored to the foundation. The shipping bracket assembly retains the headstock and tailstock in correct alignment during shipping and installation.

1. Unbolt each component from its shipping skid using a ¾-inch socket (see Figure 8).
2. Use forklift(s) or overhead crane to lift each component away from its shipping skid.
3. Discard or recycle all shipping materials including the shipping skids. **DO NOT REMOVE THE POSITIONER SHIPPING BRACKET ASSEMBLY.**

*Figure 8  Shipping Bolt Removal*
4.4 Installation — MRM2-1200 M3X Positioner

CAUTION!

Do NOT remove the positioner shipping bracket assembly until the MRM2-1200 M3X positioner is securely anchored to the foundation. The shipping bracket assembly retains the headstock and tailstock in correct alignment during shipping and installation.

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

WARNING!
The positioner (without the Overhead Robot Mounting Frame) weighs approximately 4100 kg (9039 lbs). Be sure that your lifting device is rated to safely handle this load.

1. Move the positioner to desired installation location. **DO NOT REMOVE THE SHIPPING BRACKET.**

*Note: When placing the positioner, be aware of the space required by other components of the ArcWorld® V–6300M TRC system (see Figure 6 and Figure 7).*

WARNING!
The Overhead Robot Mounting Frame (with robots installed) weighs approximately 1960 kg (4321 lbs). Be sure that your lifting device is rated to safely handle this load.

2. With the positioner in place, use a suitable hoist or overhead crane to lift the Overhead Robot Mounting Frame into position on top of the headstock and tailstock housing assemblies (see Figure 1, Figure 9, and Figure 10).

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**Figure 9** Mounting Details — Overhead Robot Mounting Frame - to - Headstock Housing
3. Secure the Overhead Robot Mounting Frame to the MRM2-1200 M3X positioner headstock and tailstock assemblies (see Figure 9 and Figure 10).

The mounting flange of the Overhead Robot Mounting Frame (tailstock end) incorporates slotted thru-drilled openings (see Figure 10). This provides for lateral adjustment of the Overhead Robot Mounting Frame if necessary.

Torque values for the Overhead Robot Mounting Frame attaching hardware are given in Figure 9 and Figure 10 of this document.

4. Insert an M20 concrete drill bit through one of the PRIMARY positioner anchoring holes (see Figure 11) and drill a hole in the foundation to a minimum depth of 102 mm (4.0 in). Repeat this process for each of the PRIMARY anchoring holes at the positioner headstock and tailstock locations (see Figure 11).

5. Remove concrete dust from each drilled hole.

6. Install anchor bolts at each PRIMARY anchoring hole (refer to Appendix A for suggested anchor bolts).
7. Remove all screws (on both sides of the positioner) that secure the shipping bracket assembly to the positioner (see Figure 12).

8. Remove the shipping bracket assembly and store it in a secure location.

Note: Do not discard the positioner shipping bracket assembly. The shipping bracket assembly is required for any future transport or relocation of the MRM2-1200 M3X positioner. After removal, store the shipping bracket assembly in a secure location.
9. Insert an M20 concrete drill bit through one of the SECONDARY anchoring holes (see Figure 11) and drill a hole in the foundation to a minimum depth of 102 mm (4.0 in). Repeat this process for each of the SECONDARY anchoring holes at the positioner headstock and tailstock locations (see Figure 11).

10. Remove concrete dust from each drilled hole.

11. Install anchor bolts at each SECONDARY anchoring hole (refer to Appendix A for suggested anchor bolts).

12. Using an M36 socket, adjust the 8 stabilizing screws, as required, to stabilize the MRM2-1200 M3X positioner (see Figure 11).

Note: The MRM2-1200 M3X positioner does not require levelling. The stabilizing screws are designed to eliminate instability or "rock" caused by imperfections in the mounting surface.

4.5 Installation — Programming Platform

WARNING!
The programming platform weighs approximately 350 kg (770 lbs). Be sure that your lifting device is capable of handling this much weight or damage to the equipment or injury to personnel can result.

![Figure 13 Installation — Programming Platform]
Procedure –

1. Use a forklift to place the Programming Platform in position according to dimensions given in the system prints that are supplied with your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

2. Using an M36 socket, turn the levelling/stabilizing screws, as required, to level and stabilize the programming platform (see Figure 13).

3. Anchor the Programming Platform to the foundation (refer to Appendix A for anchoring suggestions).

4.6 Installation — Safety Fence Assembly

The safety fence assembly is shipped on its own skid with all hardware needed for the installation.

Procedure –

**CAUTION!**

Use protective eye wear and heavy gloves when you cut metal shipping bands. Ensure that all personnel are a safe distance away from the shipping bands. The shipping bands are under great tension and can cause injury when cut.

1. Cut the metal bands that secure the safety fence components.

2. Remove all safety fence components (and attaching hardware) from the shipping skid.

3. Discard or recycle the shipping skid.

4. Place safety fence components flat on the floor around the positioner (see Figure 14).

Figure 14 Layout of Safety Fence Components
**WARNING!**

Work with an assistant while accomplishing the following procedures. Safe assembly of the fence panels requires a minimum of two people working as a team.

Refer to Figure 6 and Figure 14 as you perform the following steps –

1. Connect and tighten fence posts to both sides of the right rear wall fence panel.
2. Attach headstock fence panel to right rear wall fence panel.
3. Have an assistant hold the fencing in place while you attach an end post to the headstock fence panel.
4. Connect and tighten fence posts to both sides of the left rear wall fence panel.
5. Attach tailstock fence panel to the left rear wall fence panel.
6. Have an assistant hold the fencing in place while you attach an end post to the tailstock fence panel.
7. Move both headstock and tailstock fence assemblies into location near the positioner.

Refer to Figure 6, Figure 14, and Figure 15 as you perform the following steps –

1. Attach one of the headstock covers to the headstock fence panel post with the provided hardware.

   **Note:** The second headstock cover will be attached to a light curtain fence panel during installation of the light curtain system (refer to Section 4.8).

2. Attach one of the tailstock covers to the tailstock fence panel post with the provided hardware.
Note: The second tailstock cover will be attached to a light curtain fence panel during installation of the light curtain system (refer to Section 4.8).

3. Measure as required to ensure that the headstock and tailstock fence assemblies are square to the positioner and conform to the installation location and angles shown in Figure 6 and Figure 15. Adjust and reposition the fence assembly as necessary.

Note: When adjusting and positioning the headstock and tailstock fence assemblies, be sure to check for correct mate-up of the headstock and tailstock covers with the headstock and tailstock assemblies.

4. Anchor the fence posts to the floor (refer to Appendix A for anchoring suggestions).

4.7 Installation — Arc Curtains

The arc curtains are packaged in an accessories box that is shipped with the ArcWorld® V–6300M TRC system.

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

Install the arc curtains as follows –

1. Unfold each arc curtain and install one arc curtain on the inside of each work cell safety fence panel, using supplied plastic cable ties and the eyelets in each arc curtain (see Figure 16).

Note: The arc curtains are precut to match the work cell fence panels. Each arc curtain bag contains documentation that includes the arc curtain dimensions. If necessary, these dimensions can be used to match the arc curtain to the correct work cell fence panel.

2. Make sure there are no gaps between the arc curtains.

3. Install the work cell door arc curtain on the inside of the door panel, using the supplied plastic cable ties and the eyelets in the arc curtain (see Figure 16).
### 4.8 Installation — Light Curtain System

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

Refer to Figure 1, Figure 6, Figure 14, and Figure 15 as you perform the following steps –

1. Unpack both light curtain fence panels from their shipping location and place them flat on the floor in front of the positioner (see Figure 14).
2. Attach each light curtain fence panel to its associated headstock or tailstock cover with supplied hardware (see Figure 15).
3. With the help of an assistant, raise the light curtain fence panel (receive unit) to vertical.

When raised to a vertical position, the light curtain fence panel (receive unit) is oriented correctly when the light curtain receive unit status lights are located near the base of the tailstock assembly, and the light curtain receive unit is inside the fence panel and facing the area in front of the positioner (see Figure 1).
4. Move the light curtain fence panel (receive unit) into alignment with the positioner tailstock assembly (see Figure 15). Make sure of correct mate-up of the tailstock cover with the positioner tailstock assembly. Also, be sure to note the optimal 90° angle between the light curtain fence panel and the edge of the tailstock assembly when positioning the light curtain fence panel (see Figure 15).

5. When aligned correctly with the tailstock assembly, anchor the light curtain fence panel (receive unit) to the foundation (refer to Appendix A for anchoring suggestions).

6. With the help of an assistant, raise the light curtain fence panel (send unit) to vertical. When raised to a vertical position, the light curtain fence panel (send unit) is oriented correctly when the light curtain send unit status lights are located near the base of the headstock assembly, and the light curtain send unit is inside the fence panel and facing the area in front of the positioner (see Figure 1).

7. Move the light curtain fence panel (send unit) into alignment with the positioner headstock assembly (see Figure 15). Make sure of correct mate-up of the headstock cover with the positioner headstock assembly. Also, be sure to note the optimal 90° angle between the light curtain fence panel and the edge of the headstock assembly when positioning the light curtain fence panel (see Figure 15).

8. When aligned correctly with the headstock assembly, anchor the light curtain fence panel (send unit) to the foundation (refer to Appendix A for anchoring suggestions).

9. Unpack the light curtain cables and connect them to the matching connectors on the light curtain send and receive units in accordance with the wiring diagram and schematic prints that are included with the ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

10. Check the alignment of the send and receive units. Adjust alignment if necessary.

4.9 Installation — Operator Station

Procedure –

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

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

4. Place the Operator Station as shown in Figure 1 and Figure 6.

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

5. Anchor the Operator Station to the foundation (refer to Appendix A for anchoring suggestions).
4.10 Robot Shipping Bracket Removal

**CAUTION!**
Be sure to remove the shipping bracket from each robot prior to power-up or operation. Operation of a robot, with the shipping bracket in place, can damage the robot drive components.

A bracket is installed on each robot at the factory to prevent undesired movement during shipping (see Figure 17). The bracket is painted bright yellow for easy location and identification. The bracket secures the lower arm of the robot to the S-axis housing. In addition, the bracket provides the correct attachment points for a hoisting sling, should the robots need to be lifted or moved. Upon bracket removal, be sure to keep both brackets and attaching hardware in a safe location, should they be needed in the future.

![Figure 17 Robot Shipping Bracket](image)

4.11 Cable Connections

After the ArcWorld® V–6300M TRC system components and peripherals are anchored in their correct locations, locate the interconnect cables for the system components and route them according to the system drawings / schematics included in the ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3). All cables and connectors are labelled to ensure correct connection to the mating connectors on the applicable system component.

*Note: A small gap exists between the bottom of the work cell safety fence and the floor. This gap provides a passage for cables that must run between components that are outside the work cell and those that are inside the work cell.*
4.11.1 Connection to Earth Ground

**WARNING!**

Do not use the ArcWorld® IV-6300M TRC system unless specified components are connected to a low-resistance earth ground. Do not connect the earth ground wire with the wires for the electric power source, welder, etc. The low-resistance earth ground must be a “dedicated” ground that is a direct connection between a component and the earth ground point. Operator injury or death, as well as equipment damage, can result from an inadequate or defective earth ground system.

The EA1400TN robots and NX100-TRC controller must be connected to a low-resistance earth ground. If a ground stake is used, it should be driven at least 2.43 m (8 ft) into the soil. The soil surrounding the driven ground stake should be treated with a chemical that increases the soil conductivity in the vicinity of the driven ground stake. This is often referred to as a “low-resistance earth ground” and may require more than a single driven ground rod, depending on soil conditions. Often, multiple ground rods (bonded together) or even a bonded network of buried copper sheeting (plus conduction-enhancing chemicals) may be required, depending on local soil condition. In any event, the “low-resistance earth ground” must indicate a resistance of 100 ohms or less (when measured directly between grounded equipment and the earth ground system). Be advised that specialized measuring equipment is usually required to get an accurate “resistance-to-ground” reading. Consult a specialist in this field, if required.

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

Connect the EA1400TN robots and the NX100-TRC controller to the earth ground as follows –

1. Connect one end of an earth ground wire to the lug marked EARTH GROUND on the connector panel of robot (R1). Connect the other end of the earth ground wire to the low-resistance earth ground. See Figure 1 for location of robot (R1).
2. Repeat Step 1 for robots R2 and R3.
3. Connect one end of an earth ground wire to the COMMON GROUND BUS BAR located inside NX100-TRC R1 controller (see Figure 2). Connect the other end of the earth ground wire to the low-resistance earth ground.
4. Repeat Step 3 for R2 and R3 expansion cabinets.

4.11.2 Connection to Local Electrical Service

**WARNING!**

Local electrical service connection to the ArcWorld® IV-6300M TRC system must be performed by a qualified, licensed electrician. Electrical and grounding connections must comply with the National Electrical Code (NEC), as well as all local electrical codes.
Note: The ArcWorld® V–6300M TRC system is configured for 3-phase 460/480V AC primary power. For additional information, refer to the electrical drawings and schematics that are included with your system documentation package (refer to Section 1.3).

After all of the system components have been properly installed and interconnected, connect local electrical service to the NX100-TRC controller and welding power sources (refer to Section 4.11.2.1 and Section 4.11.2.2).

4.11.2.1 NX100-TRC Controller

For detailed electrical service interconnect procedures for the NX100-TRC controller, refer to the NX100 Controller Manual and ArcWorld® V–6300M TRC system drawings / schematics that are included with your system documentation package (refer to Section 1.3).

4.11.2.2 Welding Power Sources

Refer to the welding power source documentation and ArcWorld® V–6300M TRC system drawings / schematics for electrical service connection procedures and diagrams for the welding power sources.

4.12 Safety / Operation Check

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

1. Ensure that the shipping bracket is removed from each robot (refer to Section 4.10).

2. Ensure correct alignment and operation of the safety light curtain system (refer to safety light curtain documentation that is included with your ArcWorld® V–6300M TRC system documentation package).

3. Check the security and integrity of all cable connections.

4. Ensure that the work cell sliding access door is closed and that the door interlock is engaged.

5. Verify the correct settings for the welding power sources. Refer to the welding power source documentation that is included with your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

6. Verify that local electrical service complies with the power requirements for your ArcWorld® V–6300M TRC system.

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

CAUTION!
The ArcWorld® V-6300M TRC system is now ready for power-up. Qualified, trained personnel, who are familiar with this system, should perform the power-up sequence.

8. Set the POWER ON-OFF switch on the NX100-TRC R1 controller to ON (see Figure 2).
9. Set the disconnect boxes for the welding power sources to ON (see Figure 6).
10. Set POWER ON-OFF switch on welding power sources R1, R2, and R3 to ON.

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

11. Check for correct operation of all E-Stop push buttons (refer to Section 3.7.4).
12. Check for correct operation of the system HOLD button on the Programming Pendant and Operator Station.
13. Check for correct action of the work cell access door safety interlock.
14. Remove power from the ArcWorld® V–6300M TRC system after completion of the safety / operation check.

### 4.13 Installation of Tooling and Fixtures

Your ArcWorld® V–6300M TRC system is now ready for installation of tooling and fixtures for your particular application. Personnel who are familiar with the operation of the ArcWorld® V–6300M TRC system should do the installation. After tooling installation, test the positioner for correct operation.

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

*Note: Motoman recommends application of a corrosion/rust preventive compound to tooling and fixtures located in a high-humidity environment.*
Chapter 5
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 chapter provides a brief overview of the operating procedures and precautions for your ArcWorld® V–6300M TRC system. For more in depth operating information, refer to specific component manuals that are part of your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

The ArcWorld® V–6300M TRC system is a fully integrated robotic GMAW welding cell.

Three EA1400TN robots weld parts on one side of the MRM2-1200 M3X positioner, while the operator loads the opposite side of the positioner with parts to be welded. When the robots complete the welding process, they return to a Home (Safe) position. The operator can then initiate another positioner sweep cycle from the Operator Station. This moves the previously loaded parts into the robot work area, where the robots then move from the Home (Safe) position to complete another welding cycle.

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

5.1 Programming

The operation of the ArcWorld® V–6300M TRC system is programming dependent. The following operating instructions are based on one possible configuration for this system. Your system configuration and job structure may differ slightly from that presented here; however, basic operation will be the same. For additional programming procedures and information, refer to the NX100-TRC controller documentation that is included with your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

Any changes made to your system configuration or job structure will alter the operation of the system. Motoman recommends that you DO NOT modify the original jobs and system configuration of your ArcWorld® V–6300M TRC 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® V–6300M TRC system. If you have questions concerning the configuration of your system, please contact Motoman 24 hour Customer Support (refer to Section 1.4).

5.2 Sweeping the Positioner

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

Selecting MANUAL mode on the Operator Station POSITIONER AUTO/MANUAL switch allows the operator to sweep the positioner without activating the robots (see Figure 4). Parts can be loaded onto the fixture to achieve the most efficient configuration, and then swept into the welding zone before teaching the robots a series of moves. To sweep Side A or Side B of the positioner into the welding zone, proceed as follows –

1. Place the robots in Home position (refer to Section 5.3.2).
2. Make sure that the Operator Station is enabled (Programming Pendant MODE SELECT SWITCH set to REMOTE).
3. Set the Operator Station POSITIONER AUTO/MANUAL switch to MANUAL and start Master job (refer to Section 5.3.3). Normally, the robots will not move out of Home position when the POSITIONER AUTO/MANUAL switch is set to MANUAL (this depends on job structure).

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

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

5.3 Daily Operation

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

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

To start up the ArcWorld® V–6300M TRC work cell from a power-off condition, proceed as follows –

1. Set POWER ON-OFF switch on NX100-TRC controller (R1) to ON (see Figure 2).
2. Set the power disconnect box for each of the welding power sources to ON (see Figure 1).
3. Set POWER ON-OFF switch on the welding power sources to ON (ON-OFF indicator lamp on the welding power sources will illuminate).
4. Open regulator valve on welding gas supply.
5. Make sure that the work cell access door is closed and that the door safety interlock is engaged.
6. Make sure all E-Stop buttons are released. E-Stop buttons are installed at the following locations –
   • Programming Pendant
   • NX100-TRC controller (R1) door panel
   • Operator Station
7. Select TEACH mode on the Programming Pendant.
8. Place the robots in Home position (refer to Section 5.3.2).

5.3.2 Robot Home Position

To move each robot to the Home position –

1. Turn the Programming Pendant MODE SELECT SWITCH to TEACH.
2. Select MAIN MENU on Programming Pendant touch screen.
4. Select SELECT JOB on Programming Pendant touch screen (a job list appears on the screen).
5. Use the Programming Pendant CURSOR KEY to move the cursor to R1 SAFE job and press SELECT (the job appears on the display screen).
6. Turn servo power ON by grasping and holding the Programming Pendant ENABLE switch in the middle position (see Figure 5), then pressing the SERVO ON button on the Programming Pendant.
7. Use the FWD button on Programming Pendant to jog robot (R1) to HOME position.
8. Repeat steps 5 through 7 for robots R2 and R3.
5.3.3 Master Job

To call up the Master Job –

1. Ensure that the ArcWorld® V–6300M TRC system is powered (refer to Section 5.3.1).
2. Set the Programming Pendant MODE SELECT SWITCH to TEACH.
5. Set the Programming Pendant MODE SELECT SWITCH to PLAY, then press the PLAY MODE ENABLE SWITCH that is located on door of NX100-TRC controller R1 (see Figure 2).
6. Press SERVO ON button on the Programming Pendant.
7. Press the START push button on Programming Pendant (the Master job cycles, waiting for a CYCLE START input from Operator Station).
8. Transfer control to the Operator Station by rotating the Programming Pendant MODE SELECT SWITCH to REMOTE.

The ArcWorld® V–6300M TRC work cell is now ready for operation.

5.3.4 Operation Cycle

The following is the typical sequence of operation for the ArcWorld® V–6300M TRC work cell after start-up –

1. Operator loads the fixture (on operator side of positioner) with parts to be welded.
2. Operator steps out of safety zone created by the light curtain system, and moves to the Operator Station.
3. Operator presses the green CYCLE START button on Operator Station. The positioner sweeps, thus placing parts to be welded into the robot work area. The robots then begins to weld the parts (if the Operator Station POSITIONER AUTO/MANUAL switch is set to AUTO).
4. While the robots are welding, the operator loads the operator side of the positioner with the next group of parts to be welded.
5. The operator again moves to the Operator Station and presses the green CYCLE START button (CYCLE LATCHED light illuminates if the robots are still welding and have not returned to the Home position). When the robots complete the welding process, each returns to Home position. The positioner then sweeps again to return completed, welded parts to the operator position, while moving the next group of parts into the robot work area.
6. Operator moves back to the protected area in front of the positioner and unloads completed, welded parts.
5.3.5 Shutdown

Use the following procedure to perform a normal shut down of the ArcWorld® V–6300M TRC system –

1. Make sure that all robots are 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 NX100-TRC controller (R1) POWER ON-OFF switch to OFF (see Figure 2).
5. Set all welding power source POWER ON-OFF switches to OFF.
7. Set all welding power source power disconnect boxes to OFF (see Figure 1).

The ArcWorld® V–6300M TRC system is now shut down.

5.4 System Recovery

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

5.4.1 Alarms and Errors

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

- Error Messages
- Minor Alarms
- Major Alarms

For more detailed information on alarm and error recovery, refer to the NX100-TRC controller and EA1400TN robot documentation that is included with your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

5.4.1.1 Error Messages

Error messages are usually the result of simple, easily-cleared operation errors. An example could include –

- Pressing the START button when the robots are not in PLAY mode

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

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

5.4.1.3 Major Alarms

Major alarms usually involve hardware failures. Examples could include –

- An overload condition
- An abnormal speed

Clear alarms of this type by cycling the NX100-TRC controller in accordance with the following steps –

1. Set the NX100-TRC (R1) POWER ON-OFF switch to OFF (see Figure 2).
2. Allow the NX100-TRC (R1) POWER ON-OFF switch to remain in the OFF position for approximately 10 seconds.
3. Rotate the NX100-TRC (R1) POWER ON-OFF switch back to the ON position.

5.4.2 E-Stop Recovery

An E-Stop (emergency stop) condition is triggered by any of the following conditions –

- An E-Stop push button switch is activated
- The work cell access door is opened while the robot is not in TEACH mode
- The light curtain system is tripped while the positioner is sweeping
- A welding torch collision triggers a shock sensor output (refer to Section 5.4.3)

If an E-Stop condition is triggered, restart the ArcWorld® V–6300M TRC system as follows –

**CAUTION!**

If an E-Stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when the ArcWorld® V–6300M TRC system is restarted.

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

The ArcWorld® V–6300M TRC system is now ready to continue operation.

5.4.3 Shock Sensor Recovery

The ArcWorld® V–6300M TRC welding package includes a Motoman gun mount for each EA1400TN robot. This mount is designed to protect the torch from damage in case of an impact (collision). A slight deflection of the torch activates a SHOCK SENSOR signal that triggers a
system E-Stop condition. To clear the E-Stop condition, you must override the shock sensor and move the affected robot clear of the impact.

Refer to Figure 3 and the following procedures to override the shock sensor –

**CAUTION!**
Always remember to reactivate the Shock Sensor before continuing system operation. The robots can be damaged if the Shock Sensor Override Switch is left in the “Override” position.

1. Press MAIN MENU on the Programming Pendant.
2. Use the Programming Pendant CURSOR KEY to select the ROBOT icon, then press SELECT.
3. Use the Programming Pendant CURSOR KEY to select OVERRUN-S.SENSOR, then press the SELECT key.
4. Select RELEASE to release the shock sensor.
5. Depress and hold the Programming Pendant ENABLE switch in its middle position (see Figure 5) while pressing the SERVO ON / READY push button.
6. Move the affected robot clear of impact position.

The ArcWorld® V–6300M TRC system is now ready to continue operation.

### 5.4.4 Brake Release

The robot braking system is designed to protect the robots and other system components from damage in the event of a system / robot failure or loss of drive power. If a system or robot failure occurs, you must release the brakes on the affected robot in order to move it.

To release the brakes, proceed as follows –

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

1. On the Programming Pendant, select TEACH mode and turn servo power OFF.
2. Select ROBOT on the Programming Pendant display (touch) screen.
3. Select the BRAKE RELEASE option.
4. Use the CURSOR key to select desired robot axis for release.
5. Press and hold the pendant ENABLE switch in its middle position (see Figure 5), while pressing the INTERLOCK key and the SELECT key.
6. The brake for the selected axis will release.
Chapter 6
Maintenance

Maintenance / inspection must be performed by authorized personnel who are familiar with the ArcWorld® V–6300M TRC system. Be sure to read and understand the documentation for a particular component before performing maintenance or inspection. Be sure that you understand the maintenance / inspection procedures, have the proper tools at hand, and comply with safety precautions given in Chapter 2.

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

For maintenance / inspection procedures and schedules that involve individual system components, refer to your ArcWorld® V–6300M TRC system documentation package (refer to Section 1.3).

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

Table 1 Periodic Maintenance and Inspection

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>COMPONENT</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily (or on condition)</td>
<td>Water Circulators (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 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 physical condition of each safeguard item and ensure that the safeguard item is working correctly</td>
</tr>
<tr>
<td>1 Month (or on condition)</td>
<td>ArcWorld® V–6300M TRC work cell</td>
<td>Remove accumulated dirt, grease, and debris from inside and outside the work cell.</td>
</tr>
<tr>
<td>6 Months (or on condition)</td>
<td>Mating surfaces of Overhead Robot Mounting Frame and headstock / tailstock housings (see Figure 9 and Figure 10)</td>
<td>Check mounting hardware integrity and verify correct torque – 370 N·m (273 lbf·ft).</td>
</tr>
<tr>
<td></td>
<td>Robot base (at robot mounting locations on Overhead Robot Mounting Frame)</td>
<td>Check mounting hardware integrity and verify correct torque – 190 N·m (140 lbf·ft).</td>
</tr>
</tbody>
</table>
Appendix A

Anchoring

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

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

<table>
<thead>
<tr>
<th>SYSTEM EQUIPMENT</th>
<th>MINIMUM HILTI® ANCHOR ROD DIA / TYPE</th>
<th>MINIMUM FLOOR PLATE</th>
<th>MINIMUM FOUNDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROBOTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP3JC, HP3, HP3C, HP3CL, HP3XF, HP5, HP5C</td>
<td>1/2&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>380 mm (15 in) Length 380 mm (15 in) Width 19 mm (0.7 in) Thick</td>
<td>381 mm (15.0 in) Length 381 mm (15.0 in) Width 76 mm (3.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UP6, UP20, UP20-6, EA1400, EA1900</td>
<td>5/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>600 mm (24 in) Length 600 mm (24 in) Width 38.1 mm (1.5 in) Thick</td>
<td>762 mm (30.0 in) Length 762 mm (30.0 in) Width 178 mm (7.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP6, HP6S, HP6R, HP20, HP20-6, EA1400N, EA1900N, DX1350N</td>
<td>5/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>600 mm (24 in) Length 600 mm (24 in) Width 38.1 mm (1.5 in) Thick</td>
<td>762 mm (30.0 in) Length 762 mm (30.0 in) Width 178 mm (7.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UP20M, UP50 SP80 (Note 2)</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>900 mm (35.4 in) Length 900 mm (35.4 in) Width 50.8 mm (2.0 in) Thick</td>
<td>1524 mm(60.0 in) Length 1524 mm(60.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP50, HP50-20, HP50-35, EPL80 (Note 2)</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>900 mm (35.4 in) Length 900 mm (35.4 in) Width 50.8 mm (2.0 in) Thick</td>
<td>1524 mm(60.0 in) Length 1524 mm(60.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UP120, UP130, UP165, SP100 SP160, SP250, SP400 (Note 2)</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>1200 mm(47.2 in) Length 1200 mm(47.2 in) Width 50.8 mm (2.0 in) Thick</td>
<td>1828 mm(72.0 in) Length 1828 mm(72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP165, HP165N-100, HP165R, ES165RN, ES165N, ES165N-100, EPL100, EPL160 (Note 2)</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3) (Note 5) (Note 6)</td>
<td>1200 mm(47.2 in) Length 1200 mm(47.2 in) Width 50.8 mm (2.0 in) Thick</td>
<td>1828 mm(72.0 in) Length 1828 mm(72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
</tbody>
</table>
Table A.1  Suggested Anchor, Floor Plate, and Foundation Specifications

<table>
<thead>
<tr>
<th>SYSTEM EQUIPMENT</th>
<th>MINIMUM HILTI® ANCHOR ROD DIA / TYPE</th>
<th>MINIMUM FLOOR PLATE</th>
<th>MINIMUM FOUNDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROBOTS UP200</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3)  (Note 5)  (Note 6)</td>
<td>1200 mm (47.2 in) Length 1200 mm (47.2 in) Width 50.8 mm (2.0 in) Thick</td>
<td>1828 mm (72.0 in) Length 1828 mm (72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS HP200, ES200N, HP200T, HP200RN, ES200RN, EPL300 (Note 2)</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3)  (Note 5)  (Note 6)</td>
<td>1200 mm (47.2 in) Length 1200 mm (47.2 in) Width 50.8 mm (2.0 in) Thick</td>
<td>1828 mm (72.0 in) Length 1828 mm (72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS UP350, UP500, SK300X</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3)  (Note 5)  (Note 6)</td>
<td>1500 mm (59.1 in) Length 1500 mm (59.1 in) Width 50.8 mm (2.0 in) Thick</td>
<td>1828 mm (72.0 in) Length 1828 mm (72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>ROBOTS HP350, HP350-200, HP500, HP600, EPL450, EPL500 (Note 2)</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3)  (Note 5)  (Note 6)</td>
<td>1500 mm (59.1 in) Length 1500 mm (59.1 in) Width 50.8 mm (2.0 in) Thick</td>
<td>1828 mm (72.0 in) Length 1828 mm (72.0 in) Width 229 mm (9.0 in) Thick 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>POSITIONER Rotary Turntable Type</td>
<td>5/8&quot; HVA Chemical Anchor (Note 3)  (Note 6)</td>
<td>Not Applicable</td>
<td>Refer to Applicable Positioner Manual</td>
</tr>
<tr>
<td>POSITIONER &quot;Ferris wheel&quot; type with headstock and tailstock (HS/TS)</td>
<td>7/8&quot; HVA Chemical Anchor (Note 3)  (Note 6)</td>
<td>Not Applicable</td>
<td>Refer to Applicable Positioner Manual</td>
</tr>
<tr>
<td>PERIPHERAL EQUIPMENT</td>
<td>1/2&quot; Kwik Bolt II Expansion Anchor (Note 4)  (Note 6)</td>
<td>Not Applicable</td>
<td>3&quot; min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete</td>
</tr>
<tr>
<td>WORK CELL FENCE POSTS</td>
<td>3/8&quot; Kwik Bolt II Expansion Anchor (Note 4)  (Note 6)</td>
<td>Not Applicable</td>
<td>3&quot; min thickness or 1.3 Embedment Depth (whichever is larger), 4000 psi Reinforced Concrete</td>
</tr>
</tbody>
</table>

Notes –

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

Contact Information –

1-800-879-8000 (USA)  http://us.hilti.com
1-800-363-4458 (CAN)  http://ca.hilti.com
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