

Motoman XRC 2001 Controller

ProcessWorld 1000

System Manual

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Chapter 1

Introduction

The ProcessWorld 1000 is part of the ProcessWorld family of standardized material handling solutions. It is a fully integrated system, ideal for gluing, dispensing, sanding, foam pouring, and other small process applications.

The ProcessWorld 1000 features a Motoman robot, XRC 2001 controller with menu-driven handling software, 180-degree reciprocating rotary positioner, operator interface, and total safety environment.

1.1 About This Document

This manual is intended as an introduction and overview for personnel who have received operator training from Motoman, and who are familiar with the operation of this Motoman robot model. For more detailed information, refer to the manuals listed in Section 1.3. This manual contains the following sections:

SECTION 1 - INTRODUCTION

This section provides general information about the ProcessWorld 1000 and its components, a list of reference documents, and customer service information.

SECTION 2 - SAFETY

This section provides information regarding the safe use and operation of the ProcessWorld 1000 system.

SECTION 3 - DESCRIPTION OF EQUIPMENT

This section provides a detailed description of the major components of the ProcessWorld 1000 system. This section also includes a table of component specifications.

SECTION 4 - INSTALLATION

This section provides instructions for set up and installation of the ProcessWorld 1000 system.

SECTION 5 - OPERATION

This section provides instructions for basic operation of the ProcessWorld 1000 system. This section also provides procedures for start-up, loading, normal operation, fault recovery, and shutdown.

SECTION 6 - MAINTENANCE

This section contains a table listing periodic maintenance requirements for the components of the ProcessWorld 1000 cell.

1.2 System Overview

The ProcessWorld 1000 provides a complete material handling solution in a standardized configuration. The system is designed around a Motoman material handling robot and XRC 2001 robot controller. A reciprocating rotary positioner allows the operator to prepare and set up parts on one side while the robot processes parts on the other side. The cell provides a full complement of safety features designed to protect both personnel and equipment. Figure 1 illustrates the system layout of the ProcessWorld 1000 cell.

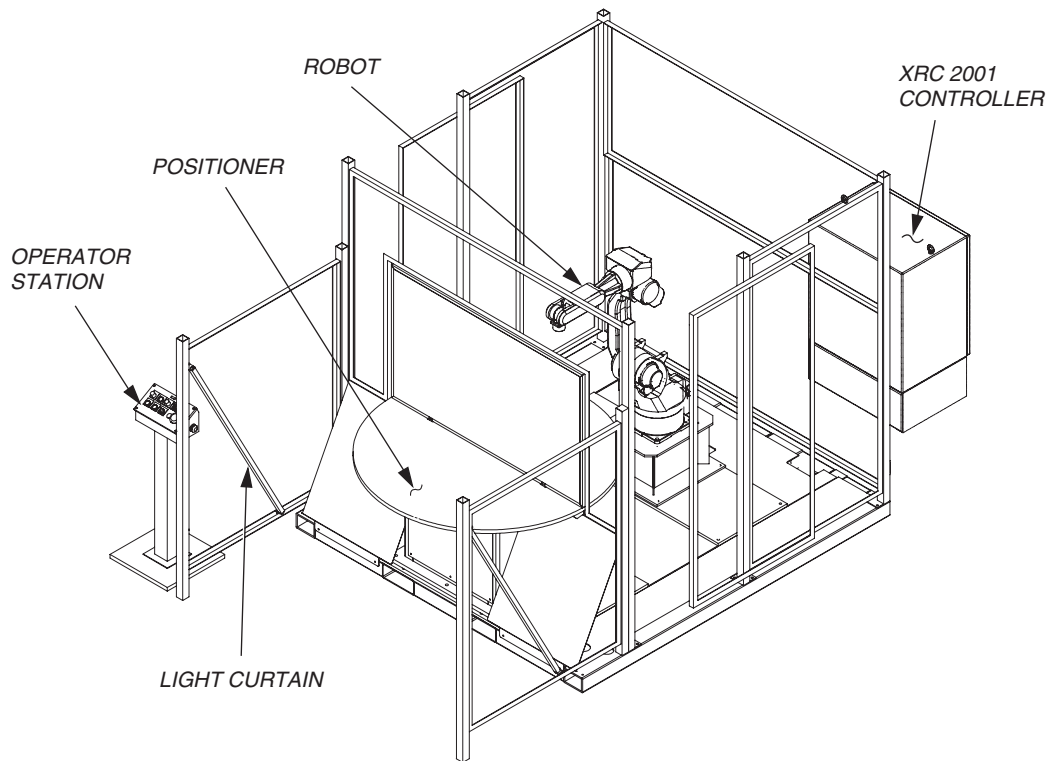


Figure 1 System Layout



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

1.2.1 System Layout

The robot manipulator and positioner share a common base for ease of installation and to help maintain proper alignment between the two components. The robotic cell is fully enclosed by safety fencing and an interlocking door. Light curtains provide a safety zone to prevent the positioner from cycling while anyone is standing within the zone. All operator controls, including those on the XRC 2001 controller, are accessible from outside the robotic enclosure.

1.2.2 Major Components

The ProcessWorld 1000 includes the following major components:

- A Motoman UP6, UP20, or UP50 manipulator and XRC 2001 controller
- MR-300 series reciprocating rotary positioner
- Operator station
- Universal Interface
- Safety equipment, including the following:
 - Safety fencing
 - Interlocked light curtains
 - Interlocked cell door
 - Positioner screen

1.2.3 Optional Equipment

The following optional equipment is available for use with the ProcessWorld 1000:

- Grippers (vacuum, mechanical)
- Upper arm pneumatic package
- Controller common base

1.3 Reference to Other Documentation

For additional information refer to the following:

- Motoman UP6 Manipulator Manual (P/N 142104-1)
- Motoman UP20 Manipulator Manual (P/N 144342-1)
- Motoman Operator's Manual for Handling (P/N 142100-1)
- Motoman Concurrent I/O Parameter Manual (P/N 142102-1)
- Vendor manuals for system components not manufactured by Motoman

1.4 Customer Service Information

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

- Robot Type (UP6 or UP20)
- Application Type (material handling)
- System Type (ProcessWorld 1000)
- Software Version (3.74A)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on front door of XRC 2001 controller)

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. The address is as follows:

Robotic Industries Association

900 Victors Way

P.O. Box 3724

Ann Arbor, Michigan 48106

TEL: (734) 994-6088

FAX: (734) 994-3338

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 section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
- Installation Safety (Section 2.5)
- Programming Safety (Section 2.6)
- Operation Safety (Section 2.7)
- Maintenance Safety (Section 2.8)

2.2 Standard Conventions

This manual includes information essential to the safety of personnel and equipment. As you read through this manual, be alert to the four signal words:

DANGER!

WARNING!

CAUTION!

NOTE:

Pay particular attention to the information provided under these headings which are defined below (in descending order of severity).



DANGER!

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



CAUTION!

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



Note: Information appearing in a Note caption provides additional information 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, section 6.13.4 and 6.13.5, 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 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 measures are available:

- Safety fences and barriers
- Light curtains
- Door interlocks
- Safety mats
- Floor markings
- Warning lights

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 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 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. All personnel involved with the operation of the equipment must understand potential dangers of operation. Programming tips are as follows:

Any modifications to PART 1 of the XRC controller PLC can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1. 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.

Back up all programs and jobs onto a floppy disk whenever 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.

The concurrent I/O (Input and Output) function allows the customer to modify the internal ladder inputs and outputs for maximum robot performance. Great care must be taken when making these modifications. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations that may damage the robot or other parts of the system.

- 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 operate the system.
- 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 the E-STOP button on the teach pendant for proper operation before programming.
- Carry the teach pendant with you when you enter the workcell.
- Be sure that only the person holding the teach pendant enters the workcell.
- Test any new or modified program at low speed for at least one full cycle.

2.7 Operation 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. All personnel involved with the operation of the equipment must understand potential dangers of operation. Operation tips are as follows:

- Be sure that only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories are permitted to operate this robot system.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Inspect the robot and work envelope to ensure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Ensure that all safeguards are in place.
- 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 operate the system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

- 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. This includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.

2.8 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. All personnel involved with the operation of the equipment must understand potential dangers of operation. Maintenance tips are as follows:

- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- 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 operate the system.
- Back up all your programs and jobs onto a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories, or equipment to avoid loss of information, programs, or jobs.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Be sure all safeguards are in place.
- Use proper replacement parts.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- 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. This includes controller parameters, ladder parts 1 and 2, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
- 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 UP-series Robot Description

The Motoman UP series robots and XRC 2001 robotic controller represent state-of-the-art technology in robotics today. The six-axis UP6 robot has a payload of 6 kg (13.2-lbs). It features a 1,373 mm (54.05-inch) reach and has a relative positioning accuracy of ± 0.08 mm (0.004-inch). The six-axis UP20 robot has a payload of 20 kg (44.09-lbs). It features a 1658 mm (65.2-inch) reach and has a relative positioning accuracy of ± 0.1 mm (0.004-inch). The six-axis UP50 robot has a payload of 50 kg (110-lbs). It features a 2046 mm (80.5-inch) reach and has a relative positioning accuracy of ± 0.07 mm (0.004-inch).

Each robot can reach below its own base as well as behind itself and can be mounted on the floor, wall, or ceiling with few modifications. However, the S-axis has been restricted by hardstops for use in this system. For more information, refer to the manipulator manual that came with your system.

3.2 XRC 2001 Controller

The XRC 2001 robotic controller (see Figure 2), coordinates the operation of the ProcessWorld 1000 system. It controls manipulator movement, processes input and output signals, and provides the signals to operate any external equipment. It maintains variable data and performs numeric processing to convert to and from different coordinate systems. In addition, the controller provides the following: main logic functions, servo control, program and constant data memory, and power distribution. For more information, refer to the manipulator manual that came with your system.

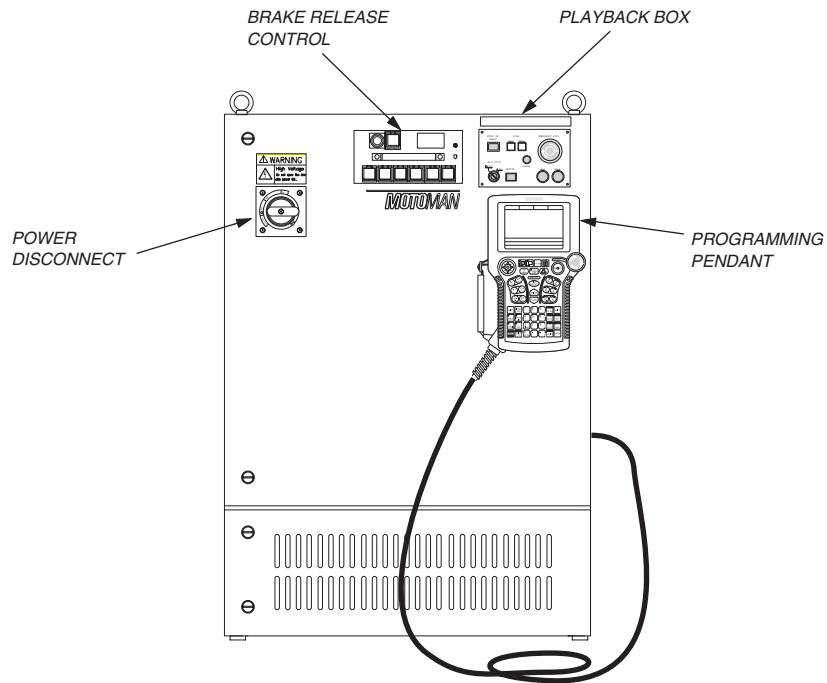


Figure 2 XRC 2001 Controller

3.2.1 Playback Panel

The playback panel (see Figure 3) contains the primary system controls and consists of the features described below. For more information, refer to the manipulator manual that came with your system.

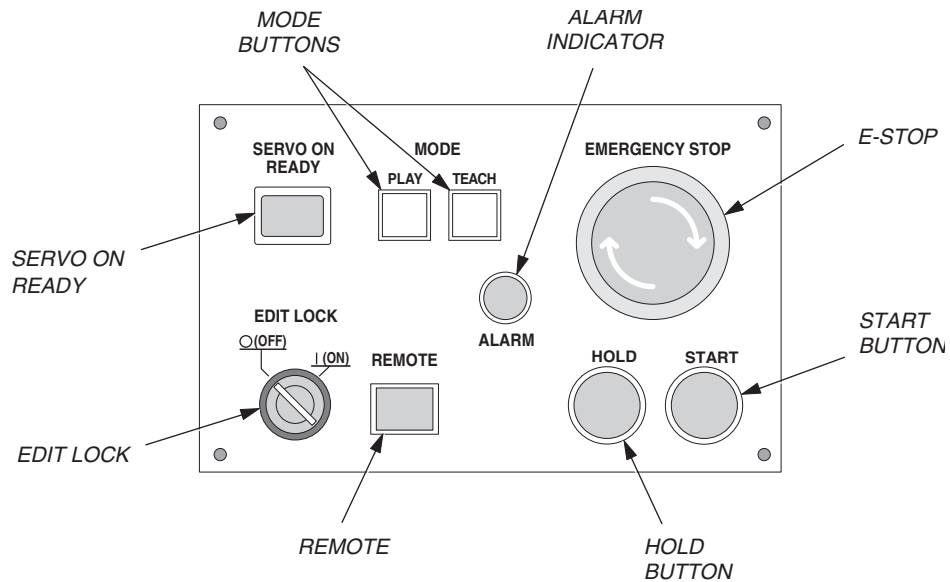


Figure 3 XRC Controller Playback Panel

Servo On Ready

The SERVO ON READY pushbutton turns servo power ON. The switch lights when servo power is on. In TEACH mode, the SERVO ON READY pushbutton operates only when the TEACH LOCK button on the programming pendant is ON and the ENABLE switch on the programming pendant is held in.

Mode

The Mode push buttons (PLAY, TEACH and REMOTE) set the robot's mode of operation.



Note: Changing modes from PLAY to TEACH, during playback, will cause the program to cease execution (similar to HOLD); to resume operation, press PLAY and then START.

Alarm/Error

The ALARM/ERROR indicator light turns ON whenever an alarm or error condition occurs.

Emergency Stop (E-STOP)

The E-STOP button on the playback panel is connected in series with the system Emergency Stop circuit. Pressing E-STOP ceases all system operation.

Start

Pressing the START button while in PLAY mode with servo power on, causes playback execution of the current job to begin.

Hold

The HOLD button is a normally closed, momentarily actuated switch. Pressing HOLD halts operation of the manipulator until another Start signal is sent.

3.2.2 Programming Pendant

The programming pendant (see Figure 4) is the primary user interface for the system. The pendant has a 4x5-inch 12-line, 40-character LCD display and keypad. The system uses the INFORM II robot language and a menu-driven interface to simplify operator interaction with the robot. By using the pendant, the operator can teach robot motion, and perform programming, editing, maintenance, and diagnostic functions. The programming pendant consists of the items described below. For more information, refer to the manipulator manual that came with your system.



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

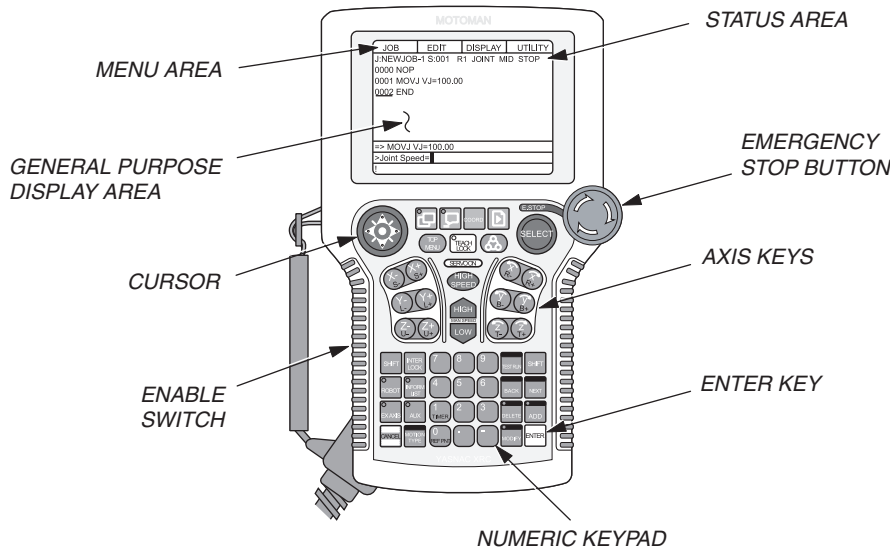


Figure 4 Programming Pendant

General Purpose Display Area

The General Purpose Display Area displays the currently selected menu choice.

Menu Area

The Menu Area contains menu selections for the currently selected screen.

Emergency Stop (E-STOP)


















The E-STOP button on the programming pendant is connected in series with the system Emergency Stop circuit. Pressing the E-STOP button interrupts this circuit and stops all system operation.

Keypad

The user keypad on the programming pendant serves as an input device. The keys are grouped into different functional sections to simplify operator use.

Status Area

The Status Area shows system status via the following symbols:

- Active Robot, External Axis, or Base Axis
R1, R2, R3; S1, S2, etc.; or B1, B2, etc.
- Coordinate System
 Joint,  World,  Cylindrical,  Tool, or  User Frame
- Manual Speed Setting
 Inching,  Low,  Medium, or  High
- Cycle Mode
 Step,  1-Cycle, or  Auto
- System Status
 E-Stop,  Stop,  Running/Start,  Hold, or  Alarm
- Additional Pages (when applicable)

TOP MENU Key

The TOP MENU key returns the pendant display to the initial start-up menu. The cursor key can then be used to choose from the following menu icons:

- JOB
This icon accesses job selections including: Master Job, Select Job, Job Capacity, and Create New Job while in TEACH mode.
- ARC WELDING, GENERAL, HANDLING, and SPOT WELDING
This icon allows you to select the applications available to the controller.
- VARIABLE
This icon accesses the display and editing menu for the arithmetic variables and display of position variables.
- IN/OUT
This icon accesses DETAIL and SIMPLE displays of all XRC I/O signals. In EDITING or MAINT. mode, Universal Outputs can be forced ON or OFF.
- ROBOT
This icon accesses robot information including: CURR.POS, POWER ON/OFF, POS, COMMAND POS, SECOND HOME POS, OPE ORIGIN POS, and TOOL and USER COORDINATE.
- SYSTEM INFO
This icon provides Version information for both hardware and software, Alarm History, and Monitoring Time.

Area Key

The Area key moves the cursor to the different areas of the display screen.

Cursor Key

The Cursor key is an 8-way, directional key that moves the up, down, left or right to highlight a desired item that can then be chosen using the SELECT key.

SELECT Key

The SELECT key is used to choose the item currently highlighted by the cursor.

TEACH LOCK Key

The TEACH LOCK key locks operation of the robot with the programming pendant. Operation is not possible from the playback panel or operator station. Servo power can not be applied in TEACH mode unless TEACH LOCK is ON.

RS-232C Serial Port

This 9-pin serial port is used for data communication between the XRC controller and a floppy disk controller (FC1 or FC2), FDE (Floppy Disk Emulator) software, or other form of communication (see Figure 5).

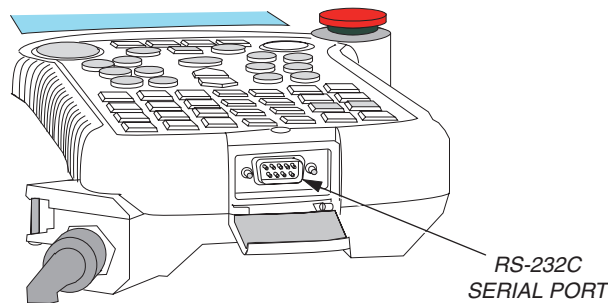


Figure 5 RS-232C Serial Port

ENABLE Switch

The ENABLE switch (see Figure 6) is a three-position switch located on the left rear of the programming pendant. It is a safety feature that controls servo power while in TEACH mode. When pressed in, this switch enables servo power to be turned on. However, should the operator release the switch, or grasp it too tightly, servo power is immediately disabled, preventing further robot movement.

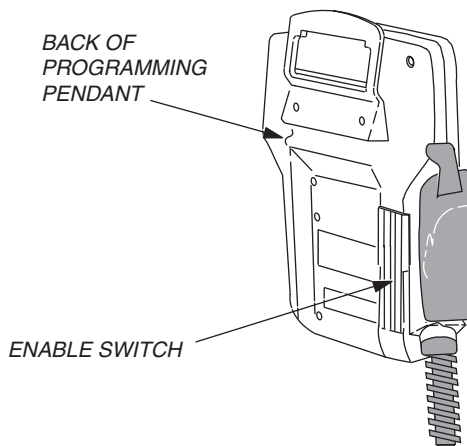


Figure 6 Enable Switch

3.2.3 Brake Release



WARNING!

Releasing brakes could cause personal injury or machine damage. Always support the axis to be released BEFORE you release it.

The Brake Release Control is a safety feature that allows you to release the automatic brakes on the robot in case of an emergency or robot failure. The Brake Release Control is mounted on the front of the XRC controller cabinet (see Figure 2).

3.3 Operator Stations

The operator station (see Figure 7) includes a NEMA enclosure on a stand-alone pedestal. The following paragraphs describe the operator station controls.

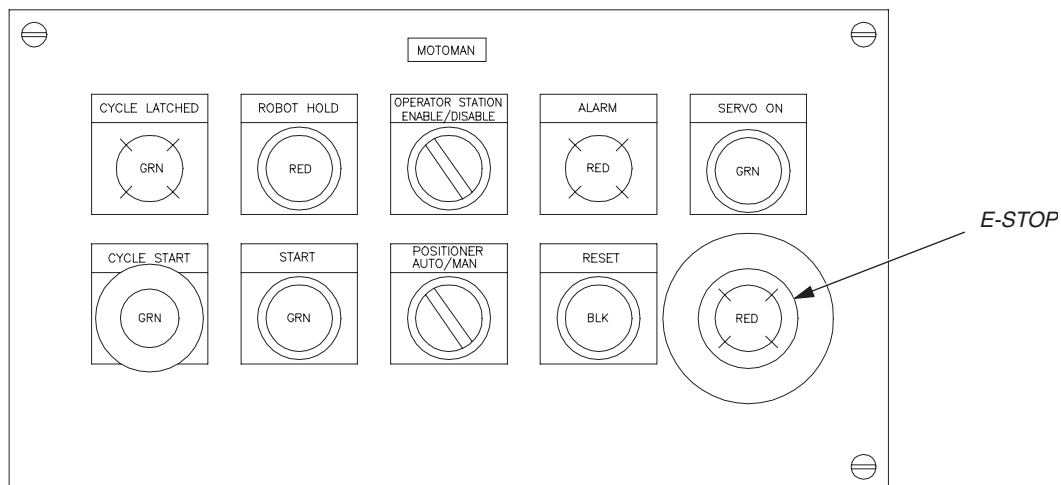


Figure 7 Operator Station

Cycle Start



WARNING!

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

The green CYCLE START button, located on the operator station, initiates a positioner sweep cycle if the robot is in the Safe or Home position (Cube 24). If the CYCLE START button is pressed while the robot is outside Cube 24, the CYCLE START command is latched into the XRC. Once the robot returns to Cube 24 and Output #1 is on, the CYCLE START command is executed and the positioner sweeps. A pulse instruction prevents the operator from holding the button down and continuously cycling the positioner.

Emergency Stop (E-STOP)

Pressing an E-STOP button or interrupting a door interlock stops all system operation. The operator station E-STOP, the robot E-STOP, and the sliding door interlocks are connected to a safety PLC and the Emergency Stop circuit. Brakes are applied to the robot and all servo power is removed from the system. The system E-STOP lights come on and all positioner motion is stopped.

Hold

The HOLD button is a normally closed, momentarily actuated switch. Pressing the HOLD button stops the operation of the manipulator until another Start signal is sent. The indicator light stays ON only while the HOLD button is pressed. Operation resumes at the point in the program where the HOLD state was initiated. Refer to the manipulator manual for more information.

Cycle Latched

CYCLE LATCHED indicates that the positioner will sweep and begin working immediately after the current work cycle is complete. The CYCLE LATCHED lamp operates and illuminates when positioner CYCLE START command has been latched. It is not necessary to wait for the robots to finish working and return to the Safe position (Cube 24) before pressing the CYCLE START button to sweep the positioner. Pressing the Cycle Start button while either robot is still in motion locks the CYCLE START command into the XRC. The CYCLE LATCHED light comes on, indicating CYCLE START latching. The positioner sweeps once the robots finish the current job and return to the Safe position (Cube 24). If a person enters the safety zone created by the light curtains, the CYCLE START command will be unlatched from the XRC controller.

Alarm

The ALARM lamp is connected to the robot SERVO ON and ALARM OCCURRENCE outputs. The ALARM lamp turns on when the robot encounters an alarm condition or when servo power is cut.

Positioner Auto/Manual

The POSITIONER AUTO/MANUAL selector switch is used to select AUTOMATIC or MANUAL mode for the positioner. The selector switch is connected to robot Input #2. When the selector switch is in the AUTOMATIC position, the robot processes the part after the positioner sweeps. In MANUAL mode, the robot does not process the part after the positioner sweeps, but remains in the Safe position.



Note: The Positioner Auto/Manual command is dependent on the structure of the Master job.

Master Job Start

The MASTER JOB START button is connected to the robot external start input. The robot will start the current active job when MASTER JOB START is pressed. The operator station must be enabled and servo power ON for the MASTER JOB START button to work.

Operator Station Enable/Disable

The OPERATOR STATION ENABLE/DISABLE selector switch transfers primary control of the ProcessWorld cell from the XRC controller to operator station. The REMOTE MODE button on XRC controller playback panel lights when the operator station is enabled. Most programming pendant functions are disabled while in REMOTE.

Reset

The RESET button is connected to the robot alarm reset input. A minor alarm or error condition is cleared when this button is pressed. The positioner only needs to be reset after initial power-up and after an emergency stop while in Play mode.



Note: Resetting the positioner may cause some positioner motion. You must be careful when you reset the positioner with the robot close to tooling. If an Emergency Stop occurs during programming, be sure to reset the positioner before resuming programming.

ServoOn

The SERVO-ON pushbutton turns servo power ON. In TEACH mode, the SERVO ON pushbutton operates only when the ENABLE switch on the programming pendant is held in.

3.4 MR-300 Positioner

The MR-300 positioner uses a reciprocating motion that sweeps each side of the circular turntable from the operator's loading zone, into the robot's work zone, handbook to the operator again. A metal screen divides the positioner into two semicircular work areas labeled Side A and Side B. When Side A is in the robot's work zone, Side B is facing the operator and ready to be loaded or unloaded with parts, and vice versa. Loading fixtures are supplied by the customer. For positioner specifications, refer to Table 3-1. Refer to Section 6.2 for maintenance procedures.



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

Table 4 MR-300 Positioner Specifications

Conditions	Specifications
Table Diameter	152.4 cm (60 in.)
Maximum Tooling Weight with Part	598 kg (1320 lbs) total weight, or 299 kg (660 lbs) per side. Load must be balanced within 20%.
Maximum Tooling Size	914 x 432 x 889 mm (36 x17 x 35 inch)
Sweep Time with Capacity	4.0 seconds for 180 degrees sweep with maximum total load of 598 kg (1,320 lbs)
Temperature Operating Range	4-43° C (40-110° F)
Humidity (maximum)	Non-condensing 10-90% relative humidity
Shock (maximum)	Less than 0.5 G
Electrical Requirement	208V AC/120 Hz/Two-Phase supplied by the XRC 2001 controller

3.5 Safety Features

The ProcessWorld 1000 system includes a total safety environment. When all standard safety precautions are taken, the safety equipment helps to ensure safe operation of the robotic cell. The ANSI/RIA R15.06 Robot Safety Standard stipulates the user is responsible for safeguarding.



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

3.5.1 Safety PLC - Programmable Logic Controller

The ProcessWorld 1000 system comes with a safety PLC (see Figure 8). The PLC monitors a large portion of the cell's safety components. These cell components are first interfaced into the PLC and then into the XRC 2001 Controller. The safety PLC is responsible for monitoring gate interlock 1, gate interlock 2, safety light curtains, operator station E-stop, and the In-position signals generated from the table. (Refer to system prints for additional signals that may be interfaced to the PLC.) The PLC monitors the status of the safety devices and is dependant on the status of the inputs. The PLC determines if an E-stop condition should occur. Refer to the safety PLC manual provided with the system for more details on the operation of the PLC and its associated fault codes.

- Due to the boot-time of the safety PLC, a Safety Gate Fault condition will occur each time power is applied to the system. Once the safety PLC is fully booted, the Safety Gate Fault condition will clear if all other conditions are met.
- Modifications to the PLC program without prior approval could cause personnel injury or invalidate the system warranty.
- All safety-related function blocks used in the ladder program, resident in the safety PLC, have been created and tested by the PLC manufacturer.
- The safety PLC will auto-reset itself in the event of a predictable error (for example: breaking light beams while sweeping, opening safety gate while in PLAY). In some instances, a non auto-resetting error may occur. In this case, either cycle power to the whole system or simply toggle the switch on the front of the safety PLC from RUN to STOP back to RUN. If the fault occurs again after resetting, consult the safety PLC manual and the system prints.

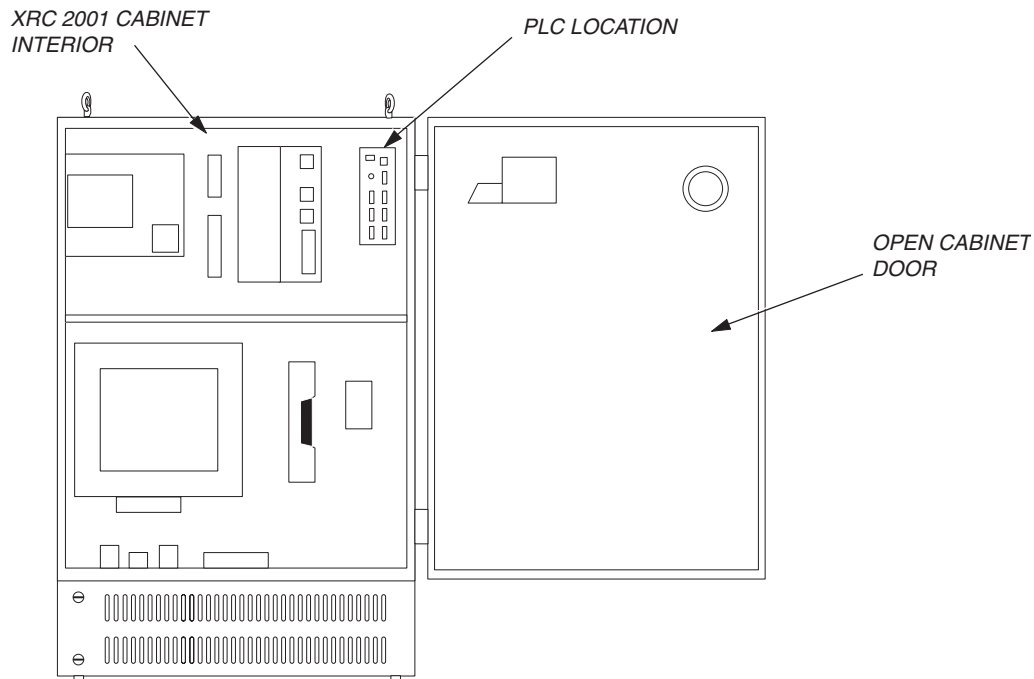


Figure 8 Safety PLC Location

3.5.2 Fencing

The safety fencing provided with the ProcessWorld system encloses the entire robotic cell. It forms a physical barrier preventing entry into the robot operating envelope during automatic operation.

3.5.3 Safety Light Curtains

The safety light curtains help prevent serious injury to anyone entering the positioner area during the sweeping process. In PLAY mode, if the positioner is sweeping and a safety light curtain is activated, servo power is removed from the system and all positioner motion stops. Servo power can be re-applied by pressing SERVO ON. However, the positioner will only continue its motion after it is reset by pressing the reset button on the operator station.

If the positioner is not in motion but the CYCLE START input has been latched (indicated by the CYCLE LATCHED light), the CYCLE START input is unlatched and the CYCLE LATCHED light turns off when the safety light curtain is activated. Servo power remains ON.

3.5.4 Emergency Stops (E-STOPS)

In addition to the safety features described above, the ProcessWorld 1000 has strategically placed E-STOPS. These are operator actuated devices that, when activated, immediately stop all system operation. Brakes are applied to the robot and all servo power is removed from the system. The system E-STOP lights come on and all positioner motion is stopped. The following is a list of their locations:

- The playback box on the controller
- The programming pendant
- The operator station

3.5.5 ENABLE Switch

The ENABLE switch is a safety feature which controls servo power while in TEACH mode. When pressed in, this switch allows the operator to turn servo power ON and initializes the system. However, should the operator release the switch or grasp it too tightly, servo power is immediately disabled, preventing further robot movement. For detailed information about the operation of the ENABLE switch, refer to the XRC controller section in the manipulator manual that came with your system.

3.5.6 Interlocked Cell Door

A safety interlock on the cell entrance door prevents entry into the cell during PLAY mode. Opening the cell door with the robot in PLAY causes a Gate Interlock Error. Brakes are applied to the robot and all servo power is removed from the system, the E-Stop lights come on, and all positioner motion is stopped.

3.5.7 Interference Cubes

Cubic interference zones prevent interference between multiple manipulators or a manipulator and peripheral devices. The XRC controller monitors the robot tool center point (TCP) during operation. If the TCP enters one of these software-defined interference zones, an output is turned on in the XRC. These outputs can be used to interlock the activity of other manipulators or peripheral devices. The XRC controller has eight possible cubes available. These cubes are internally tied to the following Specified Outputs:

R1 = SOUT #081 - 104

The ProcessWorld 1000 uses interference cubes to interlock robot position with positioner motion. The robot Home or Safe position (Cube 24) is defined behind the positioner, clear of the sweep zone. Each axis is placed in a position that provides the least amount of strain on the servo motors, with the U- and L- axes at 90 degree angles and the B axis in a relaxed, vertical position. This prevents drifting when servo power is off. Before the positioner can sweep, the robot must be in this safe position.

3.5.8 Brake Release



WARNING!

Releasing brakes could cause personal injury or machine damage. Always support the axis to be released **BEFORE** you release it.

The Brake Release Control is a safety feature that releases the automatic brakes on the robot in case of an emergency or robot failure. The Brake Release Control is mounted on the front of the XRC controller cabinet (see Figure 3-1). Refer to Operation Section for the proper operation of the brake release.

Notes

Chapter 4

Installation

The ProcessWorld system can be installed easily in just a short time by three workers. The more people involved (within reason), the more quickly installation can be completed. Follow established safety procedures **at all times** throughout the installation process. Failure to use safe work practices can result in damage to the equipment and injury to the workers.



CAUTION!

Installation of the ProcessWorld system is not a task for the novice. The ProcessWorld system is not fragile, but it is a highly sophisticated robotic system. Handle components with care. rough handling can damage system electronic components.

4.1 Materials Required

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

4.1.1 Customer-Supplied Items

- Incoming power supply
- Two earth ground cables with two earth ground stakes
- Incoming air supply: 0.04cmm at 620.5 kPa (1.5scfm at 90 psi)
- Forklift and/or overhead crane

4.1.2 List of Tools

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

4.2 Site Preparation

To prepare your site, proceed as follows:

1. Clear floor space needed for unit (see Figure 9).



Note: To make installation easier, allow an additional 1.2 to 1.5 m (4 to 5 ft) on all sides of cell.

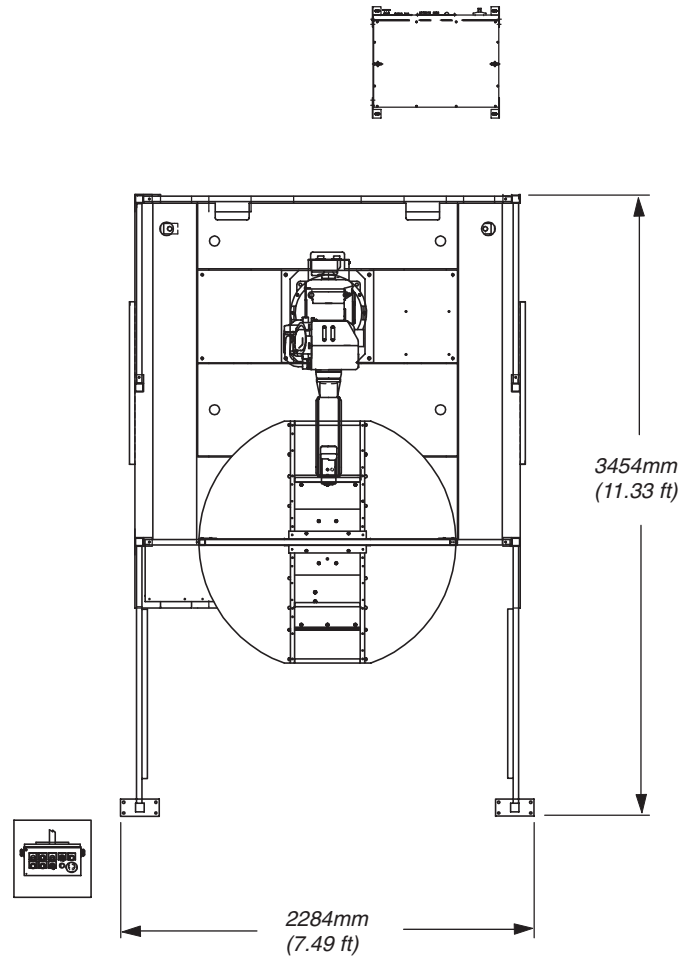


Figure 9 Area Needed for Installation

2. Gather all customer-supplied items and required tools listed in Section 4.1.

4.3 Installing the Robot Common Base

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



CAUTION!

Handle ProcessWorld 1000 components carefully to avoid damage.

1. Unbolt robot common base from the wooden shipping skid using a 3/4-inch socket (see Figure 10).

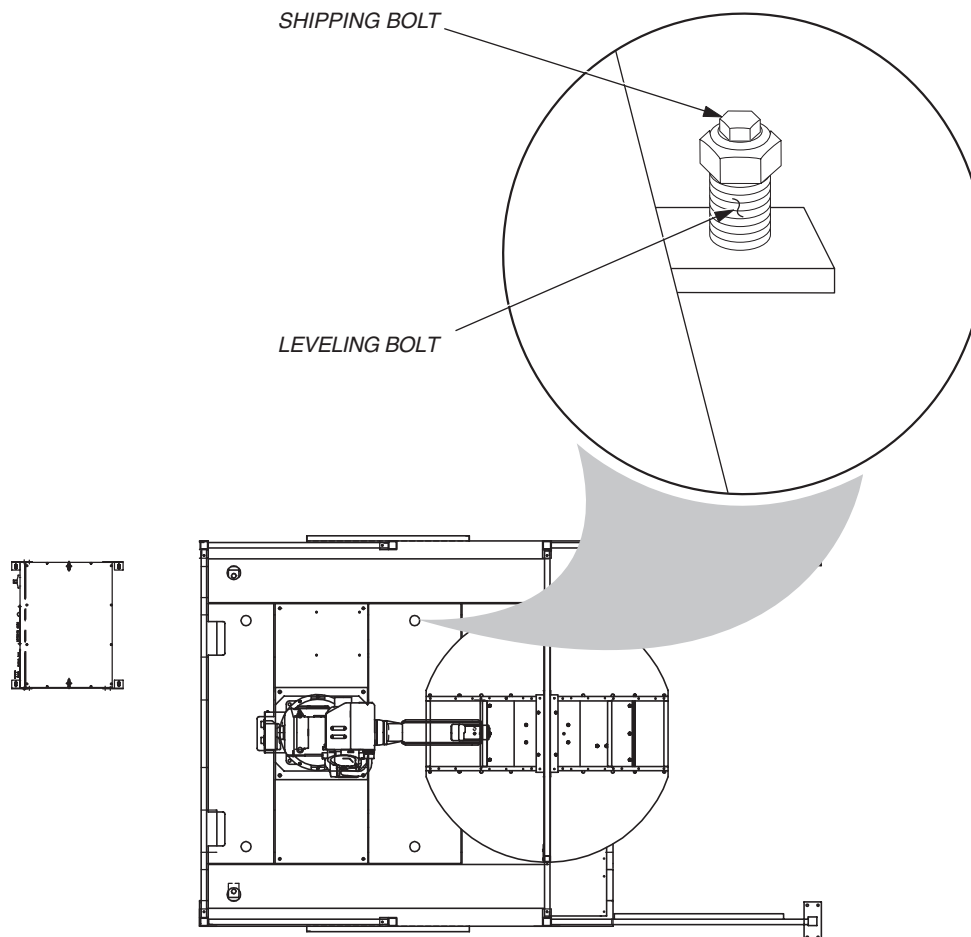


Figure 10 Unbolting the Robot Common Base



WARNING!

The robot common base weighs 1630 kg (3594 lbs). Be sure that your crane or forklift is capable of handling this weight or damage to the equipment or injury to personnel can result.

2. Using a forklift, remove common base from wooden shipping skid.

3. Place robot common base in position (see Figure 9).



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

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



Note: If damage is found, notify shipper immediately.

6. Remove operator station from skid and set safely aside.

4.3.1 Removing the Shipping Brackets



CAUTION!

Failure to remove shipping brackets from robot before operating the ProcessWorld 1000 may result in damage to the robot drive mechanisms.

Three yellow brackets(see Figure 11) prevent the robot from moving during shipping. Two rod brackets secure the lower arm assembly to the S-axis housing. The smaller bracket on the rear of the robot prevents the S-axis housing from pivoting. After the robot is in place, remove the shipping brackets. The positioner also has shipping brackets or bolts to prevent movement during shipment. After the positioner is in place, remove the shipping brackets or bolts.

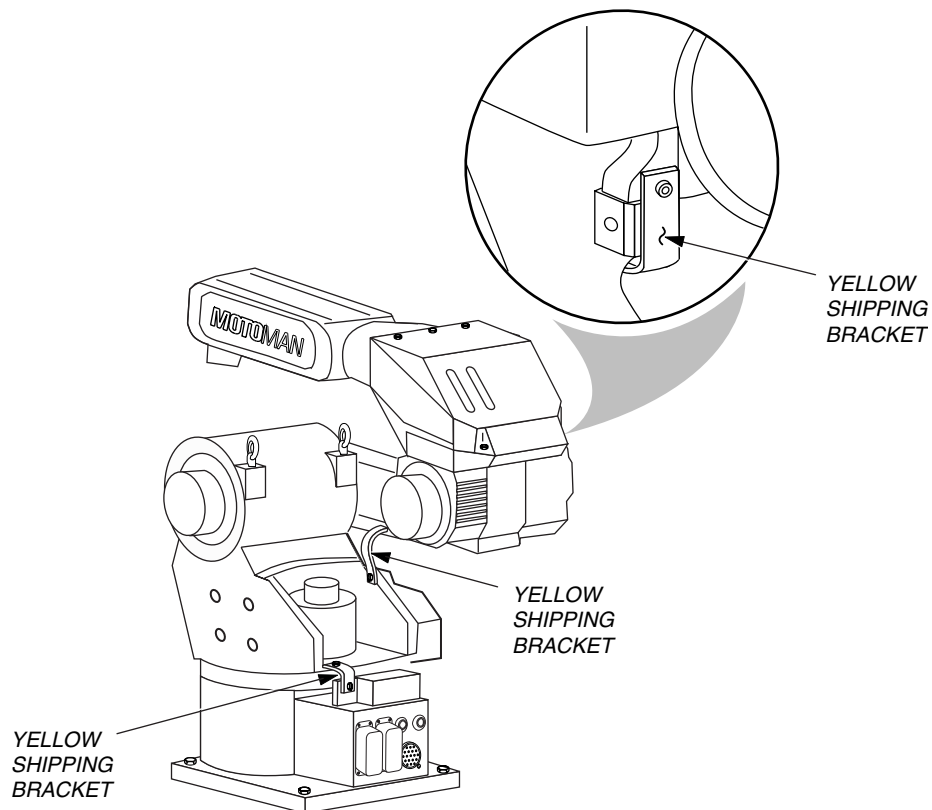


Figure 11 Location of Shipping Brackets

4.4 Installing the Controller

The XRC 2001 controller weighs approximately 70kg (154 lbs), make sure the lifting device used to move the controller is capable of safely handling this much weight.

The controller is lagged into the concrete in back of the cell (see Figure 9).

1. Unbolt controller from shipping skid using a 3/4 in. socket.
2. Using a forklift, lift the controller from the shipping skid.
3. Move controller in place using the supplied system drawings to ensure that it is properly aligned.
4. Insert a 1/4 in. concrete drill bit through center of lag holes in controller mounting brackets and drill holes for lag bolts.
5. Vacuum concrete dust from holes.
6. Lag controller to floor.

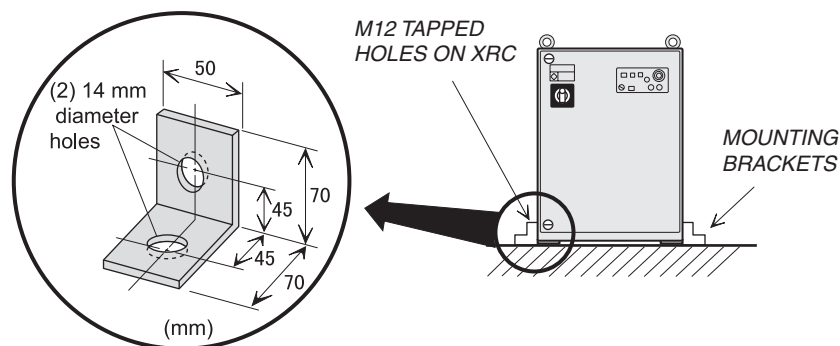


Figure 12 XRC Mounting Brackets

4.5 Installing the Operator Station

To install the operator station, proceed as follows:

1. Unload operator station from the robot base.
2. Carefully remove protective plastic wrapping from operator station.
3. Inspect operator station for shipping damage.



Note: If any equipment is damaged, notify shipper immediately.

4. Place operator station outside the fence in front of the positioner (see Figure 9).
5. Insert a 1/4 in. concrete drill bit through center of lag holes in operator station and drill holes for lag bolts.
6. Vacuum concrete dust from holes.
7. Lag operator station to floor.

4.6 Installing the Safety Light Curtains

4.6.1 Installation

The three light curtain components, the emitter, collector, and safety fence comes pre-assembled and fastened inside the cell for shipping.

Unfasten both fences from their shipping position and install. The light curtains are oriented properly with the status lights located near the base of the positioner. Use the three bolt holes (see Figure 13) located on the fence posts to mount the light curtain/fence assemblies onto the fencing. The wiring connections are tucked underneath the positioner base. Pull those wires out and match them with the connectors from the light curtains.

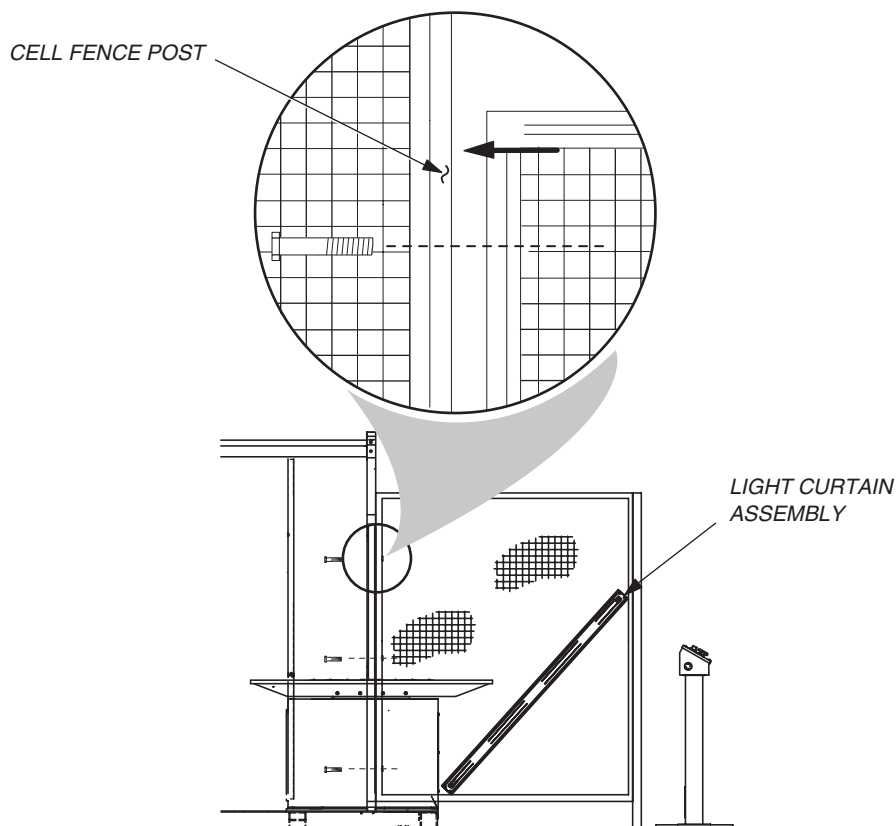


Figure 13 Light Curtain Installation

4.6.2 Alignment

The emitter and collector must be aligned properly. Refer to the light curtain manufacture's literature that accompanies the robot cell for exact alignment procedures.

4.6.3 Fencing

Once the light curtains have been properly installed onto the fencing, tightly fasten the fence posts to the concrete floor. Check the alignment of the light curtains again after fence posts have been anchored. Readjust as necessary.

4.7 Leveling and Securing the Equipment

After everything is in position, level the equipment and secure it to the floor. The lag bolts are shipped in the accessories box. To level and secure the equipment, proceed as follows:

1. Level robot/positioner common base by adjusting leveling bolts (see Figure 14).

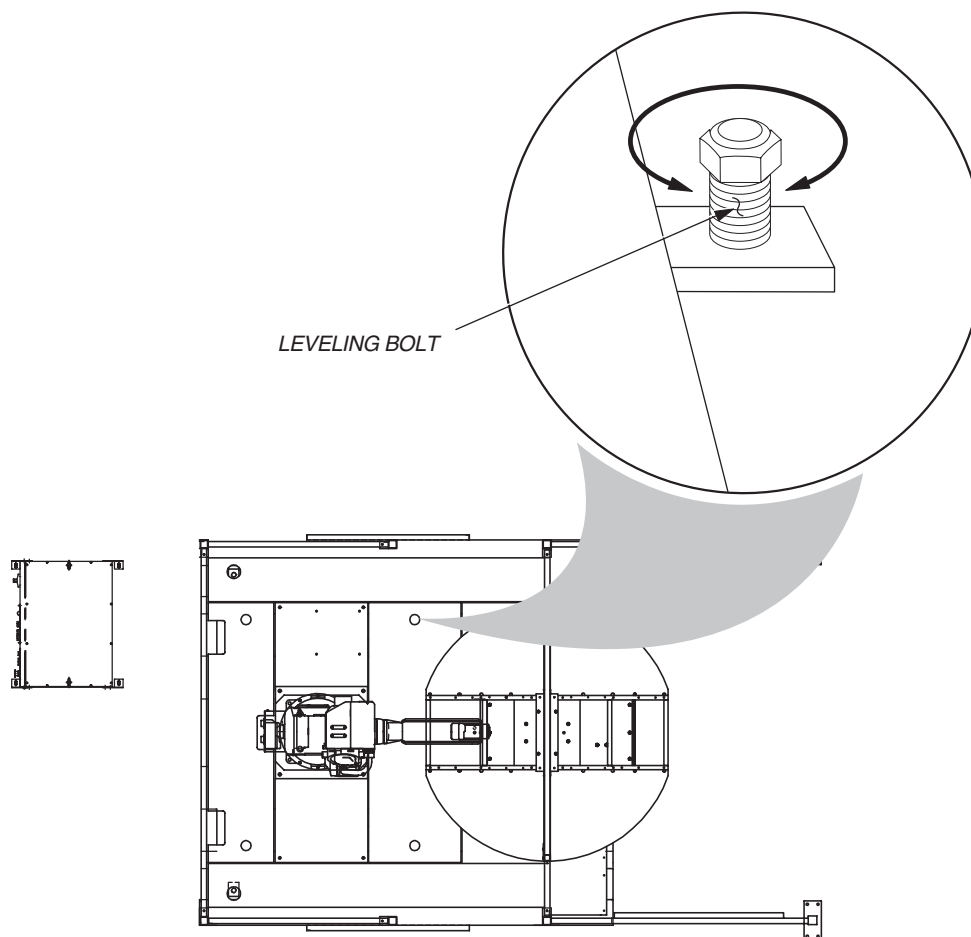


Figure 14 Leveling Bolts

2. Insert 1/2-in. concrete drill bit through center of leveling bolts and drill holes for lag bolts.
3. Vacuum concrete dust from holes.
4. Lag robot/positioner common base to floor.

4.8 Connecting the Cables

After components are level and securely in place, the cables should be unwrapped from around the equipment and laid out according to the cable diagram included in the system drawing package. Each cable connection is clearly identified for ease of installation.



CAUTION!

Route wires and cables away from hazardous work areas to avoid wire breakage and unnecessary interruption of cell operation.

4.8.1 Connecting the Earth Ground

Each robot and XRC 2001 must each be connected to an earth ground. An earth ground is a ground in which the equipment is connected to a ground stake driven into the earth. The ground stake must be driven a minimum of eight feet into the earth, and the earth must be treated with chemicals in order to reduce resistance to the ground stake. Deeper ground stakes may be required depending on area soil conditions. A maximum of 100 ohms ground resistance is recommended. To ground the robot and controller, proceed as follows:



WARNING!

If proper earth grounds cannot be provided, do not use the equipment! Serious injury or death can occur.



Note: If the robot and controller are within 15 feet of each other, a common earth ground may be used. Otherwise, separate earth grounds must be used.

1. Connect one end of robot earth ground cable to lug marked EARTH GROUND on bottom back of robot.
2. Connect other end of robot earth ground cable to earth ground stake.
3. Connect one end of second earth ground cable to common ground bus bar inside controller.
4. Connect other end of second earth ground cable to earth ground stake.

4.8.2 Connecting the Robot Cables

Two cables, 1BC and 2BC, connect the robot to the controller. The 1BC encoder cable provides communication between the controller and the robot. The 2BC motor power cable supplies power to the robot servo motors. To connect the robot cables, proceed as follows:

1. Unpack programming pendant and plug connector into receptacle on right side of XRC controller.
2. Unpack two large black manipulator cables, connected to XRC controller, and route to back of robot.
3. Carefully engaging connectors, connect two cables (labeled 1BC and 2BC) to 1BC and 2BC connections on back of robot (see Figure 15).

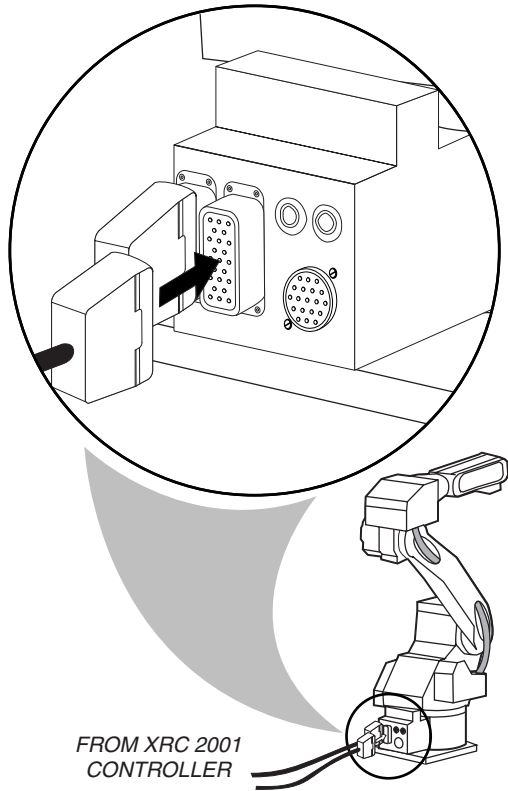


Figure 15 Connecting Robot to XRC 2001 Controller

4.9 Connecting Power

After all of the system components have been properly installed, connect the power to the ProcessWorld 1000 cell. To connect incoming power to the cell, proceed as follows:



DANGER!

Power should be connected only by a qualified electrician. Electrical and grounding connections must comply with applicable portions of the national electrical code and/or local electrical codes.

1. Install 3-phase power wiring to the circuit breaker located inside each XRC cabinet (see Figure 16). Table 4-1 shows the size and type of wire needed.
2. Tighten screws to the torque indicated in Table 4-1.

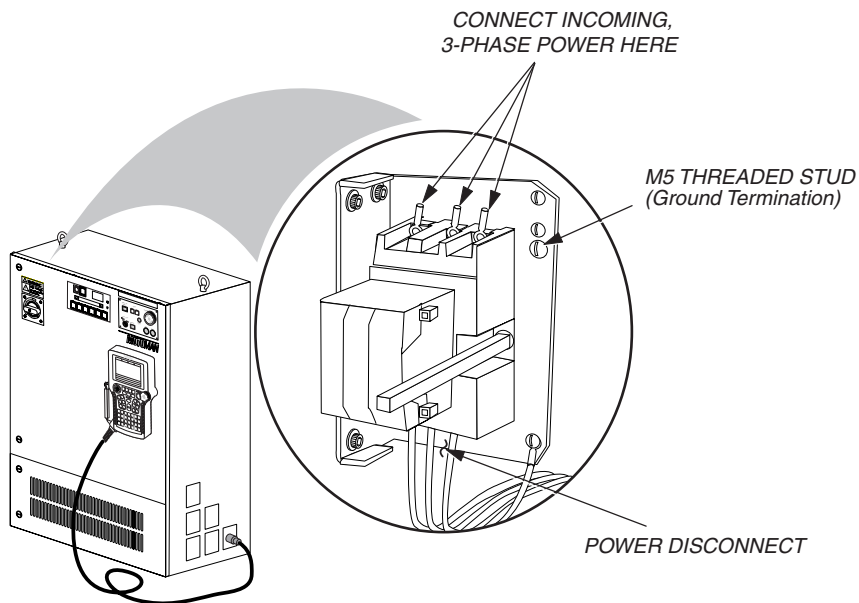


Figure 16 Incoming Power Connections

3. Install an M5 lug on incoming ground wire.
4. Terminate ground wire to frame ground M5 threaded stud with M5 hardware provided.



Note: The ProcessWorld 1000 is configured for three-phase 460/480V AC, unless other voltage was requested. If other voltage is required for your plant, it will be necessary to make modifications to the transformer. For more information, refer to the manipulator manual that came with your system.

Table 5 Incoming Power Specifications

Lug Data	60/75° C wire
Catalog No	TCAL14
Wire Size	#14-7 Copper #12-8 Aluminium
Torque	#14-7, 4.0N•m (35 lb.-in.)

4.10 Conducting a Safety/Operation Check

Before installing the tooling and fixtures for your application, take a few minutes to perform a safety/operation check. To conduct a safety/operation check, proceed as follows:

1. Check that all three shipping brackets have been removed from each robot (see Section 4.3.1).
2. Be sure light curtains are placed correctly.
3. Check that cell door is closed and latched.
4. Check that all cable connections are tight.
5. Verify incoming line power matches input power specified on front of controller.

Your ProcessWorld 1000 is now ready for power-up. The ProcessWorld system should be operated only by personnel who have received operator training from Motoman and who are familiar with the operation of this Motoman robot model. Turn the main power ON, and continue the safety/operation check.

6. Check all system E-STOPS for proper operation (pendant, operator station, breakaways, playback panel).
7. Check system Hold buttons for proper operation.
8. Check light curtains and door interlocks for proper operation

4.11 Installation of Tooling and Fixtures

Your ProcessWorld 1000 system is now ready for the installation of tooling and fixtures for your application. Installation of tooling and fixtures should be performed by personnel who are familiar with the operation of this system. After tooling is installed, test the positioner for proper operation:

NOTES

Chapter 5

Operation

The ProcessWorld 1000 is a fully integrated robotic material handling cell. The robot processes parts on one side of the turntable positioner while the operator loads the opposite side with parts. Once the robot is finished with its process, it returns to the Safe position. The operator then enables the positioner sweep, allowing the robot to start working on the next part. This section provides operating instructions for the ProcessWorld 1000 system.

5.1 Programming

The operation of this system is programming dependent. The following operating instructions are based on one possible configuration of this system. Your system configuration and job structure may differ slightly from that presented here, however basic operation will be the same.

Any changes made to your system configuration and/or job structure will alter the operation of this cell. Motoman recommends you do not modify the original jobs and system configuration that came with your system. If modifications need to be made, they should be made to copies of these jobs and not to the originals. Modifications should only be performed by personnel who have received operator training from Motoman, and who are familiar with the operation of this Motoman system. If you have questions concerning the configuration of your system please contact the 24 hour Service Hotline, at (937) 847-3200 (see Section 1.4).

5.1.1 I/O Assignment

The ProcessWorld 1000 uses the following user and dedicated inputs and outputs (see Tables 5-1 and 5-2).

XRC 2001 Dedicated Inputs

- Servo On
- External Job Start
- Alarm Reset
- REMOTE mode ON
- Hold
- External Emergency Stop

XRC Dedicated Outputs

- Servo Power ON
- TEACH mode
- Cube 22
- Cube 23
- Cube 24
- Alarm Occurrence

For more information on user and dedicated I/O, refer to the XRC 2001 Concurrent I/O and Parameters Manual (P/N 142102-1).

Table 6 XRC 2001 Controller User Inputs

Input	Assignment
IN#001 thru 016	NOT USED
IN#017	FIXTURE A LOCKED
IN#018	FIXTURE B LOCKED
IN#019	SERVO DRIVE RETURNED
IN#020	SERVO DRIVE FORWARD
IN#021	SWEEP LOCK ENGAGED
IN#022	SWEEP LOCK DISENGAGED
IN#023	AIR PRESSURE LOW
IN#024	CYCLE START

Table 7 XRC 2001 Controller User Outputs

Output	Assignment
OUT#001 thru 016	NOT USED
OUT#017	WITHDRAW SERVO
OUT#018	ADVANCE SERVO
OUT#019	SWEEP LOCK ON
OUT#020	SWEEP LOCK OFF
OUT#021 thru 024	NOT USED

5.1.2 Sweeping the Positioner

To sweep positioner side A or B into the robot work area, proceed as follows:



Note: In order to sweep the positioner, each robot must be in the Safe position in Cube 24.

MANUAL mode allows you to sweep the positioner without activating the robot. Parts can be loaded onto the fixture to achieve the most efficient configuration and then swept into the work zone, before teaching the robot a series of moves. Cycle Start latching is not operative in Manual mode.

1. Place robots in home position (see Section 5.2.2).
2. Set operator station POSITIONER switch to MANUAL mode and start Master Control job (see Section 5.2.3). Normally, the robot will not move out of home position when POSITIONER switch is in MANUAL. Check the job structure to ensure that the movement of either robot will not cause a hazard when the POSITIONER switch is set MANUAL.
3. Press CYCLE START palm button on operator station. The controller sweeps the positioner each time CYCLE START button(s) are pressed.



Note: The Cube function is a software feature that turns on an output when the robot tool center point is within established boundaries. If the robot moves outside of home position, the output is lost and the positioner will not sweep. The cube position is factory set to be clear of the table.

5.2 Daily Operation

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

- Perform Start-up Procedures (see Section 5.2.1).
- Move Robot to Safe Position (see Section 5.2.2).
- Selecting Master Job (see Section 5.2.3).
- Perform Operation Cycle (see Section 5.2.4).
- Perform Shutdown Procedures (see Section 5.2.5).

5.2.1 Start-Up

To start up the ProcessWorld cell from a Power-Off condition, proceed as follows:

1. Set MAIN POWER switch on controller to ON.
2. Make sure enclosure door is closed and securely latched.
3. Disable operator station.
4. Press TEACH mode button on XRC playback panel.
5. Place robot in home position (Cube 24).

5.2.2 Robot Safe (Cube 24) Position

To move the robot to the home position (Cube 24), proceed as follows:

1. Press TEACH mode button on XRC playback panel.
2. Press TOP MENU on programming pendant.
3. Select JOB icon using cursor keys and press SELECT.
4. Cursor to SELECT JOB and press SELECT key.
5. Using cursor keys, move cursor to Cube 24 job and press SELECT. Cube 24 job appears on display screen.
6. Turn servo power ON by pressing SERVO ON, pressing TEACH LOCK and holding in ENABLE switch.
7. Use INTERLOCK and FWD buttons on programming pendant to jog robot to home (Cube 24) position.

5.2.3 Starting the Master Job

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

1. Press TOP MENU key on programming pendant.
2. Select JOB icon using cursor keys and press SELECT.
3. Cursor to SELECT JOB and press SELECT key. Job list appears on display screen.
4. Using cursor keys, move cursor to Master job and press SELECT. Master job appears on display screen.
5. Make sure both enclosure doors are closed and securely latched.
6. Press PLAY mode button on XRC playback panel. Job playback operation is enabled.
7. Press SERVO ON button on playback panel.
8. Reset positioner by simultaneously pressing RESET and right CYCLE START buttons on operator station.
9. Place ENABLE/DISABLE switch on operator station in ENABLE position. XRC is placed in REMOTE mode and system control is transferred to operator station.
10. Press MASTER JOB START button on operator station. The Master job cycles, waiting for a Cycle Start input from operator station.

The ProcessWorld 1000 cell is now ready for operation.

5.2.4 Perform Operation Cycle

The following is the typical sequence of operation for the ProcessWorld 1000 cell after start-up:

1. Load production parts on fixtures located on operator side of positioner.
2. Step out of light curtain area.
3. Press the CYCLE START palm button(s) on operator station to sweep positioner. The positioner sweeps, placing unprocessed parts in robot's work area and turning empty side to operator's loading area.
4. After the positioner sweeps, the robot begins processing the parts.
5. While the robot is working on the robot side of the positioner, load more parts to be processed into fixture on operator's side of positioner.
6. Press the CYCLE START palm button(s) on operator station. The positioner sweeps, returning processed parts outside cell and placing newly loaded, unprocessed parts in robot's work area.
7. Unload processed parts from fixture while robot is working.



Note: Before sweeping at first power up, make sure the correct job has been loaded.

5.2.5 Shutdown

Use the following procedure to shut down the cell after operation is complete:

1. Make sure robot is in home position (Cube 24).
2. Turn off system servo power by pressing E-STOP button on operator station, programming pendant, or playback panel.
3. Press TEACH mode button on playback panel.
4. Set controller Main Power switch to OFF position.

The ProcessWorld 1000 cell is now shut down.

5.3 System Recovery

Under certain conditions you will be required to clear an alarm or error. Clearing an alarm or error requires different operator actions depending on the type. The paragraphs below describe the different types of alarms and errors you may encounter and how to remedy them when you do.

5.3.1 Alarms and Errors

Alarms and errors will cause the program to stop. There are three levels of alarms and errors: Error Messages, Minor Alarms, and Major Alarms. For more detailed information about alarm recovery, refer to manipulator manual that came with your system.

5.3.1.1 Error Messages

These are simple errors such as pressing the START button when the robot is not in PLAY mode, or enabling the programming pendant without the servo power being live. Errors like these are cleared by pressing the CANCEL button on the programming pendant.

5.3.1.2 Minor Alarms

Minor alarms are usually programming errors. Minor alarms might occur if a circle has been programmed with fewer than three circular points, etc. These alarms are cleared by pressing the RESET (F5) soft key on the programming pendant.

5.3.1.3 Major Alarms

Major alarms are hardware failures. Major alarms might occur because of a servo tracking error or an abnormal speed and are usually associated with crashes. To clear these alarms, you must turn off the controller and then turn it on again.

5.3.2 E-STOP Recovery

An E-STOP can occur under any of the following conditions:

- Pressing the E-STOP button on the operator station, programming pendant, or playback panel (see Section 5.3.4).
- Opening door on robot enclosure when robot is in PLAY mode.
- Stepping into light curtain when positioner is sweeping.

5.3.2.1 Restart

To restart the ProcessWorld 1000 cell after an E-STOP condition occurs, follow the procedure below.

1. To clear E-STOP condition, perform any of the following actions that apply:
 - Release the E-STOP button on the operator station, programming pendant, or XRC playback panel.
 - Close sliding door.
 - Clear object(s) from light curtain zone.



CAUTION!

If an emergency stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when system is re-initialized.

2. Press SERVO ON button on operator station, or playback panel.
3. Press RESET button and right CYCLE START button on operator station to initialize system.
4. Ensure operator station is enabled.
5. Press MASTER JOB START button on operator station.

The ProcessWorld 1000 cell is now ready to continue operation.

5.3.3 Using the Brake Release

The brake release control panel is located on front of the XRC. Each axis brake is controlled by an individual axis buttons. Simultaneously pressing the ENABLE button and one of these axis buttons releases the indicated axis. To release the brakes, proceed as follows:

1. Press E-STOP button on programming pendant, playback panel, or operator station, to be sure servo power is OFF.
2. Provide adequate support for axis to be released. Support should withstand payload of robot and approximate weight of robot. Listed below are weights for each robot:

UP6 – 135kg (297 lb)

UP20 – 280kg (617 lb)

UP50 – 560kg (1235 lb)



WARNING!

Releasing brakes could cause personal injury or machine damage. Always support the axis to be released BEFORE you release it.

3. Release specific axis brake by pressing and holding corresponding axis button and ENABLE button at same time.



Note: You must hold both the axis and ENABLE buttons down for the axis to remain released. Releasing either button will automatically lock the brakes again.

Notes

Chapter 6

Maintenance

Table 6-1 provides periodic maintenance items and intervals for the ProcessWorld 1000 cell. Keep in mind that the maintenance intervals serve as guidelines only. You should adjust the frequency of maintenance to suit your specific work conditions.

For periodic maintenance procedures and schedules for the individual components of your system, refer to the manipulator and additional manuals that came with your system.



WARNING!

Ensure that servo power is off before performing the following procedures. Observe standard lockout/tagout practices.

Table 8 Periodic Maintenance

Frequency	Component	Procedure
<ul style="list-style-type: none"> Monthly 	Bull Gear and Pinion	Grease with Motoman P/N 133174-2.
<ul style="list-style-type: none"> 1st Month Semi-annual 	Drive Motor and Gear Reducer	Check for loose fasteners, tighten as required. Check for oil leaks. If more than 50cc is needed to refill, this indicates a reducer problem. Reducer is lubricated for life.

6.1 MR-300 Maintenance Procedures

Read through the instructions completely before performing any maintenance procedure. Be sure that you understand the procedure, have the proper tools, and observe all applicable safety precautions.



WARNING!

Ensure that servo power is off before performing the following procedures. Observe standard lockout/tagout practices.

6.1.1 MR-300 Hardstop/Shock Absorbers

Proper adjustment of the positioner hardstop/shock absorbers is important to achieve reliable positioning of the parts fixtures. All units are preset at the factory for maximum performance before shipping. Should a hardstop/shock absorber need replaced, care must be taken not to alter the position of the parts fixtures or performance of jobs will be compromised. For more information, call the Motoman Customer Service Department 24-Hour Hot Line at (937) 847-3200.

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