

Motoman XRC 2001 Controller
FabWorld
System Manual
for UP-Series Robots

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SECTION 1

INTRODUCTION

The FabWorld is part of the FabWorld family of standardized arc welding solutions. It is a fully integrated welding system, and is supported from wire to weld by Motoman, Inc.

The FabWorld features a Motoman arc welding robot and XRC 2001 controller with menu-driven arc welding application software, complete welding package, rotary plane positioner, operator interface, and a 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 1.4. This manual contains the following sections:

SECTION 1 - INTRODUCTION

Provides general information about the FabWorld 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 FabWorld system.

SECTION 3 - DESCRIPTION OF EQUIPMENT

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

SECTION 4 - INSTALLATION

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

SECTION 5 - OPERATION

This section provides instructions for basic operation of the FabWorld 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 FabWorld cell.

1.2 System Overview

The FabWorld provides a complete arc welding solution in a standardized configuration. The cell is designed around a Motoman arc welding robot and XRC 2001 robot controller and includes a complete welding package.

The FabWorld cell is modular in design. It gives the customer seven available positioners to incorporate into each of three available work stations. Each work station has its own operator station with only one controller controlling the cell.

Choosing a robot is the first step to configuring the cell layout. A single UP20-6 cell assembly is designed for customers requiring a single welding arc with a maximum part length up to three meters. If larger parts are being fabricated, the UP20-M cell assembly offers a 4-meter part length from. The cell assemblies are available with either a 5-amp or 25-amp converter. The 25-amp converter is required if the total power of all positioner axis exceeds 3900 Watts (3.9 kW).

Use Figure 1-1 to select the robot, number of stations, and positioners for configuration of the FabWorld cell.

Robot Assembly:	
<input type="checkbox"/> UP20M Cell Assembly:	
<input type="checkbox"/> UP20M Robot Kit (XRC 2001,WLDG)	145687-2
<input type="checkbox"/> 5-Amp Converter	146309-1
<input type="checkbox"/> 25-Amp Converter	146309-2
<input type="checkbox"/> UP20-6 Cell Assembly:	
<input type="checkbox"/> UP20-6 Robot Kit (XRC 2001,WLDG)	145686-2
<input type="checkbox"/> 5-Amp Converter	146310-1
<input type="checkbox"/> 10-Amp Converter	146310-2
Station 1 Positioner:	
<input type="checkbox"/> MT1-1500	146326-1
<input type="checkbox"/> MHT-340	146669-1
<input type="checkbox"/> MHT-450	146324-1
<input type="checkbox"/> MHT-1500	147315-1
<input type="checkbox"/> MHT-3000	146325-1
<input type="checkbox"/> Tack Table	
<input type="checkbox"/> Single Table, 4 x 3 ft	146327-1
<input type="checkbox"/> Dual Table, 8 x 3 ft	146327-2
Station 2 Positioner:	
<input type="checkbox"/> MT1-1500	146326-2
<input type="checkbox"/> MHT-340	146669-2
<input type="checkbox"/> MHT-450	146324-2
<input type="checkbox"/> MHT-1500	147315-2
<input type="checkbox"/> MHT-3000	146325-2
<input type="checkbox"/> Tack Table	
<input type="checkbox"/> Single Table, 4 x 3 ft	146327-3
<input type="checkbox"/> Dual Table, 8 x 3 ft	146327-4
<input type="checkbox"/> NONE (Fence kit #)	146571-1
Station 3 Positioner:	
<input type="checkbox"/> Tack Table, 4 x 3 ft	146327-5
<input type="checkbox"/> None Fence kit	131755-8

Figure 1-1 Configuration Sheet

1.2.1 System Layout

The robotic cell is fully enclosed by safety fencing with an interlocking door. Standing in the safety zone prevents robot or positioner motion. All operator controls, including those on the controller and welding power supply, are accessible from outside the safety fencing. All cell components are floor mounted in permanent locations.

FabWorld offers up to three work stations, Station 1 and Station 2 are to the left and right of the single robots while Station 3 resides in front of the robot. Station 1 or Station 2 can contain any combination of the various Station Kits with the exception of having a MT1-1500 in both Stations 1 and 2. A third station, Station 3, is equipped with a 1220 mm x 910 mm tack table for sub-assemblies or short production runs,

Figure 1-2 illustrates the proposed system layout of the FabWorld cell. Station 1 is standard with Stations 2 and 3 being optional.

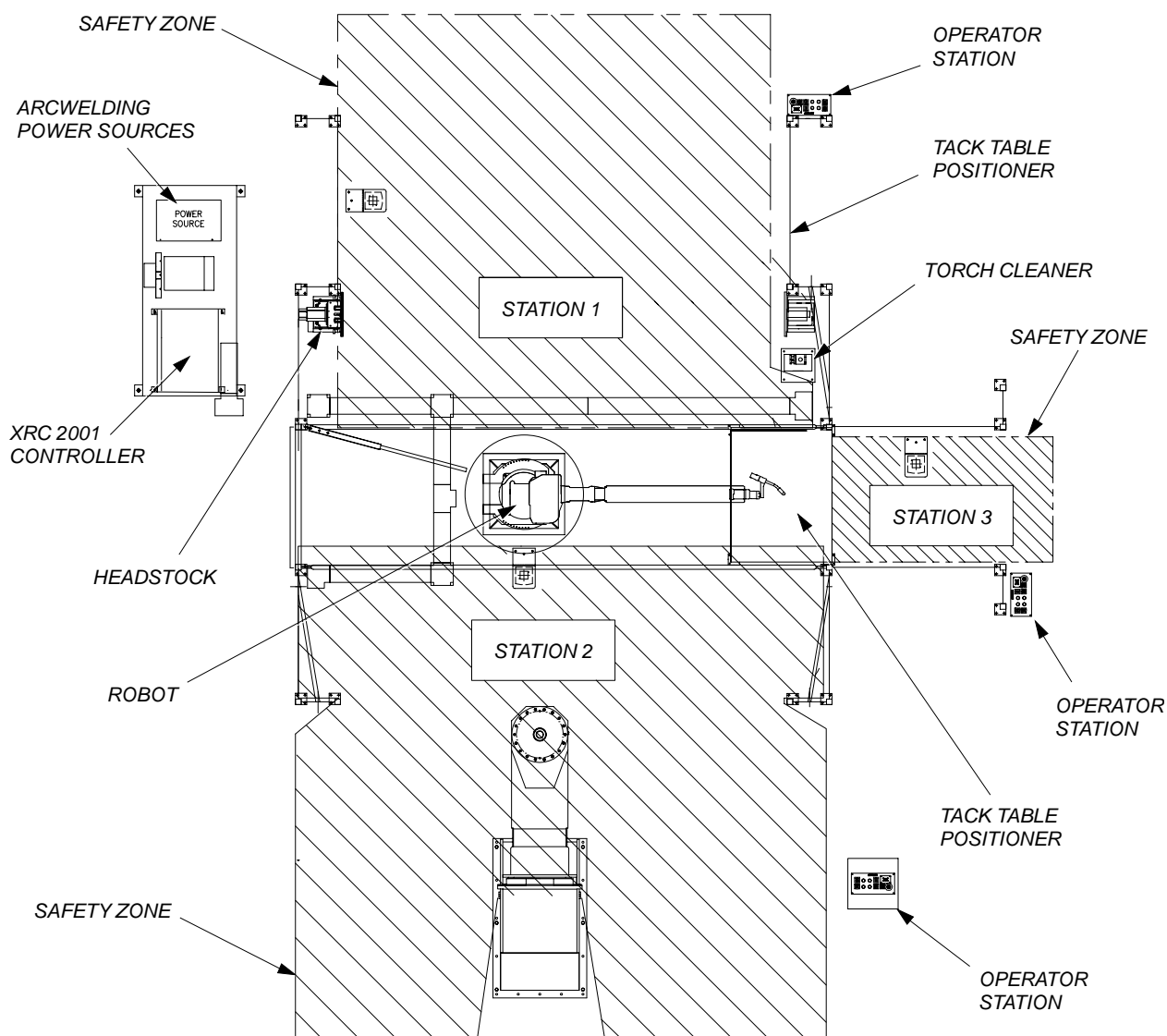


Figure 1-2 Proposed System Layout

NOTE: System and layout dimensions vary, refer to system drawings for accurate cell components. Figure 4-1 shows three work stations.

1.3 Major Components

The major components for the FabWorld starts at the cell assembly level with station kits added on.

- Motoman UP20M, or UP20-6 manipulator
- XRC 2001 controller

1.3.1 Cell Assembly Level

- Riser
- Zone Rings
- Wire Way
- Cable Carrier
- L and U Axis Limit Switch
- Safety PLC
- Robot Cables
- Fence Kit With 4 ft. Door
- Door Interlock
- Disconnect
- Top Mount Enclosure

1.3.2 Station Kits

- Positioner with Tailstock including MotoMount (see Figure 1-1)
- Station fence Kit
- Operator Station
- Cables for Positioner and Operator Station
- Laser Scanner

1.3.3 Welding equipment

- Welding power source
- Motoman torch (water-cooled or air-cooled)
- Wire feeder
- Torch mount

1.3.4 Safety equipment, including the following:

- Safety fencing with arc curtains
- Safety scanners
- Interlocked cell door
- Positioner arc screen

1.3.5 Optional Equipment

The following optional equipment is available for use to enhance the FabWorld cell:

- Torch tender
- Com-Arc III seam tracking unit
- Water circulator

1.4 Reference to Other Documentation

For additional information refer to the following:

- Motoman UP20M Manipulator Manual (P/N 145959-1)
- Motoman UP20-6 Manipulator Manual (P/N 145962-1)
- Motoman Operator's Manual for Arc Welding (P/N 142098-1)
- Motoman Concurrent I/O Parameter Manual (P/N 142102-1)
- MH-series Positioners w/ MotoMount and Drive Assemblies (P/N 146703-1)
- Com-Arc III Instruction Manual (P/N 132753-1)
- Coordination Instructions for Multi-axes Systems (P/N 139418-1)
- Vendor manuals for system components not manufactured by Motoman

1.5 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 (UP20M or UP20-6)
- System Type (FabWorld)
- Software Version (access using TOP KEY/SYSTEM INFO/VERSION/SYSTEM on the programming pendant)
- Robot Serial Number (located on the back side of the robot arm)
- Robot Sales Order Number (located on back side of controller)

NOTES

SECTION 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 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).

SECTION 3

EQUIPMENT DESCRIPTION

3.1 UP-series Robot Description

The Motoman UP20M and UP20-6 robots and XRC 2001 robotic controller represent state-of-the-art technology in robotics today. The six-axis UP20-6 robot has a payload of 6 kg (13.2 lbs). It features a 1885 mm (74.21 in.) reach and has a relative positioning accuracy of ± 0.06 mm (0.0023 in.). The six-axis UP20M robot has a payload of 20 kg (44.09 lbs). It features a 3106mm (122.2 in.) reach and has a relative positioning accuracy of ± 0.15 mm (0.005 in.).

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 L and U-axis have been restricted by limiting devices 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 3-1) coordinates the operation of the FabWorld system. It controls manipulator movement and welding power supply, processes input and output signals, and provides the signals to operate the welding system. 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.

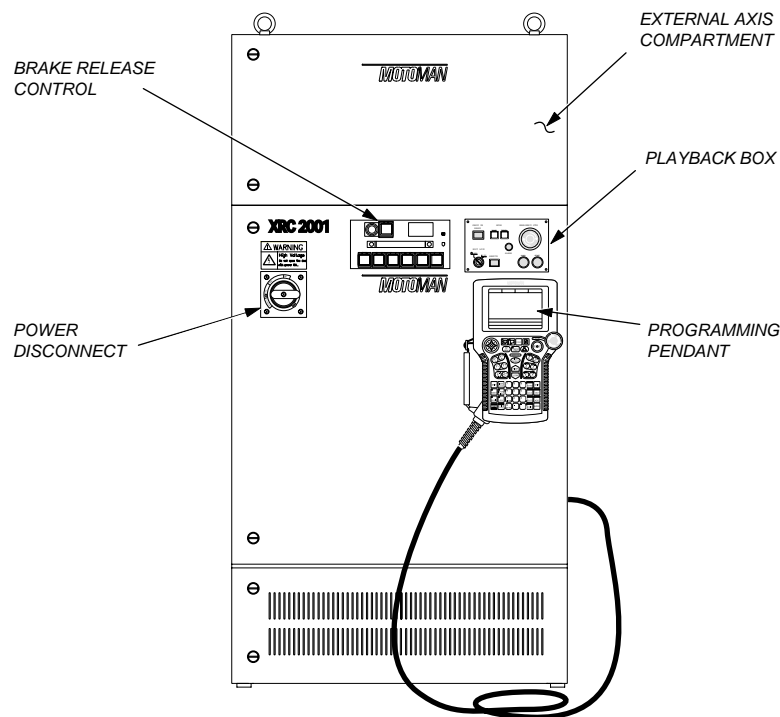


Figure 3-1 XRC 2001 Controller

3.2.1 Playback Panel

The playback panel (see Figure 3-2) 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.

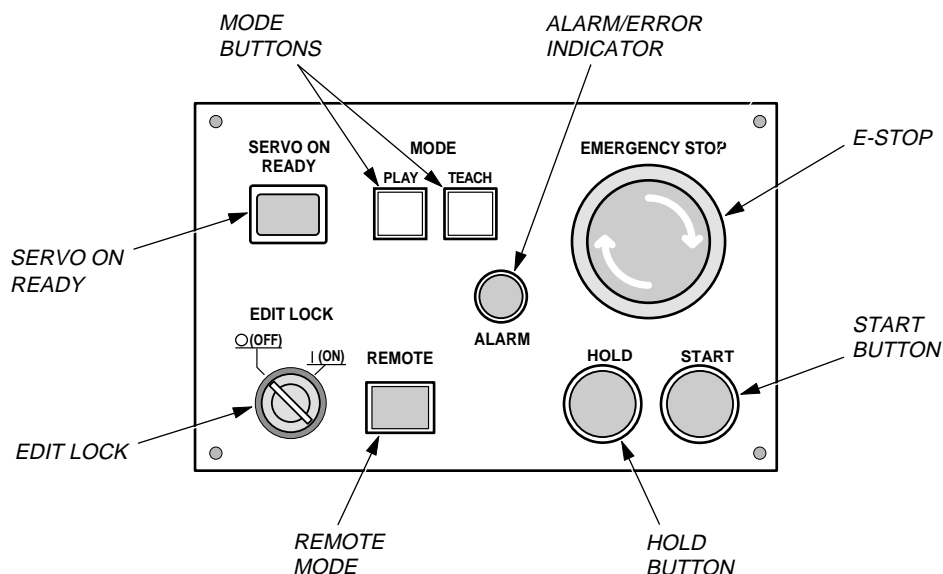


Figure 3-2 XRC 2001 Playback Panel

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)

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

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 3-3) 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.*

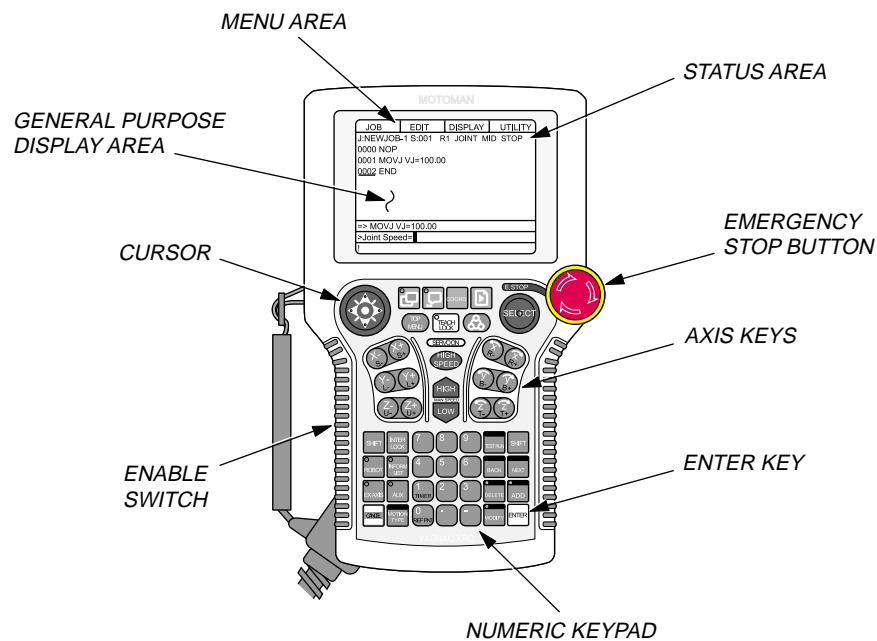


Figure 3-3 Programming Pendant

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 controller 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 (see Figure 3-4) is used for data communication between the controller and a floppy disk controller (FC1 or FC2), FDE (Floppy Disk Emulator) software, or other form of communication.

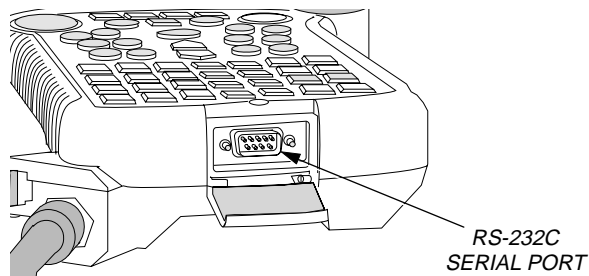


Figure 3-4 RS-232C Serial Port

ENABLE Switch

The ENABLE switch (see Figure 3-5) 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.

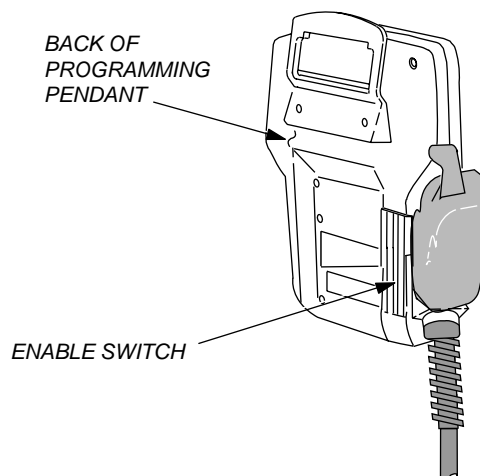


Figure 3-5 Enable Switch

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 controller cabinet (see Figure 3-1).

Provide adequate support for axis to be released. Support should be able to withstand the payload and the approximate weight of robot.

3.3 Operator Stations

Each operator station (see Figure 3-6) includes a NEMA enclosure on a stand-alone pedestal or mounted to the fence. The following paragraphs describe the operator station controls.

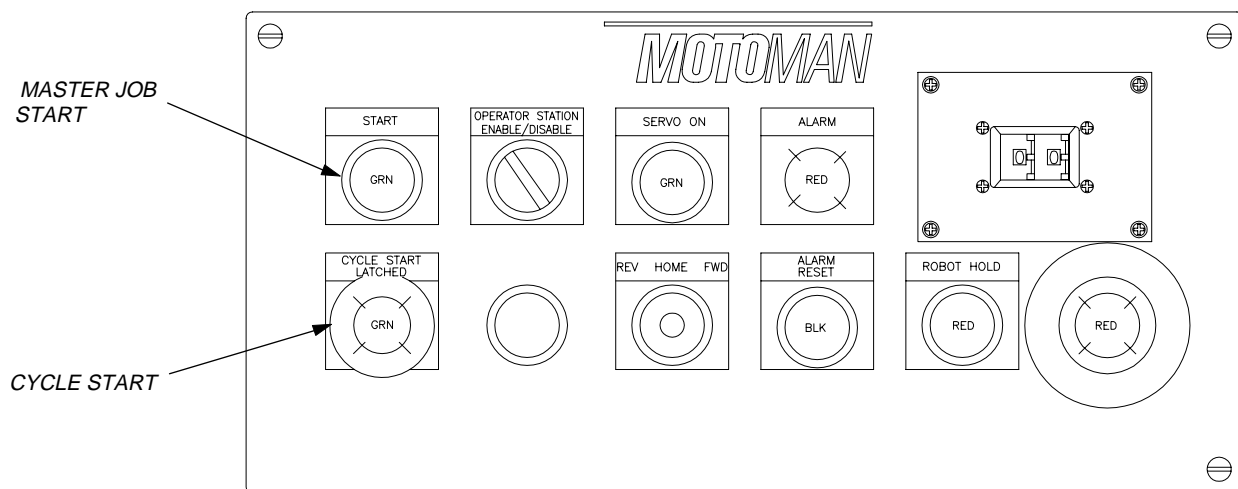


Figure 3-6 Master Operator Station at Station 1

3.3.1 Master Job Start

If the CYCLE START button is pressed, the MASTER JOB START button starts the execution of the customer indicated MASTER JOB. The MASTER JOB START button is connected to the robot external start input. The operator station must be enabled and servo power ON for the START button to work.

3.3.2 **Cycle Start Latched**



WARNING!

The operation of the CYCLE START palm 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 palm button, located on the operator station, initiates a positioner sweep cycle if/when the robot reaches Safe or Home position (Cube 24). If the CYCLE START button is pressed while the robot is outside Cube 24 (or moving), the CYCLE START command is latched into the controller. Once the robot returns to Safe or Home position (Cube 24) and CYCLE LATCHED lamp is on, the CYCLE START command is executed and the positioner sweeps. It is not necessary to wait for the robots to finish welding and return to the Safe position (Cube 24).

3.3.3 **Emergency Stop (E-STOP)**

The operator station E-STOP button is connected to the system Emergency Stop circuit. Pressing the E-STOP button interrupts this circuit and stops all system operation. Brakes are applied to the robot and all servo power is removed from the system.

3.3.4 **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.

3.3.5 **Alarm**

The ALARM lamp is connected to the robot ALARM OCCURRENCE outputs. The ALARM lamp turns on when the robot encounters an alarm condition.

3.3.6 **Three-position Joystick**

A spring loaded joystick controls rotary positioner rotation to access the user defined load position(s). Moving the joystick right (forward) and letting go causes the tooling plate to rotate clockwise at 30-degree intervals. Moving the joystick left (reverse) and letting go causes the tooling plate to move counterclockwise 30-degree intervals. Home position on the joystick resets the headstock to zero degrees.

3.3.7 **Operator Station Enable/Disable**

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

3.3.8 **Thumb Wheel Job Selector**

The thumb wheel selector is used to select user jobs at the operator station without the use of the programming pendant. The number shown on the thumb wheel reflects the next job that will run. The job on the thumb wheel will not start until the current job is completed and the robots are in Safe (Cube 24) position.

3.3.9 **Reset**

A minor alarm or error condition is cleared when the RESET button is pressed. The RESET button is connected to the robot alarm reset input. A minor alarm or error condition is cleared when this button is pressed.

3.3.10 **Servo On**

The SERVO-ON pushbutton enables servo power. In remote PLAY mode, the SERVO ON pushbutton operates the same as the SERVO READY push button on the front of the controller.

3.4 **Positioner Module**

MT1-1500 Positioner

The MT1-1500 positioner is a two axis positioner that provides two perpendicular planes of rotation. For MT1-1500 positioner specifications, refer to the MT1-1500 positioner manual that came with this system.

MHT-series Positioner

This series of positioners consists of a headstock and optional tailstock (HS/TS). For positioner specifications, refer to the MH-series Positioner manual (P/N 146703-1) that came with this system.

MHT-340/680 HS/TS Positioner

This positioner consists of a headstock and tailstock (HS/TS) mounted on the positioner common base providing 2925 mm (115.1 in.) between mounting plates. For positioner specifications, refer to Table 3-1. Refer to Section 6, for maintenance procedures.

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

Table 3-1 MH-340/680 Positioner Specifications

Conditions	Specifications
Capacity	
HS only	340kg (750 lbs) load, center of gravity, 6in. overhang, 6in. off-center 323 mm (12.7 in.) over-hang C.G. (1100 Nm Bearing Moment) 136 mm (5.35 in.) off center C.G. (1100 Nm Holding Moment)
HS/TS	Combined HS/TS capacity 680kg(1500 lbs.) 3in. off-center of gravity. 68mm (2.67 in.) off center C.G
Rotation	
Speed	0 to 12.4 RPM variable speed.
Max. Load Inertia	74.5kg-m ² .
Chassis	
	Standard height: 787mm (31.98 in.) Swing radius 769mm (30.28 in.) above floor.

Table 3-1 MH-340/680 Positioner Specifications

Conditions	Specifications
Sweep Time with Capacity	3 seconds for 180 degree sweep with maximum total load of 598kg (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 Requirements	208V AC/120 Hz/Two-phase supplied by the controller
Welding Current Rating	600 amperes at 100% duty cycle.

Stationary Flat Plane

The stationary flat plane module is a steel table with a ground flat steel top.

Table 3-2 Stationary Flat Plane Specifications

Conditions	Specifications
Work Surface Dimensions	912.4 mm L x 1219.2 mm W x 12.7mm thick (36 in.L x 48 in.W x 1/2 in. thick)
Part/Fixture Rating	907.2kg (2000 lbs)

3.5 Welding Equipment

In its standard configuration, the FabWorld system includes a power source, wire feeder, torch, and torch mount. Optional equipment including water circulators, Com-Arc units, and torch tenders may be included to enhance performance.

3.5.1 Power Sources

Motoman offers several different power sources for use with the FabWorld system depending on your system's application. The following are some of the more common power sources used (see Figure 3-7). However, the power source your system uses may be different. For more specific information, refer to the vendor manual that came with your system.

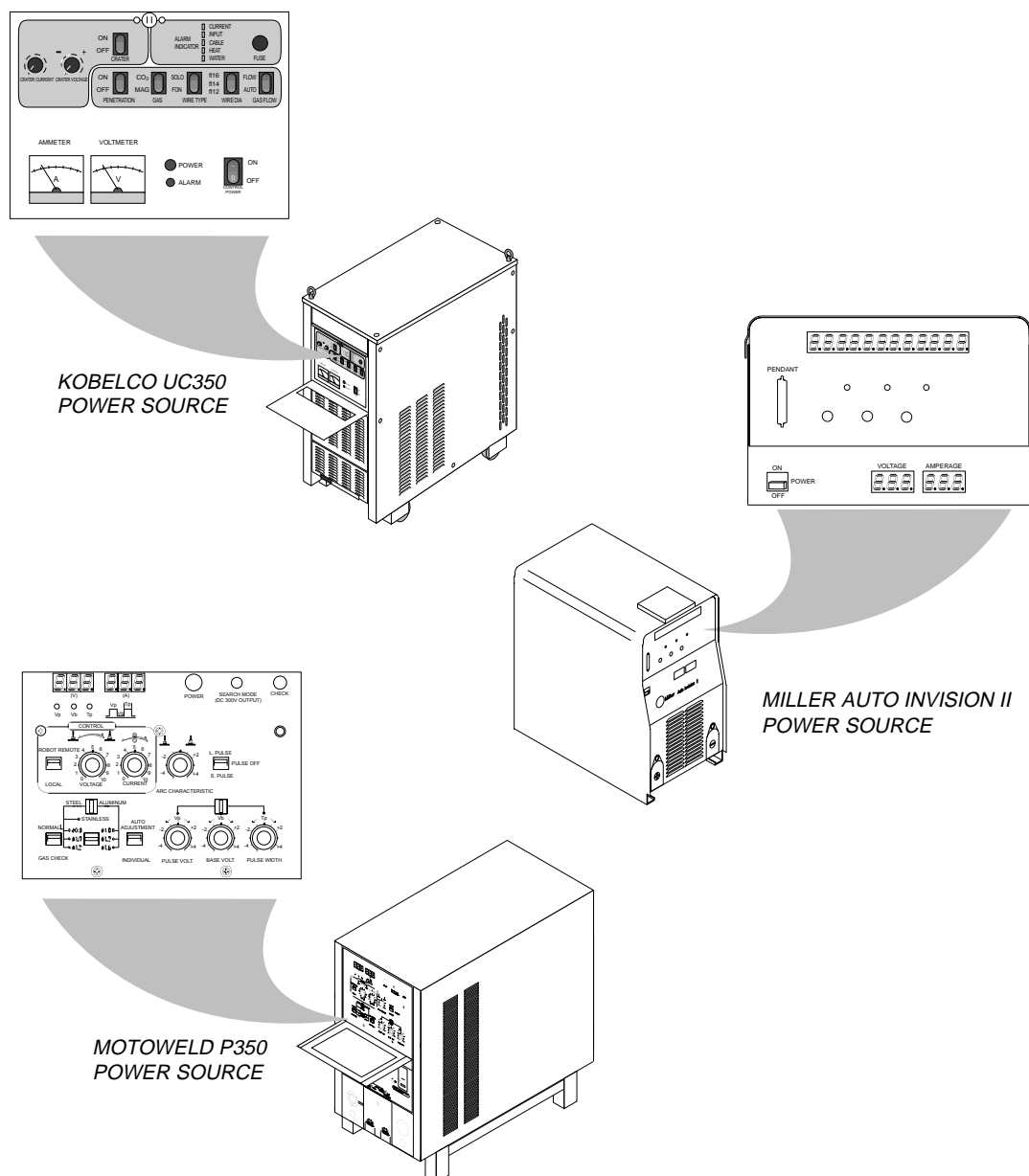


Figure 3-7 Available Power Sources

3.5.2 Wire Feeder

The wire feeder mounts on the robot arm. This 4-roll wire feeder provides reliable wire feeding various rates. An integral gas valve provides fast gas response time. The wire feeder may have an inch forward button to help simplify set-up and reduce change-over time. Interchangeable feed rolls are used to accommodate different types and sizes of wire.

3.5.3 **GMAW Torch**

The FabWorld system uses either an air-cooled or a water-cooled robotic/automatic GMAW torch. These are heavy-duty torches designed for quick replacement while requiring minimum robot reprogramming. The GMAW torch is installed at the end of the robot wrist. For applications that use the water-cooled torch, the FabWorld system includes a water circulator kit.

3.5.4 **Motoman Torch Mount**

The Motoman Torch Mount protects the robot, workpiece, fixture, and positioner. It provides multi-directional impact detection, including Z-axis collisions. Torch impact causes a system E-STOP and immediately stops all system operation. Servo power is removed from the system and brakes are applied to the robot. All positioner motion is also stopped.

3.6 **Safety Features**

The FabWorld system incorporates a host of safety equipment. When all standard safety precautions are taken, the safety equipment helps to ensure safe operation of the robotic cell.

ANSI/RIA R15.06 Robot Safety Standard

This standard stipulates that the user is responsible for safeguarding.

ANSI/RIA R15.06: 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.

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.

3.6.1 **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 controller cabinet (see Figure 3-1). Refer to Section 5.3.4 for the proper operation of the brake release.

3.6.2 Safety PLC – Programmable Logic Controller

The FabWorld system comes with a safety PLC (see Figure 3-8). 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 the gate interlock, safety scanners, operator station E-stops, and the In-position signals generated from the positioners. (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 nonauto-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.

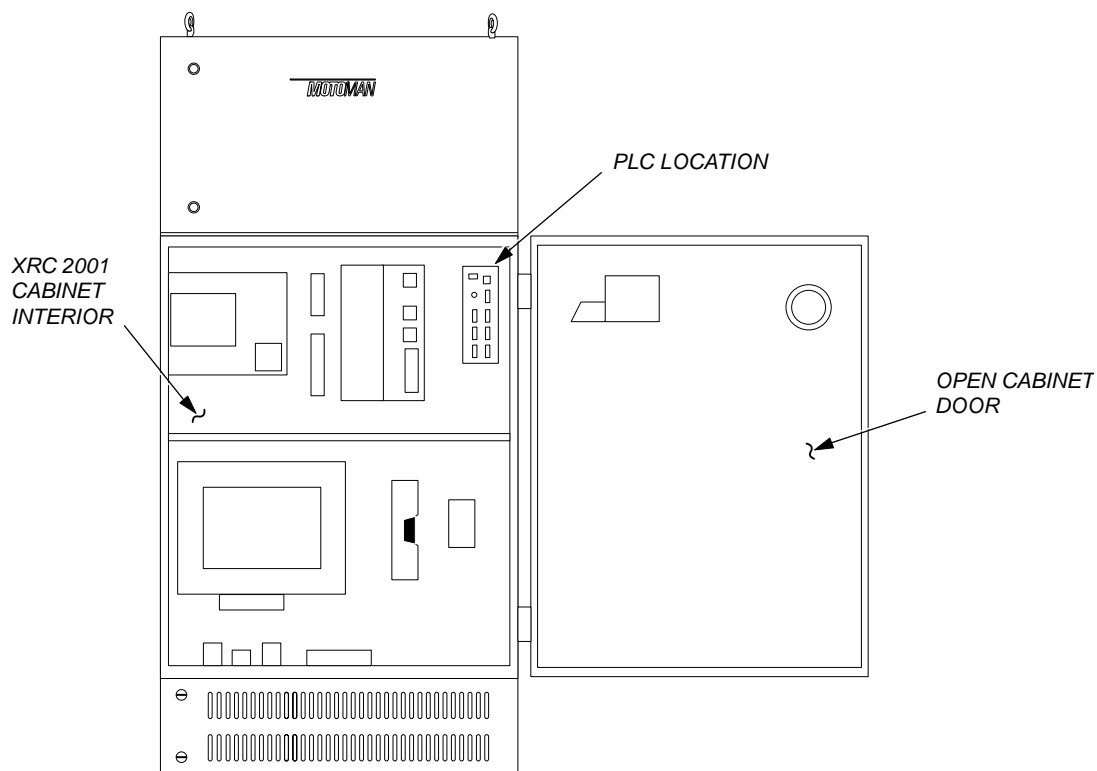


Figure 3-8 Safety PLC Location

3.6.3 Arc Screens



WARNING!

Although the arc curtain blocks dangerous arc radiation, never look directly at the arc without protective eyewear!

The material used to cover the safety fencing of the entire robotic cell acts as an arc screen. This material reduces the amount of ultra-violet radiation that escapes from the robotic cell.

3.6.4 Fencing

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

3.6.5 Safety Scanner

The safety scanner is a small radial scanning device that uses lasers to detect movement over designated areas. The safety scanner helps prevent serious injury to anyone entering the positioner area during the sweeping process. In PLAY mode, if the positioner is sweeping and a safety scanner is activated, servo power is removed from the system and all positioner/robot motion stops. Servo power is reapplied by pressing SERVO ON.

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

3.6.6 Emergency Stops (E-STOPS)

In addition to the safety features described above, the FabWorld 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 robot and positioner motion is stopped. The following is a list of their locations:

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

3.6.7 Safety Gate Stop

Servo power is removed and brakes are applied during a safety gate stop, however the operator can still turn servo power on to move the robot or positioner by using TEACH MODE on the teach pendant.

A safety gate stop will occur on the following conditions:

- Safety gate open
- Operator steps into safety scanner zone when robot is in station
- Operator steps into safety scanner zone when positioner is not on in-position switches
- Robot trips L or U axis over travel switches

The teach pendant will display SAFETY GATE on all of the above conditions.

3.6.8 Teach Pendant 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 the robot. 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 2001 section in the manipulator manual that came with your system.

3.6.9 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 SAFETY GATE STOP. Brakes are applied to the robot and all servo power is removed from the system.

3.6.10 Welding Ground System

The welding ground system consists of a spring-loaded, copper brush block that contacts the backside of the faceplate. The ground cable to the welding power source is connected to this brush block.

NOTE: The ground cable connection to the brush block must be secure. If the connection is loose, arcing can occur and cause the insulator to melt.

SECTION 4

INSTALLATION

The FabWorld 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 FabWorld System is not a task for the novice. The FabWorld 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 FabWorld system is included with the system. This section identifies customer-supplied items and tools required to perform installation.

4.1.1 Customer-supplied Items

- Gas for the welding torches
- Incoming power supply
- Two earth ground cables with two earth ground stakes
- Weld wire
- Stepladder
- Forklift and/or overhead crane

4.1.2 List of Tools

- Safety glasses
- Face shields
- Gloves
- Level
- Ratchet and socket set
- Adjustable wrench set
- Hammer drill with appropriate concrete bits
- Phillips and flat screwdrivers
- Hammer
- Socket set
- Forklift and/or overhead crane
- Air-impact gun and sockets
- 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 the floor space needed for the unit (see Figure 4-1).

NOTE: When clearing space for the cell, Motoman recommends an additional 2.43 to 3.05m (8 to 10 ft) on all sides after installation.

2. Gather all customer-supplied items and required tools (see Section 4.1.2).

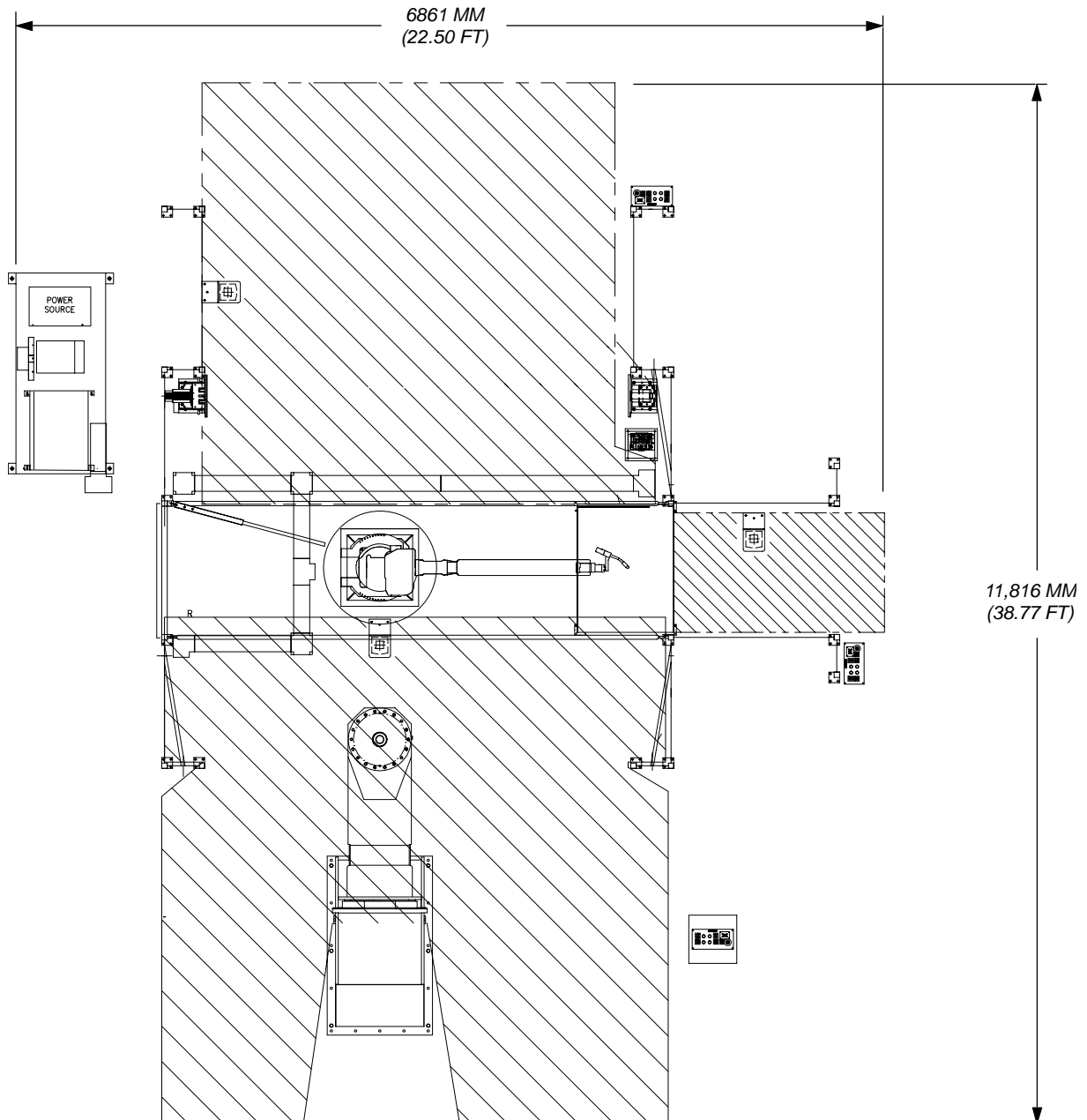


Figure 4-1 Area Needed for Installation

NOTE: System and layout dimensions vary, refer to system drawings for accurate cell dimensions. Figure 4-1 shows three work stations.

4.3 Removal from Shipping Skid

Cell components are placed onto a large shipping skid and then shipped to the customer. The customer is responsible for safely removing the components from the skid and inspecting them for damage.

NOTE: If damage is found, notify shipper immediately.

4.3.1 Unloading Procedures

To successfully unload the shipping skid, proceed as follows:



WARNING!

The shipping skid with all cell components loaded onto it weighs 1814 kg (4000 lbs). Be sure that your crane or forklift is capable of handling this much weight or damage to the equipment or injury to personnel can result.

1. Using a forklift, lift the loaded shipping skid and remove it from the hauler.
2. Carefully remove protective plastic wrapping from all cell components.
3. Inspect all cell components for shipping damage.

NOTE: If damage is found, notify shipper immediately.

4. Unbolt the each component from the wooden shipping skid.
5. Use the lifting eye bolts to remove each component from the shipping skid.

4.4 Cell Components

4.4.1 List of Components

Once the cell components have removed from the shipping skid, account for each item with the following list (verify cell components with system prints):

- UP-series Robot
- Station 1 Positioner
- Station 2 Positioner (optional)
- Station 3 Positioner (optional)
- Safety Fence
- XRC 2001 Controller
- Welding power sources
- Cables
- Wire ways
- Water cooler (optional)
- Torch cleaner (optional)
- Operator Station(s)
- Safety Scanner(s)

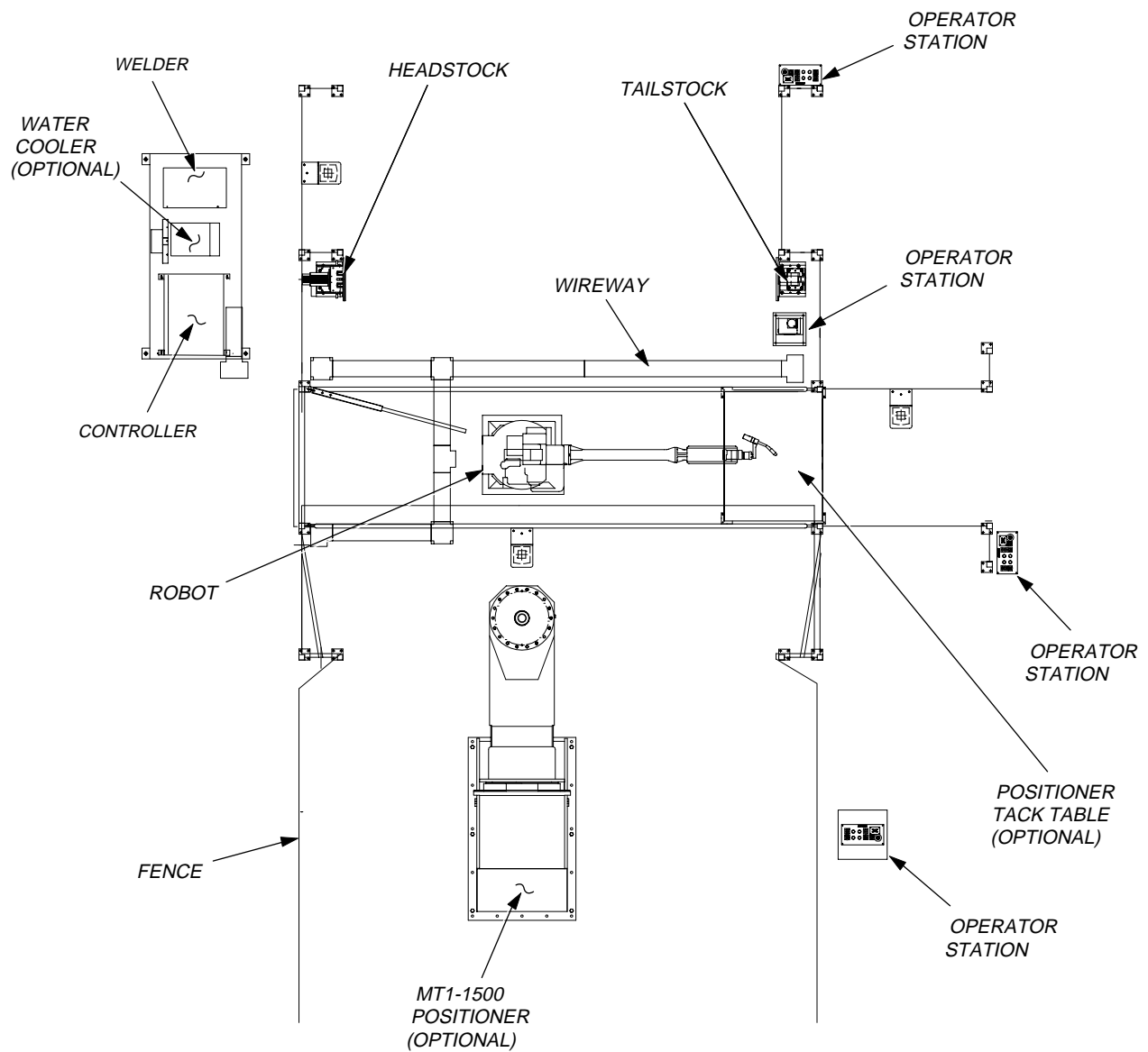


Figure 4-2 System Components

4.5 Assemble Cell Components

To make sure the cell is complete and to verify floor space efficiency, Motoman recommends that all cell components be set in place together prior to anchoring to the floor. Assemble the cell component in the order they appear below. Use Figure 4-2 and the system drawings to identify cell component locations.

4.5.1 **Setting Up the Cell**

Before permanently anchoring the cell components to the floor, set all pieces in place and fasten them together if applicable.



CAUTION!

It is critical to the efficiency of the cell to use system prints to set up the cell components.

1. Set the robot in the place.
2. Set the Station 1 positioner in place.
3. Set the Station 2 (optional) positioner in place.
4. Set the Station 3 (optional) positioner in place.
5. Set wire ways in place
6. Construct the fencing around the cell. Stand the fencing up and fasten to outer guards.
7. Apply the arc shield to the fencing.
8. Install Safety Scanners using the system drawings and vendors literature.
9. Recheck the location of all components and adjust if necessary.
10. Place system cables in place.
11. Set the controller and power source equipment base in place. The equipment base must be placed a minimum of 152.4 mm (6 inches) from the cell fencing.

4.6 **Leveling and Securing the Equipment**

NOTE:

For all issues regarding leveling and securing MHT-series positioners, refer to the MH-series Positioner Manual with MotoMount and Drive Assemblies, P/N 146703-1.

After everything is in position, level the equipment and secure it to the floor. The customer provides suitable anchoring for equipment. To level and secure the equipment, proceed as follows:



CAUTION!

Handle FabWorld components carefully to avoid damage.

1. Level the component by adjusting leveling bolts.
2. Insert a 1/2-inch 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.

4.7 **Installing the Operator Station**

To install an operator station, proceed as follows:

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

NOTE:

If damage is found, notify shipper immediately.

4. Place the operator station in place using the system prints.
5. Lag the operator station to the floor or to fence as indicated on system prints.

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 in cable trays to avoid wire breakage and unnecessary interruption of cell operation.

4.8.1 **Connecting the Earth Ground**

The robot and the controller 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 2.43 m (8 ft) 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 the controller, proceed as follows:



WARNING!

- ***If proper earth grounds cannot be provided, do not use the equipment! Serious injury or death can occur.***
- ***Do not place the MIG system within 15.24 m (50 ft) of other sources of noise (i.e., GTAW arc starters, plasma cutters, induction furnaces, high-power-resistance spot welders, dielectric heaters, etc.). Equipment that generates impulse or high-frequency noise can cause unexpected equipment operation and failure, which can result in serious injury or death.***

NOTE:

If the robot and the controller are within 4.57 m (15 ft) 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 the controller.
4. Connect other end of second earth ground cable to earth ground stake.

4.8.2 Connecting the Robot Cables

If the robot has a water-cooled torch, two cables and three hoses must be connected to various components. If the robot has an air-cooled torch, two cables and one hose must be connected to various components. These cables and hoses are enclosed in a leather casing. In addition to these cables, the robot I/O and power cables must be connected to the robot.



CAUTION!

Route wires inside robot/positioner wire ways to avoid wire breakage and unnecessary interruption of cell operation (see Figure 4-3).

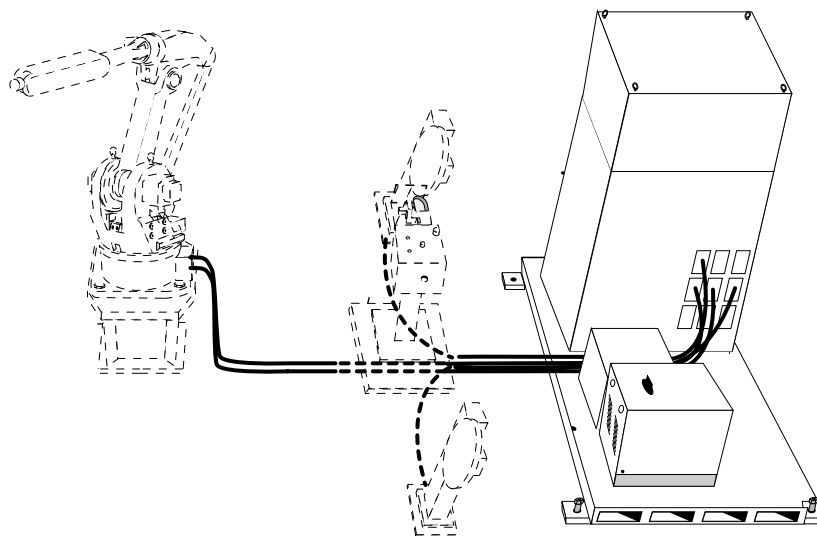


Figure 4-3 Robot Cable and Hose Routing

UP20-6 Robot

For the UP20-6 robot, three cables labeled 1BC, 2BC, and 3BC, connect the robot to the controller. The 1BC cable supplies power to the robot servo motors. The 2BC cable provides communication between the controller and the robot. The 3BC cable is used for feeder connections.

To connect the robot and system cables and hoses, proceed as follows:

1. Unpack programming pendant and plug connector into receptacle on right side of the controller.
2. Unpack two large black manipulator cables, connected to the controller, and route to back of robot.
3. Carefully engaging connectors, connect two cables (labeled 1BC, 2BC, and 3BC) to 1BC, 2BC, and 3BC connections on back of robot (see Figure 4-4).

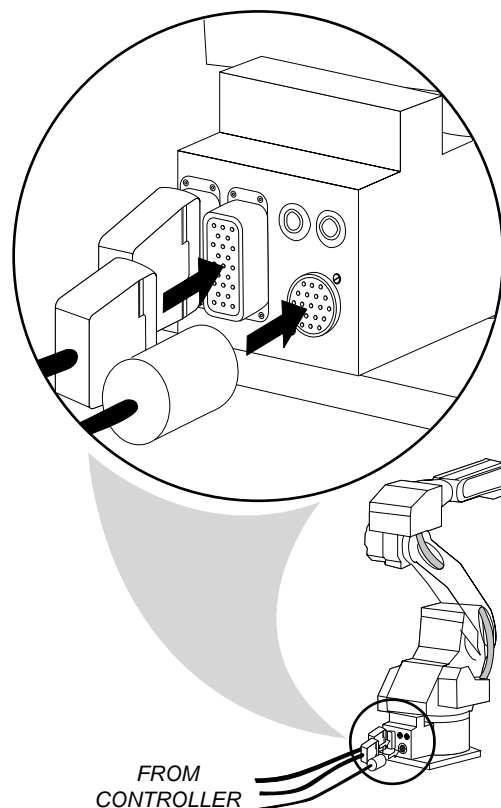


Figure 4-4 Connecting Robot to Controller – UP20-6

UP20M Robot

For the UP20M robot, four cables, 1BC, 2BC, 3BC and 4BC, connect the robot to the controller. The 1BC cable supplies power to the robot servo motors. The 2BC and 3BC cables provides power to the robot. The 4BC cable is used for feeder connections.

To connect the robot and system cables and hoses, proceed as follows:

1. Unpack programming pendant and plug connector into receptacle on right side of the controller.
2. Unpack two large black manipulator cables, connected to the controller, and route to back of robot (see Figure 4-3).
3. Carefully engaging connectors, connect four cables (labeled 1BC, 2BC, 3BC and 4BC) to 1BC, 2BC, 3BC and 4BC connections on back of robot (see Figure 4-5).

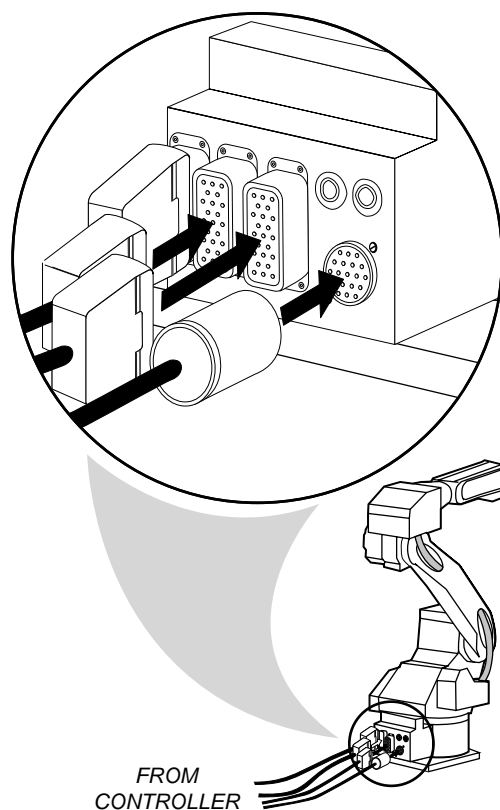


Figure 4-5 Connecting Robot to Controller – UP20M

4.8.3 Connecting Water Circulator (Optional)

If your system uses the water-cooled welding torch, it is necessary to connect the Motoman water circulator. To connect the water circulator, proceed as follows:

1. Connect two water hoses for weld torch to connections on water circulator marked WATER-IN and WATER-OUT (see Figure 4-6).

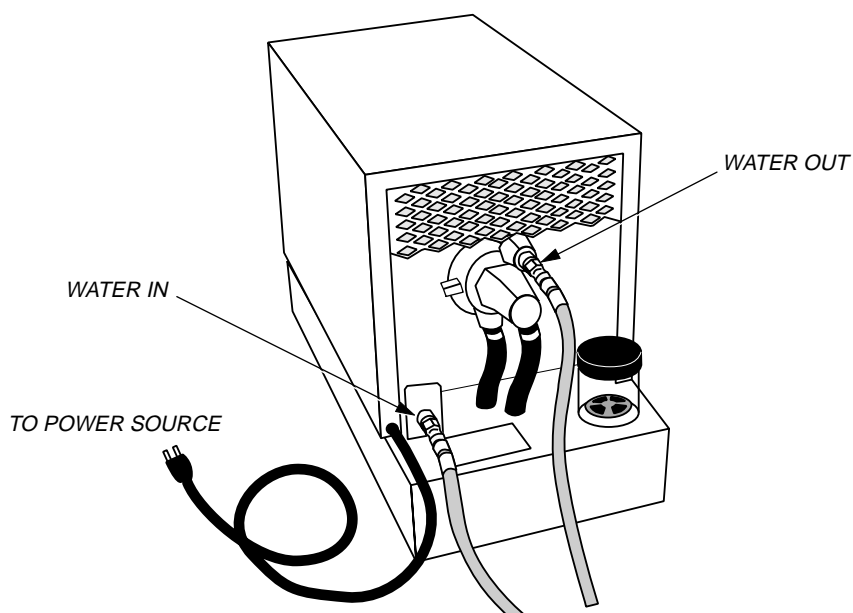


Figure 4-6 Water Circulator Connections

2. Plug power cable into electrical outlet on back of power source.

4.9 Connecting the Power

After all of the system components have been properly installed, connect the power to the FabWorld. To connect incoming power to the FabWorld, 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 or damage could occur.

1. Install 3-phase power wiring to the circuit breaker located inside the right wall of the controller cabinet (see Figure 4-7).
2. Tighten screws to the torque indicated on the engineering layout drawings.

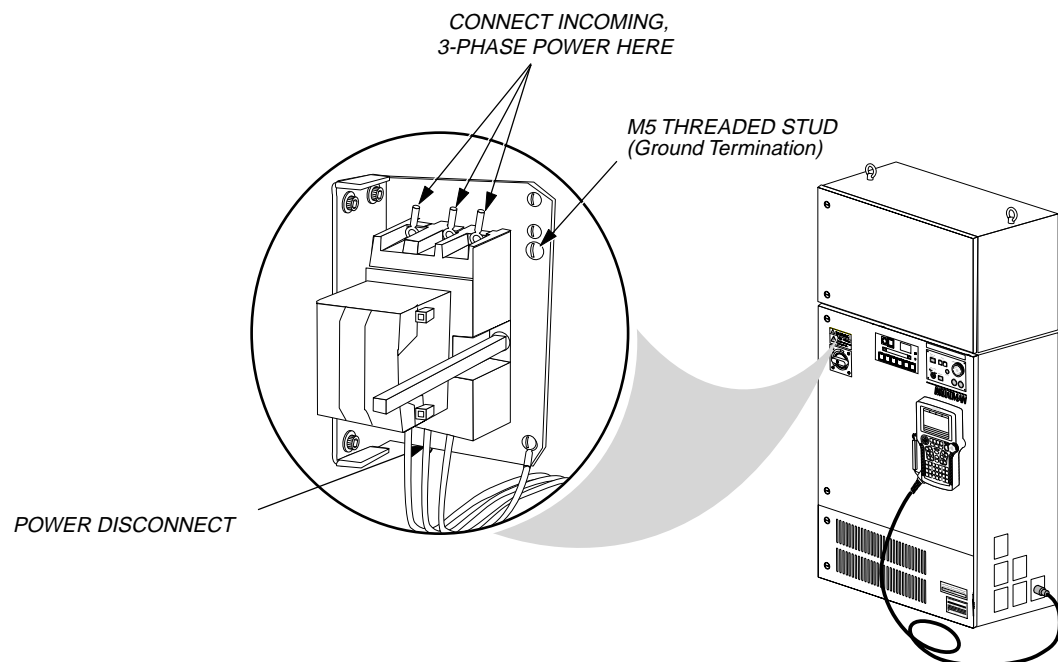


Figure 4-7 Incoming Power Connections

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

NOTE:

The FabWorld is configured for three-phase 460/480V AC, unless other voltage was requested. If other voltage is required for your plant, you must make the necessary modifications to the transformer. For more information, refer to the manipulator manual and electrical diagrams that came with your system.

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. Be sure the safety scanners are placed correctly.
2. Check that the cell door is closed and latched.
3. Check that all cable connections are tight.
4. Check air line connections to the optional torch cleaner and wire cutter.
5. Be sure that the welding power source is set correctly (refer to the welding power source vendor's manual).
6. Verify that incoming line power matches the input power specified on the sticker on the front of the controller.

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

7. Check operation of all system E-STOPS (pendant, operator station, breakaways, playback panel).
8. Check operation of system Hold buttons.

4.11 *Installation of Tooling and Fixtures*

Your FabWorld 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. Tooling and fixtures are supplied by the customer. After tooling is installed, test the positioner for proper operation.

For tooling and fixture specifications, refer to the MH-series Positioner manual (P/N 146703-1) or the MT1-1500 Positioner manual that came with this system.

NOTES

SECTION 5

OPERATION

The FabWorld is a fully integrated robotic GMAW welding cell. The robot welds parts on the active station. Once the robot is finished with this process, it returns to the safe position. The operator is then able to enter the safety zone and safely process the parts.

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. The application programs may assign values to memory locations in the controller. Consult your system documentation before modifying your system. If you need to modify existing jobs, make copies of originals first. This way you will always be able to restore your systems to the original configuration. 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 1.5).

5.1.1 I/O Assignment

The FabWorld uses the following user and dedicated inputs and outputs.

XRC 2001 Dedicated Inputs

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

XRC 2001 Dedicated Outputs

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

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

5.1.2 Programming the Positioner

The rotation axis of the positioner(s) is controlled by the controller external axis function. The motion points for the external axes are taught and recorded in the program in the same manner as any of the robot axes. The speed and position are controlled by the controller. Pressing the EXT AXIS button on the teach pendant changes the motion keys from robot axis keys to positioner axis keys. Refer to the Independent/Coordinated function instruction more information P/N 142969-1 for programming the positioner and robot.

5.2 **Daily Operation**

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

- Perform Start-up Procedures.
- Move robot to Safe position.
- Select master job.
- Perform Operation Cycle.
- Perform Shutdown Procedures.

5.2.1 **Start-Up**

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

1. Turn on welding power source disconnect.
2. Set MAIN POWER switch on controller to ON.
3. Set INPUT POWER switch on welding power source to ON.
4. Open regulator valve on welding gas supply.
5. Make sure enclosure door is closed and securely latched.
6. Disable operator station.
7. Press TEACH mode button on controller playback panel.
8. Place robot in Safe position (Cube 24).

5.2.2 **Robot Safe (Cube 24) Position**

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

1. Press TEACH mode button on controller 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 Safe job and press SELECT. The Safe 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 Safe (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 proceed as follows:

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 the enclosure door is closed and securely latched.
6. Press PLAY mode button on controller playback panel. Job playback operation is enabled.

7. Press SERVO ON button on playback panel.
8. Place ENABLE/DISABLE switch on operator station in ENABLE position. The controller is placed in REMOTE mode and system control is transferred to operator station.
9. Press START button on operator station. The job cycles, waiting for a Cycle Start input from an operator station.

The FabWorld cell is now ready for operation.

5.2.4 Sample Jobs

This system has arrived with numerous jobs already programmed as an example for cell operation. The system has been tested prior to shipment with these jobs for proper operation and changing the jobs will change the operation of the system.

Adding a User Job

To add a user job into the system, the following steps should be followed:

1. Create a robot job that contains the operation to be completed by the robot. This job can be created on either side and shifted to other side using the mirror shift function. Refer to the Independent/coordinated Function Manual for further instructions regarding mirror shifting
2. Determine a 2-digit number that refers to the job. This number will be used to call the job from the thumb wheel located on the operator station.
3. Using the examples provided in the Work 1 or Work 2 job, add the created job into that structure. Refer to the Independent/coordinated Function Manual for information regarding PSTART and PWAIT instructions.
4. The system will now run the programmed job when the 2-digit number is displayed on the thumb switch.

A list should be maintained to inform the operator of the job/number relationship to prevent inadvertent operation of the incorrect job during operation.

5.2.5 Perform Operation Cycle

1. Load parts onto the fixture in Station 1. Check the thumb wheel is selected to the correct number for the parts loaded.
2. Press the CYCLE START palm button on operator station. CYCLE LATCHED light comes on and robot begins welding parts at Station 1.
3. During Station 1 welding process, load Station 2 fixture with parts on both sides and press CYCLE START palm button.
4. During Station's 1 and 2 welding processes, load Station 3 fixture with parts on both sides and press CYCLE START palm button.
5. When robot finishes welding, it returns to Home position then begins welding in Station 1. This allows the operator to enter Station's 2 and 3 and process parts.

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

5.2.6 Daily Operation

Upon completion of the start up procedure, with the master job selected and operating, the jog switches on the operator station are active. The fixture can now be rotated to facilitate part loading. After loading the fixture the positioner must be returned to the home position.



CAUTION!

The positioner will move to the start position.

The operator should be clear of the safety scanned zone or the system will immediately E-stop as the headstock moves off the in-position switches.

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

Loading the Positioner

The headstock tooling plate can be rotated from the home position (zero degrees) using the three-position joystick at the operator station. Moving the joystick FORWARD rotates the headstock tooling plate clockwise while moving it to REVERSE rotates the tooling plate counterclockwise.

As the tooling plate rotates, a factory installed screw located at home position, activate a limit switch. When activated, the limit switch overrides the safety scanner functions. That allows operator access to the positioner without disrupting cycle time in the other station.

Safety scanner functions are active during rotation of the headstock because the next tooling plate screw have not yet reached the limit switch.

Five user-defined load positions (see Figure 5-1) are available on the tooling plate at 30-degree intervals.

NOTE: Do not enter the work area to load parts until the positioner has stopped moving. Failure to wait will shut down servo power

Home Position – MH-series Positioner

For setting home position on MH-series positioner, refer to the MH-series Positioner with MotoMount and Drive Assemblies Manual, P/N 146703-1.

Home Position – MT1-1500

For setting home position on MT1-1500 positioner, refer to the MT1-1500 positioner manual that came with the cell.

Home Position – MHT-340/680

Once the positioner is loaded properly, step out of the safety scanner zone and select HOME POSITION on the joystick. The headstock will rotate back to zero degrees position with the screw(s) activating the limit switch to allow CYCLE START.

Depress the CYCLE START push button now to permit the robot to sweep the positioner and begin to weld when ready.

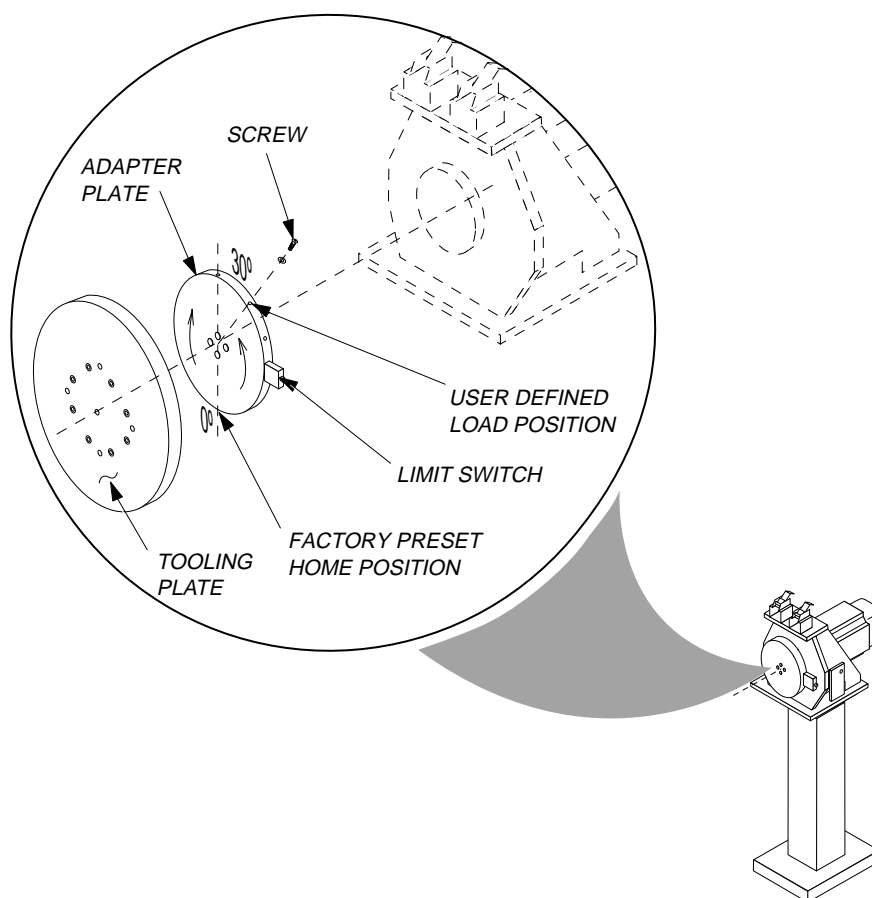


Figure 5-1 MHT-340/680 – Home/User Defined Load Positions

5.2.7 Shutdown

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

1. Make sure the robot is in the Safe 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.
5. Set Main Power switch on welding power source to OFF position.
6. Close regulator valve on welding gas supply.

The FabWorld 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.

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.

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.

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 or Safety Gate Recovery can occur under any of the following conditions:

- Pressing the E-STOP button on the operator station, programming pendant, or playback panel.
- Opening sliding door on robot enclosure when robot is in PLAY mode.
- Stepping into safety scanner zone when positioner is sweeping.
- Actuating shock sensor on torch mount.

To restart the FabWorld system 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 controller playback panel.
 - Close sliding door.
 - Step into safety scanner zone.
 - Clear Shock Sensor condition (see Section 5.3.3).

5.3.3 Shock Sensor Recovery

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



CAUTION!

It is possible to crash the robot with the Shock Sensor Override Switch left in the “Override” position. Always remember to reactivate the Shock Sensor before continuing system operation.

1. Press TOP MENU on programming pendant.
2. Select ROBOT icon using cursor keys and press SELECT.
3. Cursor to OVERRUN-S.SENSOR and press SELECT key.
4. Select RELEASE to release shock sensor.
5. Turn servo power ON by holding ENABLE switch on the programming pendant and pressing SERVO ON.

NOTE: TEACH LOCK must be ON to turn servo power on in TEACH mode.

NOTE: Robot motion type must be JOINT motion.

6. Move manipulator clear of impact position.

The FabWorld cell is now ready to continue operation.

5.3.4 Using the Brake Release

The brake release control panel is located on front of the controller. 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 is the weight of each robot available:

UP20-6 – 260 kg (629 lb)

UP20M – 495 kg (1092 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.

SECTION 6

MAINTENANCE

NOTE: For all issues regarding MotoMount, MotoMount HD, and MHT-series positioners, refer to the MH-series Positioner Manual with MotoMount and Drive Assemblies, P/N 146703-1.

For all issues regarding the MT1-1500 positioner, refer to the MT1-1500 Positioner Manual that came with your system.

6.1 Periodic Maintenance

Table 6-1 provides periodic maintenance items and intervals for the FabWorld system. 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 FabWorld, refer to the manipulator and additional manuals that came with your system.



WARNING!

Use only the antifreeze provided by Motoman. Automotive antifreezes contain stop-leak additives that will clog the small torch water-cooling ports, and damage the gaskets in the water circulator pump.

Table 6-1 Periodic Maintenance

Frequency	Component	Procedure
Daily	Water circulator (For water-cooled torch applications only.)	Check the fluid in the water circulator. Add fluid as required. Use only distilled water and approved antifreeze (Motoman P/N 131224-1).
Weekly	Wire Cutter (option)	Clean the unit with detergent machine cleaner. Apply grease to the wire cutting mechanism through the grease zirk provided.
6 Months	Wire Feeder	Clean feed roll grooves with industrial machine cleaner. Replace feed rolls as required.
Annually	Water Circulator Kit (option)	Flush the system completely. Refill as needed.

6.2 Fuse and Circuit Breaker Protection

In most cases, spare fuses are placed in the accessory bag with the controller.



WARNING!

Replace fuses with those of the same type and rating. Replacement with fuses of higher amperage rating or lower voltage will damage the robot controller and/or auxiliary equipment, necessitating costly replacement.

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