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SECTION 1

INTRODUCTION

The FabWorld IISG is part of the Motoman 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 IISG features a Motoman Servo Gallows with arc welding robot, an XRC controller with menu-driven arc welding application software, complete welding package, headstock/tailstock positioner(s), operator interface, and total safety environment.

1.1 About this Document

This manual provides system information for the FabWorld IISG and contains the following sections:

SECTION 1 - INTRODUCTION

Provides general information about the FabWorld IISG and its components, a list of reference documents, and customer service information.

SECTION 2 - SAFETY

Provides information regarding the safe use and operation of the FabWorld IISG system.

SECTION 3 - DESCRIPTION OF EQUIPMENT

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

SECTION 4 - INSTALLATION

Provides instructions for set up and installation of the FabWorld IISG system.

SECTION 5 - OPERATION

Provides instructions for basic operation of the FabWorld IISG system. This section provides procedures for start-up, loading, normal operation, fault recovery, and shutdown. A number of sample robot programs are also included in this section.

SECTION 6 - MAINTENANCE

Contains a table listing periodic maintenance requirements for the components of the FabWorld IISG cell.
1.2 **System Overview**

FabWorld systems feature a modular, flexible approach to configuring robotic arc welding systems and is designed for larger applications. The system is designed around a Motoman Servo Gallows with wall-or ceiling-mounted robot, XRC controller, and complete welding package. Motoman’s Servo Gallows is designed to rotate the robot over the positioning stations providing greater part accessibility. The standard configuration includes one MH-1500 headstock and one MT-1500 tailstock positioner mounted on a common bed, with a second positioner and stationary table offered as options. The cell provides a full complement of safety features designed to protect both personnel and equipment. Figure 1-1 illustrates the system layout of the FabWorld IISG cell.

![Figure 1-1 FabWorld IISG System](image)

1.2.1 **System Layout**

The Servo Gallows is mounted on a separate base for ease of installation. The XRC controller (with external axis cabinet) and welding power source also share a wide common base. FabWorld IISG cell has three possible layout configurations: in-line, perpendicular, and combination. Figures 1-2, 1-3, and 1-4 illustrate these three combinations.
Figure 1-2  FabWorld IISG In-Line Layout

Figure 1-3  FabWorld IISG Perpendicular Layout
The robotic cell comes equipped with a dual safety package which includes safety fencing, two interlocking doors, and two non-contact opto-electric safety scanning devices, which define two safety zones. A safety zone is active when the gallows arm is in that zone. Entering the active safety zone will E-stop the cell (all equipment motion will stop). All operator controls, including those on the XRC and welding power supply, are accessible from outside of the robotic enclosure.

The FabWorld IISG includes the following major components:

- Motoman SK16X or UP6 manipulator and XRC controller
- MH-1500 headstock and MT-1500 tailstock positioner
- Operator stations
- Welding equipment, including the following:
  - MotoArc or Kobelco welding power source
  - Motoman torch (water-cooled or air-cooled)
  - Wire feeder
  - Universal Welding Interface (UWI)
  - Torch mount
- Safety equipment, including the following:
  - Safety fencing with arc curtains
  - Zone ring monitor
  - Zone scanner
  - Interlocked cell doors
  - Positioner arc screen
1.2.2 Optional Equipment
The following optional equipment is available for use with the FabWorld IISG:

- Torch tender
- Wire cutter
- Com-Arc III seam tracking unit
- Water circulator
- Stationary table

1.3 Reference to Other Documentation
For additional information refer to the following:

- Motoman UP6 Manipulator Manual (P/N 142104-1)
- Motoman SK16X Manipulator Manual (P/N 142105-1)
- Motoman Operator's Manual for Arc Welding (P/N 142098-1)
- Motoman Concurrent I/O Parameter Manual (P/N 142102-1)
- Coordination Instructions for Multi-axes Systems (P/N 139418-1)
- Com-Arc III Instruction Manual (P/N 132753-1)
- 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 SK16X)
- Application Type (welding)
- System Type (FabWorld IISG)
- Software Version (5.101A)
- Robot Serial Number (located on the back side of the robot arm)
- Robot Sales Order Number (located on back side of XRC controller)
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: 313/994-6088
FAX: 313/994-3338

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/SKX-Series Robot Description

The Motoman six-axis UP6 and SK16X robots and XRC robotic controller represent state-of-the-art technology in robotics today. The UP6 robot has a payload of 6 kg (13.2 lbs). It features a 1,325 mm (52.1 in.) reach and has a relative positioning accuracy of ± 0.08 mm (0.004 in.). The SK16X robot has a payload of 16 kg (35.2 lbs). It features a 1,555 mm (61.2 in.) reach and has a relative positioning accuracy of ± 0.1 mm (0.004 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 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 Controller

The XRC robotic controller, shown in Figure 3-1, coordinates the operation of the FabWorld IISG 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.
### 3.2.1 Playback Box

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 Playback Box](image)

#### Servo On Ready
The SERVO ON READY push button turns servo power ON. The switch lights when servo power is on. In TEACH mode, the SERVO ON READY push button 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 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 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 TOOLS 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 and a floppy disk controller (FC1 or FC2), FDE (Floppy Disk Emulator) software, or other form of communication (see Figure 3-4).

![Figure 3-4 RS-232C Serial Port](image)

**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](image)
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 cabinet (see Figure 3-1).

3.3 Operator Station

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

![Operator Station](image)

3.3.1 Cycle Start

**WARNING!**
*The operation of the CYCLE START palm buttons 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 buttons, located on the sides of the operator station, initiate a job start cycle if the robot is in the Safe or Home position. If the CYCLE START buttons are pressed while the robot is outside Cube 1, the CYCLE START command is latched into the XRC. Once the robot returns to Cube 1 and Output #1 is on, the CYCLE START command is executed and the current job starts. An anti-tiedown timer, normally set to 10 seconds, prevents the operator from holding the palm buttons down and continuously cycling the system.
3.3.2 Emergency Stop (E-STOP)

The operator station E-STOP, the robot E-STOP, and the sliding door interlocks are connected in series in the Emergency Stop circuit. Pressing an E-STOP button or interrupting a door interlock interrupts this circuit and stops 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 system motion is stopped.

3.3.3 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.

3.3.4 Cycle Latched

The CYCLE LATCHED lamp operates as an indicator light showing that the positioner CYCLE START command has been latched. It is not necessary to wait for the robot to finish welding and return to the Safe position (Cube 1) before pressing the CYCLE START palm buttons. Pressing the Cycle Start palm buttons while the 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 robot finishes the current job and returns to the Safe position (Cube 1). Stepping on the safety mats will unlatch the CYCLE START command from the XRC.

3.3.5 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.

3.3.6 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.

3.3.7 Operator Station Enable/Disable

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

3.3.8 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. In addition, the RESET button and the RIGHT CYCLE START buttons are interlocked and, when pressed simultaneously, enable the positioner when servo power is ON in Play mode. In TEACH mode, the positioner is automatically reset when servo power is turned ON using the ENABLE switch. The positioner only needs to be reset at initial power up or after an emergency stop while in PLAY mode.
3.4 **MH-Series Positioners**

The FabWorld IISG cell uses a servo-driven MH-1500 headstock and the MT-1500 tailstock positioner (see Table 3-1), which are mounted on a common bed and provide a fixed height, rotation axis at 27-3/4” above the base. The common bed expands to a maximum of 72” table-to-table distance for longer parts.

<table>
<thead>
<tr>
<th>Table 3-1 MH-1500 Positioner Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conditions</strong></td>
</tr>
<tr>
<td>Capacity</td>
</tr>
<tr>
<td>Work Area</td>
</tr>
<tr>
<td>Rotation Speed</td>
</tr>
<tr>
<td>Temperature Operating Range</td>
</tr>
<tr>
<td>Humidity (maximum)</td>
</tr>
<tr>
<td>Shock (maximum)</td>
</tr>
<tr>
<td>Sweep Speed</td>
</tr>
<tr>
<td>Electrical Requirements</td>
</tr>
<tr>
<td>Welding Current Rating</td>
</tr>
</tbody>
</table>

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

3.5 **Stationary Flat Plane Module**

The stationary flat plane module is steel table with a blanchard ground steel top. The unit includes an operator station and zone scanner.

<table>
<thead>
<tr>
<th>Table 3-2 Stationary Flat Plane Module Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conditions</strong></td>
</tr>
<tr>
<td>Work Surface Dimensions</td>
</tr>
<tr>
<td>Part/Fixture Rating</td>
</tr>
<tr>
<td>Welding Current Rating</td>
</tr>
</tbody>
</table>

**NOTE:** In high-humidity areas, use surface protection to prevent corrosion of the table surface.
3.6 Welding Equipment

The FabWorld system provides a complete complement of arc welding equipment. In its standard configuration, the FabWorld IISG system includes a power source, wire feeder, torch, and torch mount. Optional equipment including a water circulator, Com-Arc unit, and torch tender may also be included with your system.

3.6.1 Power Sources

Motoman offers several different power sources for use with the FabWorld IISG system depending on your system’s application. The following are some of the more common power sources used. 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 Kobelco UC Power Source

Figure 3-8 MotoArc Power Source
3.6.2 **PWF4 Wire Feeder**

The PWF4 wire feeder mounts on the robot arm. This 4-roll wire feeder provides reliable wire feeding at rates up to 750 inches per minute (IPM). An integral gas valve provides fast gas response time. The wire feeder has 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. A Shock Sensor Override switch located on the front of the feeder is used to recover from torch impact.

3.6.3 **Universal Welding Interface (UWI)**

The UWI provides microprocessor control to the wire feeder and power source. It scales the signals from the XRC controller to the appropriate levels required for control of the welding components. It also provides isolation of the power source analog signals.

**NOTE:** Some power sources available with the FabWorld system do not use the UWI. For more information specific to your system, refer to the vendor manuals shipped with your system.

3.6.4 **GMAW Torch**

The ArcWorld 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 ArcWorld system includes a suitable water circulator kit.

3.6.5 **Motoman Torch Mount**

A 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 and door motion is also stopped.

3.7 **Safety Features**

The FabWorld IISG 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. The ANSI/RIA R15.06 Robot Safety Standard stipulates the user is responsible for safeguarding. **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.**

3.7.1 **Arc Screens**

**WARNING!**

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

The FabWorld IISG cell uses two different arc screens. The first set covers the safety fencing of the robotic cell. The second set mounts on posts located at the sides of each station. The cell has no fencing or arc screen at the openings of the separate stations (where the operator loads and unloads parts). Motoman recommends that the user provide portable arc screens that can be put in place to protect workers in the area against arc radiation.
3.7.2 **Fencing**

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

3.7.3 **Zone Scanner**

The zone scanner emits a laser beam, and, like radar, measures the environment using reflex flight time – the time it takes for light to return from an object. The zone scanner establishes two monitoring ranges: a warning field and a protection field, which can be set independently. If the operator enters the warning field while the robot is in Play mode and in the same zone, the scanner issues a stop signal to the controller and a warning is issued. If the operator steps into the protection zone while the robot is in Play mode and in the same zone, an emergency stop condition will occur.

3.7.4 **Zone Ring Monitor**

The zone ring monitor is a monitoring control that allows the operator to load and unload parts in any zone other than the active welding zone. The zone monitor works in conjunction with the zone scanner. Entering the active welding zone while the robot is in Play mode causes an emergency stop condition to occur.

3.7.5 **Emergency Stops (E-STOPS)**

In addition to the safety features described above, the FabWorld IISG 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 has one E-STOP button.
- The programming pendant has one E-STOP button.
- The operator station has one E-STOP button.

3.7.6 **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 section in the manipulator manual that came with your system.

3.7.7 **Interlocked Cell Doors**

A safety interlock on the cell entrance doors prevent entry into the cell during PLAY mode. Opening a cell door with the robot in PLAY causes an E-STOP. 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.
### 3.7.8 Interference Cubes

Cubic interference zones prevent interference between multiple manipulators or a manipulator and peripheral devices. The XRC monitors the robot tool center point (TCP) during operation. If the TCP enters one of the 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. These cubes are internally tied to Specified Outputs:

\[
R1 = SOUT \#081 - 088
\]

The FabWorld IISG uses interference cubes to interlock robot position with positioner motion. The robot Home or Safe position (Cube 1) is defined behind the positioner, clear of the sweep zone.

Setup of these cubes is done at the factory prior to shipment. However, should any of these cubes need redefined or modified due to changes in tooling or system components.

### 3.7.9 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 cabinet (see Figure 3-1).
SECTION 4
INSTALLATION

The FabWorld II SG 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.

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 II SG system is included with the system. This section identifies customer-supplied items and tools required to complete installation.

4.1.1 Customer-Supplied Items

- Gas bottles for the welding torches
- Incoming power supply
- Two earth ground cables with two earth ground stakes
- Weld wire
- Incoming air supply: 0.04 cmm at 620.5 kPa (1.5 scfm at 90 psi)

NOTE: The FabWorld II SG is configured for three-phase 460/480V AC unless other voltage was requested before shipment.

4.1.2 List of Tools

- Safety glasses
- Face shields
- Gloves
- Level
- Ratchet with 3/4-in. 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-in. socket
- Open-end wrench set
- Two socket-head (Allen) wrench sets (standard and metric)
4.2 Site Preparation

**WARNING!**
The FabWorld II SG MUST be properly installed in a suitable location or serious injury or death can occur to personnel and equipment can be seriously damaged or destroyed.

The FabWorld II SG must be properly installed in a suitable location where floor construction is of sufficient thickness and composition to support the forces in effect during operation (see Figure 4-1). Additionally, the FabWorld II SG must have enough room on all sides to operate without contacting the ceiling, walls, or any other objects or equipment (see Figure 4-2). It is your responsibility to install the FabWorld II SG in a suitable location.

*Figure 4-1 Forces on Servo Gallows*
Once you have located a suitable location (as defined on the preceding page), prepare it as follows:

1. Clear the floor space needed for installation (see Figure 4-2).

**NOTE:** All FabWorld II SG configurations will require a minimum area of 7.3 m (24.37 ft.) by 9.16 m (30.04 ft.). However, an additional 2.43 to 3.05 m (8 to 10 ft.) on all sides is recommended for all configurations.

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

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

**4.3 Installing the Servo Gallows Base and Column**

**4.3.1 Unpacking the Servo Gallows Base and Column**

To install the Servo Gallows base and column, proceed as follows:

1. Unbolt base and column from wooden shipping skid using a 3/4 in. socket (see Figure 4-3).
2. Using a forklift, carefully remove base and column from shipping skid.
3. Place base and column in position (see Figure 4-2).
4. Carefully remove the protective plastic wrapping from the base and column.
5. Inspect for shipping damage.

NOTE: If damage is found, notify the shipper immediately.
6. Remove operator station from skid and set safely aside.

4.3.2 Leveling and Securing the Servo Gallows Base and Column

Once the base and column are in place, level and secure the base to the floor. Lag bolts are shipped in the accessories box. To level and secure the gallows base, proceed as follows:

1. Level the base by adjusting leveling bolts (see Figure 4-3).
2. Insert a 1/2” concrete drill bit through center of lag holes and drill holes in floor for lag bolts.
3. Vacuum concrete dust from holes.
4. Lag base to floor.

WARNING!
The combined weight of the base and column is approximately 544 kg (1200 lbs). Be sure your crane or forklift is capable of handling this much weight or damage to equipment or injury to personnel can result.
4.4 Installing the Servo Gallows S1 Axis

The Servo Gallows S1 axis is shipped on a separate shipping skid. To install the Servo Gallows S1 axis, proceed as follows:

The Servo Gallows components should be handled carefully to avoid damage from collisions or other mishaps.

1. Unbolt S1 axis from wooden shipping skid using a 3/4 in. socket.
2. Using an overhead crane or forklift, lift S1 axis from shipping skid.

WARNING!
The S1 axis weighs approximately 544.3 kg (1200 lbs). Be sure that your forklift/crane is capable of handling this much weight or damage to the equipment or injury to personnel can result.

3. Install S1 axis on Servo Gallows column, as shown in Figure 4-4, using two pre-drilled alignment holes and painted silver stripes to correctly orient axis on gallows column. Secure S1 axis to column with hardware provided.

Figure 4-4 Installing the Servo Gallows S1 Axis
4.5 Installing the Servo Gallows Boom

The Servo Gallows boom is shipped on a separate shipping skid. To install the Servo Gallows boom, proceed as follows:

1. Unbolt the boom from the wooden shipping skid using a 3/4 in. socket.
2. Using an overhead crane or forklift, remove boom from the shipping skid.

**WARNING!**

- The Servo Gallows boom arm weighs approximately 454 kg (1000 lbs). Be sure that your crane or forklift is capable of handling this much weight. Damage to the equipment or injury to personnel can result.
- Eyebolts are designed to support the weight of the boom arm. Use the bolts for lifting the arm ONLY.

3. Install the boom on the Servo Gallows column, as shown is Figure 4-5. Secure boom to column with hardware provided.

![Figure 4-5 Installing the Servo Gallows Boom](image-url)
4.6 Installing the Robot

The robot can be mounted in either a wall or ceiling position on the Gallows boom. However, due to the weight of the robot, and because it is necessary to turn the robot upside down to mount it on the Gallows, Motoman highly recommends hiring a rigger to lift and install the robot. A second method, requiring a forklift, is described in Appendix A. This method requires the use of a rollover arm to turn the robot upside down.

4.6.1 Lifting the Robot

To lift the robot with a cable or sling, proceed as follows:

1. Unbolt robot from wooden shipping skid using a 3/4 in. socket.
2. Ensure all shipping brackets are securely in place (see Figure 4-6).

**WARNING!**

- *The robot weighs approximately 280kg (617.3 lbs). Use a cable or sling, that can withstand this weight or injury to personnel/damage to equipment can occur.*

- *Eyebolts are designed to support the robot weight. Use eyebolts for lifting ONLY.*

3. Ensure eyebolts are attached securely to robot.
4. Attach a suitable lifting device securely to eyebolts.

![Figure 4-6 Lifting the robot](image)

Crane operations or sling applications must be performed by authorized personnel only, or injury or damage may result.

5. Carefully lift robot, taking care to avoid excessive vibration or shock or exerting force on arm or motor unit, and place in desired location.
4.6.2 Removing Shipping Brackets

Failure to remove shipping brackets from robot before operating the FabWorld II SG may result in damage to the robot drive mechanisms.

Three yellow brackets Figure 4-7 prevent the robot from moving during shipping. Two angle 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.

Figure 4-7 Location of Shipping Brackets

4.7 Installing the Torch Tender Option

The optional torch tender is shipped on the auxiliary equipment common base. To install the torch tender, proceed as follows:

1. Remove torch tender from robot shipping skid.
2. Place the torch tender next to the robot Figure 4-8.
4.8 Installing the Positioners

One MH-1500 headstock combined with an MT-1500 tailstock on a common bed is the standard positioner with the FabWorld II SG single system. One headstock/tailstock positioner (S2 axis) is provided in a standard system. Two different system configurations are possible for a single positioner system: in-line and perpendicular. A second identical positioner may be purchased as an option. If a second headstock/tailstock positioner (S3 axis) is purchased, three different positioner configurations are possible: in-line, perpendicular, or combination.

4.8.1 Installing a Single Positioner Configuration

NOTE: Positioner placement is based on your FabWorld II SG system configuration. Ensure that positioners are placed as shown in the print included in the "Read First" documentation package, which is attached to the XRC.

1. Unbolt the positioner from the wooden shipping skid.

WARNING!
This positioner weighs approximately 449 kg (990 lbs). Use a cable or sling, that can withstand this weight or injury to personnel and/or damage to equipment can occur.

2. Using a forklift or overhead crane, remove positioner from the shipping skid.
3. Inspect the positioner for any shipping damage.

NOTE: If damage is found, notify the shipper immediately.

4. Set the positioner into place. If the system is an in-line configuration, place the positioner as shown in Figure 4-9; if it is perpendicular, place the positioner as shown in Figure 4-10. There should be adequate room on all sides of the positioner for the fencing, the operator station, the safety zones, and the auxiliary equipment common base.
5. Level and align the headstock to the tailstock, as instructed in Section 4.9.

\[\text{Figure 4-9  Location of Positioner for Single In-Line Configuration}\]

\[\text{Figure 4-10  Location of Positioner for Single Perpendicular Configuration}\]

4.8.2 Installing a Dual Positioner Configuration

1. Unbolt the positioners from the wooden shipping skid.

**WARNING!**
Each positioner weighs approximately 449 kg (990 lbs). Use a cable or sling, that can withstand this weight or injury to personnel and/or damage to equipment can occur.

2. Using a forklift or overhead crane, remove positioners from shipping skid.

3. Inspect positioners for any shipping damage.

**NOTE:** If damage is found, notify the shipper immediately.

4. Set positioners into place. If the system is an in-line configuration, place the positioners as shown in Figure 4-11; if perpendicular, place as shown in Figure 4-12; if combination, place as shown in Figure 4-13. There should be adequate room on all sides of the positioners for the fencing, the operator station, the safety zones, and the auxiliary equipment common base.

\[\text{Figure 4-11  Location of Positioners for Dual In-Line Configuration}\]
5. Align the headstock to the tailstock as instructed in Section 4.9.

4.9 **Leveling and Aligning the Headstock/Tailstock**

To level and align the headstock/tailstock, proceed as follows:

1. Level headstock/tailstock base within 1.5 mm (1/16") and bolt it rigidly to a concrete floor or appropriate steel pads.

2. To assure parallelism of the headstock and tailstock faceplates, use an appropriate scale to measure the distance between the faceplates at the outside edge and at 0°, 90°, 180° and 270°. The plates should be parallel to one another within.75 mm (.030”). If not, loosen tailstock mounting bolts and twist the tailstock faceplate side to side until the two faceplates are parallel within.75 mm (.030”).
4.10 Installing the Auxiliary Equipment Common Base

The auxiliary equipment common (AEC) base contains the XRC controller and the welding power source with disconnect. It may also include the optional water circulator and/or the Com-Arc III. The accessories box is secured to the top of the welding power source.

4.10.1 Unpacking the AEC Base

To unpack the AEC base, proceed as follows:

1. Unbolt the AEC base from the wooden shipping skid by removing the four shipping bolts using a 3/4-in. deep well socket (Figure 4-15).

![Unbolting the AEC Base](image)

**Figure 4-14 Unbolting the Auxiliary Equipment Common (AEC) Base**

**WARNING!**

*The AEC base weighs 680 kg (1500 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.*

2. Using a forklift, lift the base and remove it from the shipping skid.
3. Place AEC base approximately 0.15 to 0.25 m (6 to 10 inches) behind Servo Gallows base (Figure 4-15).
4. Carefully remove protective plastic wrapping and cardboard from AEC base.
5. Remove accessories boxes from welding power source.
6. Inspect the AEC base components for any shipping damage.

**NOTE:** If damage is found, notify the shipper immediately
4.10.2 Leveling and Securing the AEC Base

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 the AEC base by adjusting the leveling bolts (see Figure 4-17).

2. Insert a 1/2-inch concrete drill bit through the center of the leveling bolts and drill the holes for the lag bolts.

3. Vacuum concrete dust from holes.

4. Lag the AEC base to the floor.
4.11 Installing the Fencing

The fencing that makes up the welding cell’s protective walls is shipped on its own skid, as shown in Figure 4-17, along with zone scanner, all necessary hardware, and specific assembly documentation.

![Figure 4-17 Crated Fencing Skid](image)

Metal bands are under tension and, when cut, may cause injury. Be cautious when cutting the metal bands.

4.11.1 Installing Weld Cell Fencing for the In-line Configuration

The in-line standard configuration is shipped with one positioner (single configuration). A second positioner may be purchased as an option (dual configuration). To install weld cell fencing for the in-line configuration, proceed as follows:

1. Place fence components on floor around servo gallows/positioner (see Figure 4-18 for single configuration and Figure 4-19 for dual configuration).
2. Connect the rear wall to two fence posts, one on each side of the wall (see Figure 4-20, Step A).
3. Connect hinges to the sides of the right rear wall (see Step B).
4. Raise the walls and bolt them together by bolting the hinges on the right rear wall to the fence post on the rear wall.
5. Connect a fence post to one side of the right wall, door section. Connect a gate post to the other side (see Step C).
6. Raise right wall, door section and connect it to right rear wall by bolting the hinges to the fence post.
7. Connect right wall to two fence posts, one on each side of wall (see Step D).
8. Attach door rail to top of right wall.
Figure 4-18  Fencing Placed on Floor Around Robot (Single Configuration)

Figure 4-19  Fencing Placed on Floor Around Robot (Dual Configuration)
9. Raise the right wall and attach the door to the door rail (see Figure 4-21).

10. If you are assembling a dual in-line system, repeat Steps 3 - 9 to assemble the fence for the opposite side of the cell.

11. Connect the right front wall to two fence posts, one on each side of the wall (see Figure 4-20, Step E). Raise the wall and place it next to the AEC base.
12. Ensure that the cell walls are in position. Figure 4-22 shows the single, in-line configuration; Figure 4-23 shows the dual, in-line configuration. In a dual configuration, the rear wall sections do not attach.

13. Once fence sections are positioned correctly, insert a drill bit through center of fence-wall feet and drill holes for lag bolts in floor at locations shown in Figure 4-22 and Figure 4-23.

14. Vacuum concrete dust from the holes.

15. Lag cell walls to floor.
4.11.2 Installing Weld Cell Fencing for the Perpendicular Configuration

The perpendicular standard configuration is shipped with one positioner (single configuration). A second positioner may be purchased as an option (dual configuration). To install weld cell fencing for the perpendicular configuration, proceed as follows:

1. Place fence components on floor around servo gallows/positioner (see Figure 4-24).
2. Connect the rear wall to two fence posts, one on each side of the wall (see Figure 4-25, Step A).
3. Connect hinges to one side of the right rear wall, top section (see Step B).
4. Connect fence posts to the right rear wall, right section (see Step C).
5. Connect a fence post on one side of right rear wall, left section (see Step D).
6. Raise right rear wall sections and connect, as shown Figure 4-26, Step E.
7. Raise rear wall and right rear wall and connect them by bolting the hinges on the right rear wall to the fence post on the rear wall (see Step F).
8. Raise right rear wall, left section and connect to right rear wall as shown in Step G.

**Figure 4-24  Fencing Placed on Floor Around Robot**
**Figure 4-25  Assembling the Fence Walls, Steps A through D**

- **STEP A**
  - Attach Fence Posts to Rear Wall

- **STEP B**
  - Attach Hinges to Right Rear Wall, Top Section

- **STEP C**
  - Attach Fence Posts to Right Rear Wall, Right Section

- **STEP D**
  - Attach Fence Post to Right Rear Wall, Left Section

**Figure 4-26  Assembling the Fence Walls, Steps E through G**

- **STEP E**
  - Connect Right Rear Wall Sections

- **STEP F**
  - Connect Right Rear Wall to Rear Wall

- **STEP G**
  - Connect Right Rear Wall, Left Section to Right Rear Wall
9. Connect the right front wall to two fence posts, one on each side of the wall (see Figure 4-27, Step H).

10. Attach the door rail to the top of the right wall.

11. Raise the right wall and attach the door to the door rail (see Figure 4-22).

12. Connect a gate post to one side of the door wall and a fence post to the other side (see Figure 4-27, Step I).

13. Connect fence posts to the right front side wall (see Step J).

14. Raise the right wall, door section and connect it to the right front side wall (see Figure 4-28, Step K).

15. If you are assembling a dual perpendicular system, repeat steps 2 through 14 to assemble the fence for the left side of the cell.

16. Ensure that the cell walls are in position. Figure 4-28 shows the single, perpendicular configuration; Figure 4-30 shows the dual, perpendicular configuration. In a dual configuration, the rear wall sections do not attach.

17. Once the fence sections are positioned correctly, insert a drill bit through the center of the fence wall feet and drill the holes for the lag bolts in the floor at the locations shown in Figure 4-29 and Figure 4-30.

18. Vacuum concrete dust from the holes.

19. Lag the cell walls to the floor.
**Figure 4-28** Assembling the Fence Walls, Step K

**Figure 4-29** Lagging Cell Walls to Floor (Single, Perpendicular)
Figure 4-30  Lagging Cell Walls to Floor (Dual, Perpendicular)
4.11.3 Installing Weld Cell Fencing for the Combination Configuration

To install weld cell fencing for the combination configuration, proceed as follows:

1. Place the fence components on the floor around the servo gallows/positioner (see Figure 4-31).

2. Connect the rear wall to two fence posts, one on each side of the wall (see Figure 4-33, Step A).

3. Connect hinges to the sides of the left rear wall (see Step B).

4. Raise the walls and bolt them together by bolting the hinges on the left rear wall to the fence post on the rear wall.

5. Connect a fence post to one side of the left wall, door section. Connect a gate post to the other side (see Step C).

6. Raise the left wall, door section and connect it to the left rear wall by bolting the hinges to the fence post.

7. Connect the left wall to two fence posts, one on each side of the wall (see Step D).

8. Attach the door rail to the top of the left wall.

9. Raise the left wall and attach the door to the door rail (see Figure 4-21).
10. Repeat Steps 2 - 14 for the perpendicular configuration to assemble the fence for the right side of the cell.

**Figure 4-32 Assembling the Fence Walls, Steps A through E**

11. Ensure that the cell walls are in position, as shown in Figure 4-33. The rear wall sections do not attach.

12. Once fence sections are positioned correctly, insert a drill bit through center of fence wall feet, and drill holes for lag bolts in floor at locations shown in Figure 4-33.

13. Vacuum concrete dust from the holes.

14. Lag the cell walls to the floor.
Figure 4-33  Lagging Cell Walls to Floor (Combination)
4.12 Installing the Arc Curtains

**DANGER!**
Do not install the arc curtains until after the cell walls have been lagged to the floor. Unsecured cell walls can fall and injure personnel and damage equipment.

The arc curtains are shipped in an accessories box. To install the arc curtains:

1. Unfold arc curtains and install one curtain on inside of each cell wall, using supplied wire ties and eyelets in material Figure 4-34.

**NOTE:** The arc curtains have been pre-cut to match the cell walls. Each arc curtain bag contains documentation that includes the arc screen’s dimensions. If necessary, these dimensions can be used to match each curtain to the correct cell wall.

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

3. Install the door panel safety curtain on the outside of the door panel, using the supplied wire ties and the eyelets in the curtain material.

---

*Figure 4-34  Securing the Arc Curtains*
4.13 **Installing the Operator Stations**

To install the operator stations, proceed as follows:

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

**NOTE:** If damage is found, notify the shipper immediately.

4. Place operator stations outside FabWorld fence to front of safety zones. If your system is an in-line configuration, see Figure 4-35; if perpendicular, see Figure 4-36; if combination, see Figure 4-37.

![Figure 4-35 Installing the Operator Stations (In-Line)](image)

![Figure 4-36 Installing the Operator Stations (Perpendicular)](image)
4.14 Installing the Zone Scanner

Two zone scanners are shipped in the accessories box, and each has its own mounting bracket. If your system is an in-line configuration, see Figure 4-38; if perpendicular, see Figure 4-39; if combination, see Figure 4-40. To install the zone scanner, proceed as follows:

1. Using hardware provided, mount the zone scanners to the mounting bracket.
2. Place the zone scanners in position as shown in Figure 4-38, Figure 4-39, or Figure 4-40, depending on system configuration.
3. Drill holes in the floor for the bracket mounting screws.
4. Mount bracket to floor using screws and lock washers provided.

**NOTE:** The zone scanners are programmed at Motoman prior to shipment. Refer to the PLS Laser Scanner instruction manual for information on programming the equipment for your specific application.
Figure 4-38 Installing Zone Scanner (In-line)

Figure 4-39 Installing Zone Scanner (Perpendicular)
4.15 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.

4.15.1 Connecting the Earth Ground

The robot and the XRC 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.

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

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 XRC.
4. Connect other end of second earth ground cable to earth ground stake.

4.15.2 Connecting the Welding Ground

The ground welding cables are shipped in an accessories box. To connect the ground welding cables, proceed as follows:

1. Remove the ground welding cables from the accessories box.
2. Connect one end of one of ground welding cables to positioner #2, and other end to grounding block on positioner #1 (see Figure 4-41).
3. Connect one end of one of ground welding cables to tack table (if provided) and the other end to the grounding block on positioner #1.

4. Connect the other end of the ground welding cable to negative (−) terminal on welding power source (see Figure 4-43).
4.15.3 Connecting the Robot and System Cables

Two cables, 1BC and 2BC, connect the robot to the XRC controller. The 1BC cable supplies power to the robot servo motors. The 2BC cable provides communication between the controller and the robot. 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.
3. If your robot is wall-mounted, route the 1BC and 2BC robot cables from the XRC, through the opening in the bottom of the column, through the column, and out the opening in the top of the boom arm (see Figure 4-43). Route the cables along the top of the boom arm and through the strain relief.

4. Carefully engaging connectors, connect two cables (labeled 1BC and 2BC) to 1BC and 2BC connections on back of robot (see Figure 4-44).
5. If your robot is ceiling-mounted, route 1BC and 2BC robot cables from XRC through opening in bottom of column and up through column to boom arm. Route cable through boom arm, out of opening in the bottom of boom and through strain relief (see Figure 4-45).

6. Carefully engaging the connectors, connect the 1BC and 2BC robot cables to the 1BC and 2BC connections on the back of the robot (see Figure 4-44).
4.15.4 Connecting the Station Cables

To connect the station cables, proceed as follows:

1. Connect the Servo Gallows (Station 1) encoder and power cables from the XRC to connection panel on side of gallows column.

![Figure 4-46 Connecting Station1 Cables on Servo Column]

2. Connect Station 2 encoder and power cables, located on side of XRC to the connections in the junction box on the positioner.

   *NOTE:* The Nichifu connections on the power cable are color-coded and marked for easy reference.

![Figure 4-47 Connecting Station 2 Power and Encoder Cables]
4.15.5 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 from weld torch to connections on water circulator marked WATER-IN and WATER-OUT Figure 4-48.

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

![Figure 4-48 Water Circulator Connections](image-url)
4.16 Connecting the Power

After all of the system components have been properly installed, connect the power to the FabWorld II SG.

**DANGER!**

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

To connect incoming power to the FabWorld II SG:

1. Install 3-phase power wiring to circuit breaker located inside right wall of XRC cabinet. Table 4-1 shows size and type of wire needed.
2. Tighten screws to the torque indicated in Table 4-1.
3. Install an M5 lug on incoming ground wire.
4. Terminate ground wire to frame ground with M5 hardware provided.

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

**Table 4-1** Incoming Power Specifications (Decal)

<table>
<thead>
<tr>
<th>Lug Data</th>
<th>60/75° C wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalog No.</td>
<td>TCAL14</td>
</tr>
<tr>
<td>Wire Size</td>
<td>#14-7 Copper, #12-8 Aluminum</td>
</tr>
<tr>
<td>Torque</td>
<td>#14-7, 4.0 N•m (35 lb-in.)</td>
</tr>
</tbody>
</table>
4.17 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:

1. Check that all three yellow shipping brackets have been removed from robot (see Section 4.6.2).
2. Check that the cell door is closed and latched.
3. Check that all cable connections are tight.
4. Be sure welding power source is set correctly (see welding power source vendor's manual).
5. Verify incoming line power matches input power specified on sticker on front of XRC.

Your FabWorld II SG is now ready for power-up. The 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 (pendant, operator station, breakaways, playback box).
7. Check system Hold buttons.

4.18 Installation of Tooling and Fixtures

Your FabWorld II SG 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.
SECTION 5
OPERATION

The FabWorld II SG is a fully integrated robotic GMAW welding cell. In a dual-station configuration, the robot welds on one headstock/tailstock positioner while the operator loads the other positioner with parts. Once the robot is finished with its process, it returns to the home position or moves to the next station.

5.1 Programming

The operation of this system is programming dependent. The operating instructions included in this section 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 FabWorld II SG uses the following user and dedicated inputs and outputs (see Tables 5-1 and 5-2).

<table>
<thead>
<tr>
<th>XRC Dedicated Inputs</th>
<th>XRC Dedicated Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo On</td>
<td>Servo Power ON</td>
</tr>
<tr>
<td>External Job Start</td>
<td>TEACH mode</td>
</tr>
<tr>
<td>Alarm Reset</td>
<td>Cube 1</td>
</tr>
<tr>
<td>REMOTE mode ON</td>
<td>Alarm Occurence</td>
</tr>
<tr>
<td>Hold</td>
<td></td>
</tr>
<tr>
<td>External Emergency Stop</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5-1  XRC User Inputs

<table>
<thead>
<tr>
<th>Input</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN#001</td>
<td>CYCLE START</td>
</tr>
<tr>
<td>IN#002</td>
<td>AUTO/MANUAL</td>
</tr>
<tr>
<td>IN#003</td>
<td>ROTATE CW</td>
</tr>
<tr>
<td>IN#004</td>
<td>ROTATE CCW</td>
</tr>
<tr>
<td>IN#005-IN#008</td>
<td>NOT USED</td>
</tr>
<tr>
<td>IN#009</td>
<td>AT SIDE A</td>
</tr>
<tr>
<td>IN#010</td>
<td>AT SIDE B</td>
</tr>
<tr>
<td>IN#011</td>
<td>ZERO SPEED</td>
</tr>
<tr>
<td>IN#012</td>
<td>DRIVE FAULT</td>
</tr>
<tr>
<td>IN#013</td>
<td>HS A IS CW</td>
</tr>
<tr>
<td>IN#014</td>
<td>HS A IS CCW</td>
</tr>
<tr>
<td>IN#013</td>
<td>HS B IS CW</td>
</tr>
<tr>
<td>IN#014</td>
<td>HS B IS CCW</td>
</tr>
<tr>
<td>IN#015-IN#020</td>
<td>NOT USED</td>
</tr>
</tbody>
</table>

### Table 5-2  XRC User Outputs

<table>
<thead>
<tr>
<th>Output</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUT#001</td>
<td>CYCLE LATCHED</td>
</tr>
<tr>
<td>OUT#002-#003</td>
<td>NOT USED</td>
</tr>
<tr>
<td>OUT#004</td>
<td>WIRE CUTTER</td>
</tr>
<tr>
<td>OUT#009</td>
<td>FORWARD RUN</td>
</tr>
<tr>
<td>OUT#010</td>
<td>REVERSE RUN</td>
</tr>
<tr>
<td>OUT#011</td>
<td>FAULT RESET</td>
</tr>
<tr>
<td>OUT#012</td>
<td>SPEED 1</td>
</tr>
<tr>
<td>OUT#013</td>
<td>ROT HS A CW</td>
</tr>
<tr>
<td>OUT#014</td>
<td>ROT HS A CCW</td>
</tr>
<tr>
<td>OUT#015</td>
<td>ROT HS B CW</td>
</tr>
<tr>
<td>OUT#016</td>
<td>ROT HS B CCW</td>
</tr>
<tr>
<td>OUT#017-#020</td>
<td>NOT USED</td>
</tr>
</tbody>
</table>
5.2 Daily Operation

The following is the typical sequence of operation for the FabWorld IISG cell after start-up:

1. In a dual-station configuration, load one fixture with the parts to be welded.
2. Press both CYCLE START buttons on the operator station for that fixture. The CYCLE LATCHED light comes on and the boom arm sweeps into position. The robot then begins welding the parts.
3. While the robot is welding, load the second fixture.
4. When robot finishes welding at first fixture, press both CYCLE START palm buttons on operator station for second fixture. The CYCLE LATCHED light comes on and the boom arm sweeps into position over the second fixture.
5. While the robot is welding at the second fixture, unload welded parts from first station and load more parts to be welded.
6. When the robot is finished welding, it returns to the Safe Position.

5.2.1 Start-Up

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

1. Turn on welding power source disconnect.
2. Set MAIN POWER switch on XRC 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 XRC playback panel.
8. Place robot in Safe position.

5.2.2 Robot Safe Position

To move the robot to the Safe position, proceed as follows:

1. Press TEACH mode button on XRC playback panel.
2. Press TOP MENU on the 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 1 job and press SELECT. Cube 1 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 1) position.
5.2.3 Starting the Master Job

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

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.

The FabWorld IISG cell is now ready for operation.

5.2.4 Shutdown

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

1. Make sure the robot is in the Safe position (Cube 1).
2. Turn off system servo power by pressing E-STOP button on operator station, programming pendant, or playback panel.
3. Press the TEACH mode button on the playback panel.
4. Set the controller Main Power switch to the OFF position.
5. Set the Main Power switch on the welding power source to the OFF position.
6. Close the regulator valve on the welding gas supply.

The FabWorld IISG 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 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 on safety mat when positioner is sweeping.
- Actuating shock sensor on torch mount.

To restart the FabWorld II SG 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.
   - Step off safety mat.
   - Clear Shock Sensor condition (refer to Section 5.3.3).
2. Press SERVO ON button on operator station, programming pendant, 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 FabWorld II SG cell is now ready to continue operation.
5.3.3 Shock Sensor Recovery

The ArcWorld 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. Place SHOCK SENSOR OVERRIDE switch, located on front of feeder, into OVERRIDE position.
2. Press CANCEL on programming pendant to clear alarm.
3. 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.

4. Move manipulator clear of impact position.
5. Move Shock Sensor Override switch to SHOCK SENSOR position.

The FabWorld II SG 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 XRC. The brakes on S-, L-, and U-axes are controlled by individual axis buttons. Simultaneously pressing ENABLE button and one of these axis buttons releases the indicated axis. However, the release mechanism for the R-, B-, and T-axes is combined into a single button. Enabling this releases the brakes on the R-, B-, and T-axes simultaneously. 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 axis. Listed below are weights support should be able to hold:
   - UP6 21 pounds
   - SK16X 55 pounds

**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

6.1 Periodic Maintenance

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

CAUTION!

- 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.

- Excessive copper ground lubricant may damage weld ground due to electrical arcing through air pockets in grease.

Table 6-1 Periodic Maintenance

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Component</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>Water circulator</td>
<td>Check the fluid in the water circulator. Add fluid as required. Use only distilled water and approved antifreeze (Motoman P/N 131224-1).</td>
</tr>
<tr>
<td>• 12,000H</td>
<td>Gallows Axis Speed Reducer and Gear</td>
<td>Grease at 12,000H with Molywhite RE No. 00 (see Sec. 6.2.1). See Note below.</td>
</tr>
<tr>
<td>• 1,000H</td>
<td>Gallows Axis Motor Connectors</td>
<td>Check for loose connections. Tighten if necessary.</td>
</tr>
<tr>
<td>• 6,000H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 12,000H</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

H=Hours of Operation

NOTE: Call Motoman Service at (937) 847-3200 for assistance in lubricating the Gallows axis speed reducer and gear.
6.2 **Fuse and Circuit Breaker Protection**

Tables 6-2 through 6-4 give the locations of fuses and circuit breakers that are significant to the operation of the total system. 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.

Abbreviations:
- CB — designates circuit breaker
- F, FU, or 101FU — designates fuse

**Table 6-2  MotoArc 450 CV Fuses and Circuit Breaker**

<table>
<thead>
<tr>
<th>Designator</th>
<th>Rating</th>
<th>Part #</th>
<th>Location</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB1</td>
<td>10A 115V</td>
<td>203627-7</td>
<td>Upper rear panel</td>
<td>Protects 115V circuit.</td>
</tr>
<tr>
<td>CB2</td>
<td>10A 24V</td>
<td>203627-7</td>
<td>Upper rear panel</td>
<td>Protects 24V circuit.</td>
</tr>
<tr>
<td>F1</td>
<td>0.5A 125V</td>
<td>W-11166-11</td>
<td>On contactor box</td>
<td>Protects contactor circuit.</td>
</tr>
</tbody>
</table>

**Table 6-3  Universal Welding Interface (UWI) Fuses**

<table>
<thead>
<tr>
<th>Designator</th>
<th>Rating</th>
<th>Part #</th>
<th>Location</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>8A 250V</td>
<td>Wickman 19374K-4A</td>
<td>On KXA motor speed control</td>
<td>Limits damage from shorts or component breakdowns in DC power supply module.</td>
</tr>
<tr>
<td>FU2</td>
<td>0.25A 125V</td>
<td>Wickman 19303K-500A</td>
<td>On interface board</td>
<td>Protects shock sensor circuit.</td>
</tr>
<tr>
<td>FU3</td>
<td>0.5A 125V</td>
<td>Wickman 19303K-500A</td>
<td>On interface board</td>
<td>Protects 24V circuit.</td>
</tr>
<tr>
<td>Fuse</td>
<td>1A 250V</td>
<td>TD-1</td>
<td>Front of Com-Arc box</td>
<td>Protects 200V circuit.</td>
</tr>
</tbody>
</table>
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