Motoman NX100 Controller

MotoSweep O
Transporter Manual

Part Number: 150590-1CD
Revision 0
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Chapter 1

Introduction

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 their Motoman robot model. For more detailed information, refer to the manuals listed in Section 1.3. This manual contains the following sections:

SECTION 1 - INTRODUCTION
Provides general information about the MotoSweep O Transporter 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 MotoSweep O transporter.

SECTION 3 - DESCRIPTION OF EQUIPMENT
Provides a detailed description of the major components of the MotoSweep O transporter. This section also includes a table of component specifications.

SECTION 4 - INSTALLATION
Provides instructions for set up and installation of the MotoSweep O transporter.

SECTION 5 - OPERATION
Provides instructions for basic operation of the MotoSweep O transporter. This section also provides procedures for start-up, loading, normal operation, fault recovery, and shutdown. Sample robot programs are also included in this section.

SECTION 6 - MAINTENANCE
Contains a table listing periodic maintenance requirements for the components of the MotoSweep O transporter.

APPENDIX A - FOUNDATION DIAGRAM
Provides a detailed diagram of the foundation requirements for the MotoSweep O transporter.

APPENDIX B - ILLUSTRATED PARTS LIST
Appendix B provides exploded views and illustrated parts lists for the MotoSweep O transporter.

APPENDIX C - OPTIONS INSTALLATION
Provides instructions for set up and installation of MotoSweep O options.
1.2 Overview

The MotoSweep O 20/50NX Robot Transporter uses a servo-driven boom that provides overhead support and motion for a number of standard NX100 robots (see table). The boom can be mounted on an off-set (c-frame), or a straight riser. The straight riser is typically preferred for welding applications, while the c-frame riser is preferred for machine tending applications. Mounting holes are provided at the end of the boom for optional robot wall mounting (restrictions apply), or for mounting required process control equipment.

Table 1 Available Robots

<table>
<thead>
<tr>
<th>Orientation</th>
<th>HP20</th>
<th>HP20-6</th>
<th>EA1900N</th>
<th>HP50</th>
<th>HP50-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Wall*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

* S-Axis Limits +/- 30° from vertical

The basic system includes the MotoSweep O 20/50NX Transporter, the desired robot, appropriate controls, and 15 meter standard motion control cables. This provides controller placement within 8 meters of the riser base. Longer cables are available upon request. Specific I/O or process control cables are configured per application and, depending upon the specific order, are supplied by either Motoman Inc., or the customer.

1.2.1 Foundation Requirements

The MotoSweep O 20/50NX can generate high overhung (pull-out) and torsional (twist) floor loads and therefore requires special anchoring considerations. A drawing of the recommended foundation is provided in Appendix A (concrete requires 21 day cure time). Detailed guidelines are provided in Section 4 for installation on an existing floor.

CAUTION!
The customer is responsible for system stability when installed on an existing floor.

Figure 1 illustrates the system layout of the MotoSweep O transporter.
1.2.2 Drive Assembly Identification

Each servo-controlled transporter has an identification label, located on the riser base, that contains information about the drive motor assembly (see Figure 1-2).

![Diagram of robot components and labels](image)

**Figure 1** Layout

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

**Figure 2** Drive Motor Identification Label

<table>
<thead>
<tr>
<th>MODEL</th>
<th>P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEAR RATIO</td>
<td>RPM</td>
</tr>
<tr>
<td>MOTOR #</td>
<td>RPM</td>
</tr>
<tr>
<td>SERIAL#</td>
<td></td>
</tr>
</tbody>
</table>

24 HOUR HOTLINE
1-937-847-3200
MADE IN USA
1.3 Reference to Other Documentation

For additional information refer to the following:

- Motoman HP20 Manipulator Manual (P/N 149615-1)
- Motoman EA1900N Manipulator Manual (P/N 149894-1)
- Motoman HP50 Manipulator Manual (P/N 149465-1)
- Motoman NX100 Controller Manual (P/N 149201-1)
- Motoman Concurrent I/O Parameter Manual (P/N 149230-1)
- 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 (HP20, EA1900N, HP50)
- System Type (MotoSweep O)
- Software Version (access using MAIN MENU, SYSTEM INFO, VERSION on programming pendant)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on front door of NX100 controller)
Chapter 2
Safety

2.1 Introduction

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

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

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. **The robot must not be operated by personnel who have not been trained!**

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.
This safety 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, Operation, and Maintenance Safety (Section 2.6)

## 2.2 Standard Conventions

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

**DANGER!**

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

**WARNING!**

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

**CAUTION!**

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

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

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

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06-1999, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 Mechanical Safety Devices

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

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

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

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

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

2.6 Programming, Operation, and Maintenance Safety

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

- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Do not enter the robot cell while it is in automatic operation. Be sure that only the person holding the programming pendant enters the workcell.
- Check the E-STOP button on the programming pendant for proper operation before programming. The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Back up all programs and jobs onto suitable media before program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
• Any modifications to PART 1, System Section, of the robot controller concurrent I/O program can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1, System Section. Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!

• Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.

• The robot controller allows modifications of PART 2, User Section, of the concurrent I/O program and modifications to controller parameters for maximum robot performance. Great care must be taken when making these modifications. All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot and other parts of the system. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations.

• Check and test any new or modified program at low speed for at least one full cycle.

• This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

• Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.

• Use proper replacement parts.

• Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
Chapter 3

Equipment Description

3.1 Robot Description

The Motoman robots and the NX100 robotic controller represent state-of-the-art technology in robotics today. The Motoman robots provide high speed, accurate path control, large work envelope, and reliability for your automation needs.

Table 2  Robot Specifications

<table>
<thead>
<tr>
<th>Robot Model</th>
<th>Payload</th>
<th>Reach</th>
<th>Repeatability</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP20</td>
<td>20 kg (44.1 lbs.)</td>
<td>1,717 mm (67.6 inches)</td>
<td>±0.06 mm (±0.002 inch)</td>
</tr>
<tr>
<td>EA1900N</td>
<td>3 kg (6.6 lbs.)</td>
<td>1,904-mm (75 inches)</td>
<td>±0.08 mm (±0.003 inch)</td>
</tr>
<tr>
<td>UP50N</td>
<td>50 kg (110.3 lbs.)</td>
<td>2,046-mm (80.5 inches)</td>
<td>±0.07 mm (±0.003 inch)</td>
</tr>
<tr>
<td>HP50-20</td>
<td>20 kg (44.1 lbs.)</td>
<td>3,106 mm (10.2 inches)</td>
<td>±0.15 mm (±0.006 inch)</td>
</tr>
</tbody>
</table>

3.2 NX100 Controller

The NX100 robotic controller, shown in Figure 3, features a Windows® CE programming pendant with color touch screen, high-speed processing, built-in Ethernet, and a robust PC architecture. The NX100 easily handles multiple tasks and can control up to four robots (up to 36 axes, including robots and external axes), and I/O devices. Advanced Robot Motion (ARM) control provides high-performance path accuracy and vibration control.

The NX100 coordinates the operation of the MotoSweep O 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 main logic functions, servo control, program and constant data memory, and power distribution. For more information, refer to the controller manual that came with your system.
3.2.1 Programming Pendant

The programming pendant (see Figure 4) is the primary user interface for the system and features a cross-shaped navigation cursor that reduces teaching time by 30 percent. The pendant has a 6.5-inch full color touch screen display (640 x 480 VGA) and provides a convenient Compact Flash slot for easy memory back-ups. The system uses the INFORM III robot language and a menu-driven interface to simplify operator interaction with the robot.

Most operator controls are located on the pendant, allowing the control cabinet to be mounted remotely. An optional on-line troubleshooting guide for expert system maintenance is also available on the pendant. By using the pendant, the operator can teach robot motion, and perform programming, editing, maintenance, and diagnostic functions. For more information, refer to the operator’s manual that came with your system.

Note: The programming pendant display goes into screen saver mode after a few minutes of inactivity. Press any key to restore screen.
**Figure 4** Programming Pendant

**Mode Selector Switch**  
The Mode Selector Switch allows the operator to select Remote, Play or Teach mode. In Remote mode, control of the system is transferred to the operator station. When Play or Teach is selected, the programming pendant controls system operation. When Play mode is selected on the programming pendant, the operator must also press the PLAY ENABLE button on the controller door to initiate Play mode.

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

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

**Emergency Stop (E-STOP)**  
Pressing the E-STOP button puts the controller in Emergency Stop 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, I-Cycle, or Auto
- System Status
  E-Stop, Stop, Running/Start, Hold, or Alarm
- Additional Pages (when applicable)

MAIN MENU Key
The MAIN MENU key returns the pendant display to the initial start-up menu. Use the cursor key or the touch screen to choose from the following menu options:

- JOB
  This option 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 option allows you to select the applications available to the controller.
- VARIABLE
  This option accesses the display and editing menu for the arithmetic variables and display of position variables.
- IN/OUT
  This option 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 option 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 option provides Version information for both hardware and software, Alarm History, and Monitoring Time.
- FD/CF
  This option accesses menu choices for FD (floppy disk) or CF (compact flash) program backup.
- SETUP
  This allows the user to set up system conditions and assign hot keys.
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.

FLASH MEMORY Slot
The compact FLASH MEMORY card slot allows for easy memory backups.

ENABLE Switch
The ENABLE switch (see Figure 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 removed, preventing further robot movement.

SERVO ON Key
When the pendant is in TEACH mode, The SERVO ON key turns servo power ON when the ENABLE switch is activated. When the pendant is in PLAY mode, the SERVO ON key turns servo power on.

![Image of Enable Switch]

**Figure 5** Enable Switch
3.3 MotoSweep O Transporter

The MotoSweep O robot transporter uses a servo-driven boom that provides overhead support and motion for a number of standard NX100 robots. The boom can be mounted on an off-set (c-frame), or a straight riser. The straight riser is typically preferred for welding applications, while the c-frame riser is preferred for machine tending applications. Mounting holes are provided at the end of the boom for optional robot wall mounting (restrictions apply), or for mounting required process control equipment.

The MotoSweep O robot transporter includes:

- C-frame or straight riser
- Boom arm (servo, fixed, or manual configuration)
- Heavy-duty drive assembly (for servo configuration)
- Motoman robot
- Robot Cables - 15 m (standard)
- External Axis cables 15 m (standard)

3.3.1 Optional Equipment

The following optional equipment is available for use with the MotoSweep O Servo:

- The Zone Ring (P/N 147680-1) defines three zones that activate dynamically with boom motion.
- The Stop Assembly (P/N 148235-1) works in conjunction with the robot’s soft limits to constrain boom rotation to 10-degree increments. A limit switch is built into the hard stop device to prevent the boom from damaging it.
- Fail-safe clips for ceiling-mounted robots (smaller - P/N 148473-1) (larger - PN 148473-2) to reinforce standard robot mounting hardware.
- The Feeder Assist Kit (P/N 149858-1) includes a constant torque, air-driven assist wire feeder, filter, lubricator, regulator (FRL), ON-OFF valve, support stand, and drum hood for a 20.4 inch diameter bulk wire drum. Standard drive rollers handle 0.045-inch wire. Wire feed “push” is controlled by regulating the air pressure. Wire feed speed is controlled by demand of the welding wire feeder. Maximum speed is 1200 IPM.
- The Conduit Kit for Miller (P/N 150589-1) is designed to be used with the remote assist feeder. The kit includes all conduit, connectors, and brackets required to deliver the weld wire from the assist feeder to the Miller feeder on the robot arm. Conduit length can be trimmed as required.
3.3.2 Transporter Configurations

See Table 3-1 for positioner kits. Figures 3-8 and 3-9 show available positioner configurations.

Table 3 MotoSweep O Transporter Kits

<table>
<thead>
<tr>
<th>Motoman P/N</th>
<th>Model</th>
<th>Available Robots</th>
</tr>
</thead>
<tbody>
<tr>
<td>149923-1</td>
<td>Transporter, MotoSweep O Servo C-Frame</td>
<td>HP20, HP20-6, EA1900N</td>
</tr>
<tr>
<td>149923-2</td>
<td>Transporter, MotoSweep O Servo C-Frame</td>
<td>HP50, HP50-20</td>
</tr>
<tr>
<td>149923-3</td>
<td>Transporter, MotoSweep O Servo Straight Riser</td>
<td>HP20, HP20-6, EA1900N</td>
</tr>
<tr>
<td>140023-4</td>
<td>Transporter, MotoSweep O Servo Straight Riser</td>
<td>HP50, HP50-20</td>
</tr>
<tr>
<td>148387</td>
<td>Transporter, MotoSweep O Manual</td>
<td>HP20, HP20-6, HP50-20, HP50, EA1900N</td>
</tr>
<tr>
<td>148388</td>
<td>Transporter, MotoSweep O Fixed</td>
<td>HP20, HP20-6, HP50-20, HP50, EA1900N</td>
</tr>
</tbody>
</table>

![MotoSweep O with C-Frame](image)

**Figure 6 MotoSweep O with C-Frame**

Table 4 MotoSweep O Ceiling Mount with C-Frame

<table>
<thead>
<tr>
<th>Robot Model</th>
<th>Working Range X</th>
<th>Working Range Z</th>
<th>Height HR</th>
<th>Height HB</th>
<th>Combined Work Range RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP20</td>
<td>1717 mm (67.6 in.)</td>
<td>2072 mm (81.6 in.)</td>
<td>1235 mm (48.6 in.)</td>
<td>2640 mm (103.9 in.)</td>
<td>3717 mm (146.3 in.)</td>
</tr>
<tr>
<td>HP20-6</td>
<td>1915 mm (75.4 in.)</td>
<td>2270 mm (89.4 in.)</td>
<td>1235 mm (48.6 in.)</td>
<td>2640 mm (103.9 in.)</td>
<td>3915 mm (154.1 in.)</td>
</tr>
<tr>
<td>HP50-20</td>
<td>3106 mm (122.3 in.)</td>
<td>3501 mm (137.8 in.)</td>
<td>750 mm (29.5 in.)</td>
<td>2640 mm (103.9 in.)</td>
<td>5106 mm (201 in.)</td>
</tr>
<tr>
<td>HP50</td>
<td>2046 mm (80.6 in.)</td>
<td>2441 mm (96.1 in.)</td>
<td>1117 mm (44 in.)</td>
<td>2640 mm (103.9 in.)</td>
<td>4046 mm (159.3 in.)</td>
</tr>
<tr>
<td>EA1900N</td>
<td>1904 mm (75 in.)</td>
<td>2259 mm (88.9 in.)</td>
<td>1155 mm (45.5 in.)</td>
<td>2640 mm (103.9 in.)</td>
<td>3904 mm (153.7 in.)</td>
</tr>
</tbody>
</table>
**Figure 7** MotoSweep O with Straight Riser

**Table 5** MotoSweep O Ceiling Mount with Straight Riser

<table>
<thead>
<tr>
<th>Robot Model</th>
<th>Working Range X</th>
<th>Working Range Z</th>
<th>Height HR</th>
<th>Height HB</th>
<th>Combined Work Range RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP20</td>
<td>1717 mm (67.6 in.)</td>
<td>2072 mm (81.6 in.)</td>
<td>1175 mm (46.3 in.)</td>
<td>2580 mm (101.6 in.)</td>
<td>3717 mm (146.3 in.)</td>
</tr>
<tr>
<td>HP20-6</td>
<td>1915 mm (75.4 in.)</td>
<td>2270 mm (89.4 in.)</td>
<td>1175 mm (46.3 in.)</td>
<td>2580 mm (101.6 in.)</td>
<td>3915 mm (154.1 in.)</td>
</tr>
<tr>
<td>HP50-20</td>
<td>3106 mm (122.3 in.)</td>
<td>3501 mm (137.8 in.)</td>
<td>690 mm (27.2 in.)</td>
<td>2580 mm (101.6 in.)</td>
<td>5106 mm (201 in.)</td>
</tr>
<tr>
<td>HP50</td>
<td>2046 mm (80.6 in.)</td>
<td>2441 mm (96.1 in.)</td>
<td>1057 mm (41.6 in.)</td>
<td>2580 mm (101.6 in.)</td>
<td>4046 mm (159.3 in.)</td>
</tr>
<tr>
<td>EA1900N</td>
<td>1904 mm (75 in.)</td>
<td>2259 mm (88.9 in.)</td>
<td>1095 mm (43.1 in.)</td>
<td>2580 mm (101.6 in.)</td>
<td>3904 mm (153.7 in.)</td>
</tr>
</tbody>
</table>
Figure 8 MotoSweep O Wall Mount with C-Frame Riser

Table 6 MotoSweep O Wall Mounted with C-Frame Riser

<table>
<thead>
<tr>
<th>Robot Model</th>
<th>Working Range X</th>
<th>Working Range Z</th>
<th>Height HB</th>
<th>Combined Work Range RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP20</td>
<td>2072 mm (81.6 in.)</td>
<td>1717 mm (67.6 in.)</td>
<td>2915 mm (114.8 in.)</td>
<td>4032 mm (158.7 in.)</td>
</tr>
<tr>
<td>HP20-6</td>
<td>2270 mm (89.4 in.)</td>
<td>1915 mm (75.4 in.)</td>
<td>2915 mm (114.8 in.)</td>
<td>4230 mm 166.5 in.)</td>
</tr>
<tr>
<td>EA1900N</td>
<td>2259 mm (88.9 in.)</td>
<td>1904 mm (75 in.)</td>
<td>2915 mm (114.8 in.)</td>
<td>4219 mm (166.1 in.)</td>
</tr>
</tbody>
</table>
Figure 9 MotoSweep O Wall Mount with Straight Riser

Table 7 MotoSweep O Wall Mounted with Straight Riser

<table>
<thead>
<tr>
<th>Robot Model</th>
<th>Working Range X</th>
<th>Working Range Z</th>
<th>Height HB</th>
<th>Combined Work Range RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP20</td>
<td>2072 mm (81.6 in.)</td>
<td>1717 mm (67.6 in.)</td>
<td>2855 mm (112.4 in.)</td>
<td>4032 mm (158.7 in.)</td>
</tr>
<tr>
<td>HP20-6</td>
<td>2270 mm (89.4 in.)</td>
<td>1915 mm (75.4 in.)</td>
<td>2855 mm (112.4 in.)</td>
<td>4230 mm (166.5 in.)</td>
</tr>
<tr>
<td>EA1900N</td>
<td>2259 mm (88.9 in.)</td>
<td>1904 mm (75 in.)</td>
<td>2855 mm (112.4 in.)</td>
<td>4219 mm (166.1 in.)</td>
</tr>
</tbody>
</table>

3.3.3 MotoSweep O Specifications

Table 8 MotoSweep Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MotoSweep Velocity</td>
<td>6.7 rpm</td>
</tr>
<tr>
<td>Servo Boom Rotation</td>
<td>± 180 degrees</td>
</tr>
<tr>
<td>Boom Orientation (for manual and fixed booms)</td>
<td>360 degrees in 10-degree increments</td>
</tr>
<tr>
<td>Sweep (manual boom only)</td>
<td>150 degrees from locked position</td>
</tr>
<tr>
<td>Motor Speed</td>
<td>2000 rpm</td>
</tr>
<tr>
<td>Repeatability (temperature-controlled environment)</td>
<td>± 0.10 mm</td>
</tr>
<tr>
<td>E-Stop Time (typical with UP50)</td>
<td>0.25 seconds</td>
</tr>
<tr>
<td>E-Stop Distance (typical with UP50)</td>
<td>5.5 degrees</td>
</tr>
</tbody>
</table>
3.4 Safety Features

The user is responsible for safeguarding and verifying that safeguards are adequate for plant conditions per ANSI/RIA R15.06-1999 Robot Safety Standard. Users must also ensure that safeguards are maintained in working order. If you need assistance, contact Motoman Customer Service.

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.

3.4.1 ENABLE Switch

The ENABLE switch on the Teach pendant, 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. However, should the operator release the switch or grasp it too tightly, servo power is immediately removed, preventing further robot movement. For detailed information about the operation of the ENABLE switch, refer to the controller manual that came with your system.

3.4.2 Brake Release

**WARNING!**

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

The robot brakes are designed to protect the robot and other system components from damage in event of a system or robot failure. The brake release is a safety feature that allows the operator to release the brake of a specific robot axis when drive power has been removed from the system. Use the programming pendant to access the brake release function. Refer to paragraph 5.3.4 for brake release procedures.

3.4.3 Emergency Stops (E-STOPs)

In addition to the safety features described above, the MotoSweep O 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 following is a list of E-STOP locations:

- The controller door
- The programming pendant
Notes
Chapter 4
Installation

Typically, this transporter is shipped with the robot mounted on the boom. If not, installation must be completed by a Motoman technician. For more information, contact the Motoman service department at (937) 847-3200.

Installation of MotoSweep O should be performed by personnel who are familiar with this Motoman product. 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 MotoSweep O transporter is not a task for the novice. The transporter 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 hardware necessary for installing the MotoSweep O transporter is included with the system. This section identifies customer-supplied items and tools required to complete installation.

4.1.1 Customer-Supplied Items

- Incoming power supply to controller – 240/480/575 volts
- Internal air lines for manual/fixed configuration.

4.1.2 List of Tools

- Safety glasses
- Gloves
- Level
- Ratchet with 3/4-inch socket
- Adjustable wrench set
- Phillips and flat screwdrivers
- Socket set
- Forklift and/or overhead crane
- Air-impact gun with 3/4-inch socket
- Open-end wrench set
- Wrench sets (standard and metric)
- 255 N•m (188 ft. lb) torque wrench
4.2 Site Preparation

The MotoSweep O transporter is shipped on two wooden shipping pallets. The riser is shipped on one pallet and the boom with robot are shipped on a second pallet. Six configurations are available:

- Servo boom with C-frame riser base
- Servo boom with straight riser base
- Fixed boom with C-frame riser base
- Fixed boom with straight riser base
- Manually movable boom with C-frame riser base
- Manually movable boom with straight riser base

All configurations are shipped partially assembled, with the drive assembly/adaptor plate mounted on the riser base, robot mounted on the boom arm, and cables partially installed. The user must install the base riser, install the boom arm on the riser and route and connect the cables.

4.2.1 Recommended Foundation

The MotoSweep O transporter must be firmly mounted on a concrete floor with sufficient thickness and composition to support its static and dynamic forces.

1. Prepare the foundation for a C-frame configuration as instructed in the foundation diagram located in Appendix A.

   ![Note: If you are installing a MotoSweep with a straight riser configuration, center the embedded anchor plates in the foundation, not offset as shown in the foundation diagram in Appendix A.]

2. Allow foundation to cure for 21 days.

3. The floor space needed for MotoSweep O varies depending upon the robot used and the type of riser base selected for the application. Figure 4-1 illustrates the area needed to install the robot and positioner with a C-frame riser base. If the straight riser base is used, ignore the 1005-mm (39.5-in.) offset dimension, as the boom will be mounted directly on top of the straight riser and will not be offset 1005 mm (39.5 in.) from the center of the base.
Figure 10 Area Needed for Installation

Table 9 Area Needed

<table>
<thead>
<tr>
<th>Robot Model</th>
<th>Combined Work Range RC (Ceiling Mount)</th>
<th>Combined Work Range RC (Wall Mount)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP20</td>
<td>3717 mm (146.3 in.)</td>
<td>4032 mm (158.7 in.)</td>
</tr>
<tr>
<td>HP20-6</td>
<td>3915 mm (154.1 in.)</td>
<td>4230 mm (166.5 in.)</td>
</tr>
<tr>
<td>EA1900N</td>
<td>3904 mm (153.7 in.)</td>
<td>4219 mm (166.1 in.)</td>
</tr>
<tr>
<td>HP50-20</td>
<td>5106 mm (201 in.)</td>
<td>N/A</td>
</tr>
<tr>
<td>HP50</td>
<td>4046 mm (159.3 in.)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

4.2.2 Existing Floor Installation

⚠️ CAUTION!
The customer is responsible for system stability when installed on an existing floor.

The MotoSweep O20/50NX can generate high overhung (pull-out) and torsional (twist) floor loads and therefore requires special anchoring considerations. The existing floor must provide sufficient ballast to keep the system upright and stable relative to the other equipment in the cell (machine tools, weld positioners, conveyors, etc.).
4.2.2.1 Anchoring and Floor Requirements:

Number of anchor holes: 12
Anchor hole diameter: 26mm (1”+)
Dynamic Load Rating, per anchor, minimum: 2040 kgf (4500 lbf)
Total System Weight, approximate: 3650 kgf (8050 lbf)
Bending Moment, Centered at Riser Base (c-frame): 75,000 Nm (55,300 lbf*ft)
Peak Torsional Moment, Centered at Riser Base (c-frame): 30,000 Nm (22,125 lbf*ft)
Grout: Use an epoxy-sand grout system

Contact your local Hilti representative if you need assistance identifying an anchor suitable for your floor. Contact Resource International, Inc. (www.resourceinternational.com) if you need assistance evaluating the structural capability of your floor.

4.2.2.2 Surface Preparation

Identify and mark out the riser base location. Use a concrete surface grinder to clean the existing floor. This will provide a clean, rough surface for the epoxy grout to lock and transfer the torsional loads to the floor.

Having procured the appropriate anchors and prepared the floor, continue on with the riser installation.

4.3 Installing the Riser Base

To install the MotoSweep O riser base, proceed as follows:

**WARNING!**
The positioner weighs 2000 kg (4400 lbs), make sure the lifting device used to move these objects are capable of safely handling this much weight.

1. Carefully remove protective plastic wrapping from riser base.
2. Gather all customer-supplied items and required tools listed in Section 4.1.
3. Inspect riser base for shipping damage.

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

4. Locate the metal shipping bands that fasten the riser base to the pallet.
**Figure 11** Metal Shipping Bands

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

5. Cut the bands securing the riser base to the skid.

**WARNING!**
The MotoSweep O C-frame riser with drive assembly weighs approximately 2600 kg (5730 lbs). The vertical riser with drive assembly weighs approximately 2300 kg (5070 lbs). Be sure that your lifting device is capable of handling this much weight or damage to the equipment or injury to personnel can result.

6. Install two M16 swivel eyebolts in the front two boom mounting holes in the drive assembly mounting plate. Hook 60-inch overhead sling straps to the swivel eyebolts and 72-inch sling straps to the cutouts in the side of the riser base (see Figure 4-2).

7. Raise the base upright on the wood shipping pallet.

8. Set the riser base in position on the foundation.

9. Secure the riser base as instructed in the foundation diagram located in Appendix A.

10. Use the four (4) jacking screws to level riser top plate and provide a 38 - 50 mm (1.5 - 2 inch) clearance for the grout.

11. Remove the cable connection plate (servo boom) or cable cover (manual/fixed boom) to gain access to the grout fill hole.

12. Fill gap underneath base with grout.
WARNING! Properly secure the riser base to the foundation before removing the lifting straps. C-frame riser can fall over if not properly secured.

13. Remove lifting straps.
14. Once the grout has cured, remove the jacking screws prior to final tightening of the anchor nuts (see foundation drawing in Appendix A).

4.4 Installing the MotoSweep O Boom

To install the MotoSweep O boom and robot on the riser base, proceed as follows:

1. Carefully remove protective plastic wrapping from boom and robot.
2. Inspect boom and robot for shipping damage.

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

3. If hoisting overhead, attach two 84-inch slings from lifting device to the boom’s front lifting eyes and two 60-inch slings to the boom’s rear lifting eyes (see Figure 4-3).

WARNING!
The MotoSweep O boom with a UP20 robot weighs approximately 750kg (1654 lbs). The boom with a UP50 robot weighs approximately 1050kg (2315 lbs). Be sure that your lifting device is capable of handling this much weight or damage to the equipment or injury to personnel can result.

WARNING!
Make sure the boom is securely supported by the lifting device before attempting to remove the boom from the shipping brackets or serious damage to equipment or injury to personnel can result.

4. The boom and robot are secured to the shipping pallet with four yellow shipping brackets. See Figure 4-3. In addition, the upper robot arm is secured to the lower arm with a yellow shipping bracket.
5. Using the lifting device, lift the boom and robot assembly.

Note: Add shackles at the overhead crane hook as necessary to ensure the assembly is level (with robot slightly higher) as it is lifted.

6. Using a suitable wrench, remove the 4 M16 bolts that fasten the rear of the boom to the shipping brackets. See Figure 4-3.
7. Using a suitable wrench, remove the four M16 bolts that fasten the front of the boom to the shipping brackets. See Figure 4-3.
Figure 12  Shipping Brackets and Bolts

8. Position the boom and robot assembly over the drive assembly mounting plate, making sure to stay clear of drive motor and robot cables. See Figure 4-4.
Figure 13 Installing the Boom (MotoSweep O Servo Shown)

CAUTION!
To avoid damage to robot cables and air hoses which extend through the positioner servo motor, move them safely out of the way during boom installation.

9. Align the three (3) rear (inside) mounting bolts on the boom and loosely install three (3) M16 X 45 socket head cap screws with three (3) conical washers.

10. Loosely install the ten (10) remaining M16 X 45 socket head cap screws and ten (10) conical washers in the right and left sides of the boom.

11. Torque the 13 M16 screws to 125 N • m (92 lb. ft) per torque sequence shown in Figure 4-5. Then torque the 13 M16 screws to 255 N • m (188 lb. ft) per torque sequence. Remove covers as necessary to access bolts.

Note: The manual and fixed boom configurations are adjustable in 10-degree increments. If the factory-set orientation is not suitable for your application, refer to detailed adjustment procedures in Sections 6.4 and 6.5.

12. Remove yellow shipping bracket from robot upper and lower arm.
13. The boom is now fully supported on the riser base. Lower the lifting device and remove the four (4) slings from the boom eye plates.

4.5 Connecting the Controller Cables

After components are level and securely in place, unwrap the cables and connect them according to the cable diagram included in the system drawing package. All cables are labeled to match the labels at the connection points.

4.5.1 Connecting the Cables (MotoSweep O Servo)

In the servo configuration, the robot-controller cables are shipped pre-installed in the MotoSweep riser. Unpack controller/robot cables. Use Table 10 to identify cables.
Table 10  Robot Cable Connections

<table>
<thead>
<tr>
<th>MotoSweep O 20</th>
<th>MotoSweep O 50</th>
<th>Cable Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1BC-A</td>
<td>1BC-A</td>
<td>Robot encoder communication</td>
</tr>
<tr>
<td>2BC-A</td>
<td>2BC-A</td>
<td>Robot motor power and brakes</td>
</tr>
<tr>
<td></td>
<td>3BC-A</td>
<td>Robot motor power and brakes</td>
</tr>
<tr>
<td>CA-25</td>
<td>CA-25</td>
<td>MotoSweep motor power and brakes</td>
</tr>
<tr>
<td>CA-26</td>
<td>CA-26</td>
<td>MotoSweep encoder cables</td>
</tr>
</tbody>
</table>

Smaller Robots (HP20)
Two cables (1BC and 2BC) connect the robot to the controller. The 1BC cable provides communication between the controller and the robot. The 2BC cable supplies power to the robot servo motors.

Larger Robots (HP50)
Three cables (1BC, 2BC, and 3BC) connect the robot to the controller. The 1BC cable provides communication between the controller and the robot. The 2BC and 3BC cables supply power to the robot servo motors.

⚠️ CAUTION!
Route cable carefully to avoid wire breakage and unnecessary interruption of cell operation.

1. Unpack programming pendant and plug connector into receptacle on front door of controller.
2. Route controller end of cables from the riser to the controller.
3. Carefully engaging connectors, connect one end of each cable (labeled 1BC, 2BC, etc.) to the connections on side of controller.
4. Route robot end of cables through the boom to the robot. Use the saddle clamps (2) in the top of the boom to provide strain relief for the cables.
5. If the robot is ceiling-mounted, remove rear access panel on the bottom of boom and route cables through the opening in the front access panel.

6. If the robot is wall-mounted, remove access panel on top of boom and route cables through this opening.

7. Carefully engaging connectors, connect one end of each cable (labeled 1BC, 2BC, etc.) to the connections on back of robot.
Figure 16  Robot Connections
4.5.2 Removing the Robot Shipping Bracket

CAUTION!
Failure to remove shipping brackets from robot before operating the MotoSweep O may result in damage to the robot drive mechanisms.

A yellow bracket (see Figure 17) prevents the robot from moving during shipping. The bracket secures the lower arm assembly to the S-axis housing. After the robot is in place, remove the shipping bracket.

![Figure 17 Location of Shipping Brackets](image)

4.6 Connecting the Power

After all of the system components have been properly installed, connect the power to the MotoSweep O transporter as follows:

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

1. Install 3-phase power wiring to the fused service disconnect located in the controller. Table 5 shows size and type of wire needed.
2. Tighten screws to the torque indicated in Table 11.
3. Install an M5 lug on incoming ground wire.
4. Terminate ground wire to frame ground stud with hardware provided.
Note: MotoSweep O is configured for 3-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 electrical diagrams that came with your system.

Table 11 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</td>
</tr>
<tr>
<td></td>
<td>#12-8 Aluminum</td>
</tr>
<tr>
<td>Torque</td>
<td>#14-7, 4.0 N•m (35 lb-in.)</td>
</tr>
</tbody>
</table>

4.7 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 the yellow shipping bracket has been removed from the robot (see Section 4.3.1).
2. Check that safeguards have been installed and are adequate for plant conditions per ANSI/RIA R15.06-1999 Robot Safety Standard.
3. Verify that incoming line power matches the input power specified on the sticker on the front of the NX100 controller.

Your MotoSweep O is now ready for power-up. This 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.

4. Check all system E-STOPS (pendant, op-station, controller door).
5. Check system Hold buttons.

4.8 Installation of Tooling and Fixtures

Your MotoSweep O transporter 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 transporter for proper operation.
Chapter 5
Operation

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. For additional programming instructions, refer to the controller and operator manuals that came with your system.

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).

5.2 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 (see Section 5.2.1).
- Perform Shutdown Procedures (see Section 5.2.5)

5.2.1 Start-Up

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

1. Set MAIN POWER switch on NX100 controller to ON.
2. Make sure E-STOP buttons on programming pendant and controller door are released.
3. Select TEACH mode on programming pendant.
4. Place system in Home position or other dedicated start position.
5.2.2 Home Position

To move the robots to the Home position:

1. Select TEACH mode on the programming pendant.
2. Select MAIN MENU on programming pendant touch screen.
3. Select JOB on programming pendant touch screen.
4. Select SELECT JOB on programming pendant touch screen. A job list appears on the screen.
5. Using cursor keys, move cursor to Home job and press SELECT. The job appears on display screen.
6. Turn servo power ON by pressing SERVO ON and holding in the ENABLE switch.
7. Use the FWD button on programming pendant to jog robots to Home position.

The MotoSweep O cell is now ready for operation.

5.2.3 Shutdown

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

1. Make sure robot is in Home position.
2. Turn off system servo power by pressing E-STOP button on controller door or programming pendant.
3. Select TEACH mode on the programming pendant.
4. Set controller Main Power switch to OFF position.

MotoSweep O is now shut down.

5.3 System Recovery

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

5.3.1 Alarms and Errors

Alarms and errors will cause the current job 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 operator’s manual that came with your system.

5.3.1.1 Error Messages

These are simple errors such as pressing the START button when the robots are not in PLAY mode, or enabling the programming pendant when servo power is off. Clear these errors by pressing the CANCEL button on the programming pendant.
5.3.1.2 Minor Alarms

Minor alarms are usually programming errors. Minor alarms might occur if a circle has been programmed with fewer than three circular points, etc. Clear these errors by pressing the CANCEL button on the programming pendant.

5.3.1.3 Major Alarms

Major alarms are hardware failures. Major alarms might occur because of a servo tracking error or an abnormal speed. 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 E-STOP button on an operator station, programming pendant, or controller door.

To restart the MotoSweep O 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 E-STOP button on operator station, programming pendant, or controller door.

CAUTION!

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

2. Press SERVO ON button on operator station or programming pendant.
3. Ensure operator station is enabled.
4. Press START button on the operator station.

MotoSweep O is now ready to continue operation.

5.3.3 Brake Release

The robot brakes are designed to protect the robot and other system components from damage in event of a system or robot failure and loss of drive power. If a system or robot failure occurs, it will be necessary to release the brakes on the robot to move it. To release the brakes, proceed as follows:

WARNING!

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

1. On the programming pendant, select TEACH mode and turn servo power OFF.
2. Select ROBOT on the programming pendant touch screen.
3. Select the MANUAL BRAKE RELEASE option.
4. A Warning dialog appears. Select YES in the warning dialog box.
5. Select the axis to be released using the cursor key.
6. Engage the ENABLE switch and press the Interlock and Select keys.
7. The brake for the selected axis releases.
Chapter 6
Maintenance

Maintenance of the MotoSweep O components should be performed by authorized personnel who are familiar with the design and construction of this positioner. The following procedures should be performed only as needed. Read through the instructions completely before performing any maintenance procedure. Be sure that you understand the procedure, have the proper tools, and observe all applicable safety precautions.

⚠️ DANGER!
Ensure power is off before performing the following procedures. Observe standard lockout/tagout practices.

6.1 Spare Parts

When a part malfunctions, it is helpful to have replacement parts in stock for quick replacement. Table 6-1 lists the recommended spare parts with Motoman part numbers. Motoman recommends the following parts be kept on hand:

⚠️ DANGER!
Always use Motoman spare parts when servicing your positioner. Use of non-Motoman parts may void your warranty and may result in machine malfunction, machine damage, or injury to personnel.

Table 12 Recommended Spare Parts

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Motoman P/N</th>
<th>Recommended Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12 Conical Spring Washer</td>
<td>471075-1</td>
<td>4</td>
</tr>
<tr>
<td>M16 Conical Spring Washer</td>
<td>132049-1</td>
<td>2</td>
</tr>
<tr>
<td>Brake pad</td>
<td>150002-1</td>
<td>2</td>
</tr>
<tr>
<td>Stripper bolts (brake)</td>
<td>148385-2</td>
<td>4</td>
</tr>
<tr>
<td>Battery, 3 V, lithium</td>
<td>479348-1</td>
<td>1</td>
</tr>
<tr>
<td>Fuse, 10 Amp AttDr</td>
<td>133653-3</td>
<td>1</td>
</tr>
<tr>
<td>Limit Switch</td>
<td>143963-1</td>
<td>1</td>
</tr>
</tbody>
</table>
6.2 Ordering Parts

Contact the Motoman service staff at 937.847.3200 to order spare parts. Please have the following information ready before you call:

- Machine type (Positioner)
- Machine Name (MotoSweep O)
- Motoman Part No.
- Part(s) name
- Number of parts

Place your order with: Motoman Customer Service
Telephone: (937) 847-3200
Telefax: (937) 847-3211

6.3 Drive Motor Maintenance

The servo drive motor is virtually maintenance free. If the servo motor is physically damaged due to a load collision or misuse, or if there is grinding or excessive noise, contact Motoman Service Department at (937) 847-3200.

Note: Maintenance on the motor and reducer are not recommended for field service. The unit should be returned to Motoman for repairs to these components.
### 6.4 Resetting the Positioner To Home Position (Servo)

Resetting the MotoSweep O servo to Home position is typically done after initial installation or after the servo motor has been serviced.

To reset Home position, proceed as follows:

1. Place robot in TEACH MODE and slowly jog boom until homing pin hole on boom mounting plate is accessible (within the homing notch).
2. Install homing pin into homing pin hole. The pin may need to be tapped in with a hammer.
3. Jog the boom slowly until homing pin is just touching edge of notch in riser top plate. If you jog the positioner too far, the pin will bend, causing an inaccuracy. Slowly jog the boom in reverse until pin straight, but still touching the edge of the notch.
4. Place the programming pendant in MAINTENANCE MODE.
5. Press the TOP MENU key on the programming pendant.
6. Cursor to ROBOT and press SELECT.
7. Cursor to HOME POSITION and press SELECT.
8. Press the PAGE OVER key to the desired station (indicated in the top right corner).

9. Make sure the boom is in the position that you want to teach as Home and press SELECT.
10. Cursor to YES and press SELECT. The boom is now reset to zero.
11. Remove the homing pin from the boom mounting plate.

*Figure 18 Home Position*
6.5 Inspecting/Replacing Brake Pads

To determine brake pad wear, proceed as follows:

1. Remove the lower boom access panel closest to the riser base. The two (2) brake assemblies are located on the drive assembly mounting plate inside the boom. See Figure 19.

![Figure 19 Location of Brake Assemblies](image)

2. On each brake assembly, measure the gap between the brake pad and weldment plate.

3. If gap is more than 5 mm (0.2 inches), replace brake pad.

![Figure 20 Brake Pad Replacement](image)
Replace brake pad as follows:

1. Order replacement brake pads and stripper bolts, as necessary. See Sections 6.1 and 6.2, for ordering part replacements.
2. To replace the brake pad/stripper bolts, remove the brake assembly by removing the two (2) M12 bolts and one (1) M16 bolt that secure the brake assembly to the mounting plate.
3. Clamp the weldment plate in a vise.
4. Using a suitable punch, remove the spring retaining roll pins. You may need to depress the retaining washer with a screwdriver or pair of pliers.
5. Remove the retaining and tension spring washers. Take care to maintain the assembly sequence.
6. Loosen the vise, and re-clamp on the brake pad.
7. Remove the stripper bolts and discard.
8. Clamp the new pad in the vise for assembly.
9. Coat the new stripper bolts with EP Moly (black) grease before installation. Install both bolts and torque to 100 N•m (74 lbf•ft).
10. Confirm the bolt and brake assembly slide smoothly in the brake plate bores.
11. Clamp the lower part of the weldment plate in the vise.
12. Install the retaining and tension spring washers. Take care to maintain original sequence.
13. While depressing the retaining washer, tap the roll pins into final location.
14. Confirm smooth operation of the assembly. The best way is to use an arbor press to compress the tension springs (take care to keep the brake material free of grease). Alternatively, a vise may be used to compress the springs.
15. Before installation, vacuum accumulated brake dust from riser top.
16. Install the assembly using new conical spring washers with the mounting bolts (M12: PN 471075-1, M16: PN132049-1). Torque the M12 bolts to 100 N•m (74 lbf•ft) and the M16 bolts to 255 N•m (188 lbf•ft).
6.6 Repositioning the Fixed Boom (Non-Servo)

The MotoSweep O fixed boom orientation is factory set. If this orientation is not suitable for your application, reposition the boom as follows:

1. Turn servo power OFF.
2. Attach two 84-inch slings from a lifting device to the boom’s front lifting eyes and two 60-inch slings to the boom’s rear lifting eyes.

**WARNING!**
The MotoSweep O boom arm with a UP20 robot weighs approximately 750kg (1654 lbs). The boom arm with a UP50 robot weighs approximately 1050kg (2315 lbs). Be sure that your lifting device is capable of handling this much weight or damage to the equipment or injury to personnel can result.

**WARNING!**
Make sure boom arm is securely supported by the lifting device before attempting to loosen the M16 bolts that secure the boom to the riser base. Serious damage to equipment or injury to personnel can result.

3. Using a suitable wrench, remove the 12 M16 bolts that fasten the boom to the riser base. See Figure 21.

![Figure 21 Repositioning the Fixed Boom](image)

4. Using the overhead lifting device, move the boom to the new position. The boom can be repositioned in increments of 10 degrees around the base.
5. Once boom is in the desired position, replace the M16 bolts and torque to 255 N • m (188 lb. ft).
6. Remove slings straps from boom.
6.7 Repositioning the Manual Boom (Non-Servo)

To rotate the manually adjustable MotoSweep O boom for maintenance and tooling changes, proceed as follows:

1. Turn servo power OFF.
2. Using a suitable socket or hand wrench, loosen and remove the four M16 bolts (two bolts on each side) that lock the boom to the hard stops. See Figure 22.

![Diagram of stabilizing bolts and hard stops](image)

**Figure 22** Repositioning the Fixed Boom

3. Loosen the two stabilizing bolts. See Figure 6-5. The boom can now rotate up to 150 degrees for maintenance or tooling changes.
4. Once maintenance procedures are complete, rotate the boom back to its Home position.
5. Tighten the four M16 bolts removed in Step 2. Torque to 255 N • m (188 lb. ft).
6. Tighten stabilizing bolts.

To move the manual boom to a permanent new position, follow steps 1 - 4 to loosen M16 bolts and stabilizing bolts. Rotate boom to new position.

7. Once boom is in desired position, loosen and remove the eight (8) M20 bolts that mount the two (2) hard stops to the riser top plate.
8. Move the two (2) hard stops to the new position (180 degrees apart). Install the eight (8) M20 bolts and torque to 370 N • m (273 lb. ft).
9. Follow steps 5 and 6 above to secure the boom to the hard stops in the new position.
6.8 Troubleshooting

Table 6-2 identifies common problems that could occur. To troubleshoot your system, identify the type of problem and look for it in the PROBLEM column. Next to this column is a list of PROBABLE CAUSES and CORRECTIVE ACTIONS.

Be aware that sometimes more than one problem can occur at the same time. After identifying and resolving a problem, test the system thoroughly to make sure no other problems exist.

**Table 13 Troubleshooting**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No positioner movement</td>
<td>Loose connection</td>
<td>Check all wire connections.</td>
</tr>
<tr>
<td></td>
<td>Incorrect wiring</td>
<td>Check that system has been wired correctly.</td>
</tr>
<tr>
<td></td>
<td>Overload</td>
<td>Reduce load and re-check. Repeat until problem stops.</td>
</tr>
<tr>
<td>Unstable operation</td>
<td>No brake operation</td>
<td>If positioner movement is unstable, check brakes and replace if necessary (see Section 6.7).</td>
</tr>
<tr>
<td></td>
<td>Loose mounting</td>
<td>Check all mounting bolts and tighten as needed.</td>
</tr>
<tr>
<td>Motor overheats</td>
<td>Excessive ambient temperature</td>
<td>Reduce ambient temperature below 45° C (104° F). Positioner has an operating range of 0 to 45° C (32 to 113°F).</td>
</tr>
<tr>
<td></td>
<td>Motor surface is dirty</td>
<td>Clean motor surface.</td>
</tr>
<tr>
<td></td>
<td>Motor overloaded</td>
<td>Check motor connections and correct as needed.</td>
</tr>
<tr>
<td>Unusual noise</td>
<td>Motor is going bad</td>
<td>Call Motoman service.</td>
</tr>
<tr>
<td></td>
<td>Brakes</td>
<td>Inspect/replace the brake pads (see Section 6.5).</td>
</tr>
</tbody>
</table>
Appendix A

Anchor Requirements
Appendix B
Illustrated Parts List

B.1 Introduction

The Illustrated Parts List identifies, describes, and illustrates detail parts of the main assemblies for the MotoSweep O positioner manufactured by Motoman.

This list provides parts identification and descriptive information for use in provisioning, requesting, purchasing, storing, and issuing spare parts.

B.1.1 Explanation of Parts List

Contents

The parts list contains a breakdown of the equipment into detail parts. All parts of the equipment are listed except the following:

1. Standard hardware items (attaching parts) such as nuts, screws, washers, etc., which are available commercially.
2. Bulk items such as wire, cable, sleeving, tubing, etc., which are also commercially available.
3. Permanently attached parts which lose their identity by being welded, soldered, riveted, etc., to other parts, or assemblies.

Parts List Form

This form is divided into four columns as follows:

1. “Figure - Item Number” Column
   This Figure column lists the figure number of the illustration applicable to a particular parts list and also identifies each part in the list by an item number. These item numbers also appear on the illustration. Each item number on the illustration is connected to the part to which it pertains by a leader line and arrow. Thus, the figure and item numbering system ties the parts list to the illustrations and vice versa.
2. “Motoman Part Number” Column
   All part numbers appearing in this column are Motoman part numbers.
3. “Description” Column
   The item nomenclature appears in this column.

4. “QTY” Column
   This column indicates the quantity of parts required for an assembly or subassembly in which
   the part appears. This column does not necessarily reflect the total used in the complete end
   item.

B.2 Parts List

B.2.2 Explanation of Parts List Arrangement

The parts list is arranged so that the illustration will appear on left-hand page and the applicable
parts list will appear on the opposite right-hand page. Unless the list is unusually long, the user will
be able to look at the illustration and read the parts list without turning a page.

B.2.3 Symbols and Abbreviations

The following is a list of symbols and abbreviations used in the parts list.

amp – ampere
AC – alternating current
cyl – cylinder
DC – direct current
fig – figure
hex – hexagon
ID – inside diameter
in. – inch
m – meter
mm – millimeter
No. – number
psi – pounds per square inch
v – voltage
<table>
<thead>
<tr>
<th>Item Number</th>
<th>Motoman P/N</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>147609-1</td>
<td>ARM, POSITIONER, MOTOSWEEP O</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>147938-1</td>
<td>COVER, ARM, SIDE</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>147308-1</td>
<td>COVER, ARM. UPPER</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>147939-1</td>
<td>COVER, ARM, END</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>148696-1</td>
<td>LABEL, MOTOSWEEP</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>148412-1</td>
<td>COVER, ARM LOWER</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>148413-1</td>
<td>COVER, ARM, LOWER</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>148417-1</td>
<td>DRIVE ASSY, MOTOSWEEP O (SEE FIGURE B-2)</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>147608-1</td>
<td>RISER, MOTOSWEEP O (C-FRAME)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>147608-2</td>
<td>RISER, MOTOSWEEP O (STRAIGHT)</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>148418-1</td>
<td>COVER, RISER, CABLE ENTRANCE</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>148419-1</td>
<td>COVER, ARM, CABLE EXIT</td>
<td>1</td>
</tr>
</tbody>
</table>
**Figure 23** Drive Assembly Exploded View

**Table 15 Parts List 148417-1 MotoSweep O Drive Assembly**

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Motoman P/N</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>146975-2</td>
<td>CAP, LOCKING, PINION</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>133970-3</td>
<td>LOCK, POWER, 22MM ID X 26MM OD</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>146973-1</td>
<td>GEAR, PINION, 45T</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>146974-1</td>
<td>HUB, LOCKING, PINION</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>142142-1</td>
<td>MOTOR, AC SERVO, SIGMA II, 4.5 KW</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>146098-1</td>
<td>PLATE, COVER, HOUSING</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>140568-4</td>
<td>SEAL, OIL, 130 X 160 X 14, VITON</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>146011-1</td>
<td>PLATE, MTG, DRIVE ASSY.</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>147610-1</td>
<td>PLATE, ARM ASSY, MOTOSWEEP SERVO</td>
<td>1</td>
</tr>
</tbody>
</table>
### Table 15 Parts List 148417-1 MotoSweep O Drive Assembly

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Motoman P/N</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>149993-1</td>
<td>BRAKE, ASSY, FRICTION</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>146022-1</td>
<td>POST, MTG, DRIVE GEAR, RV</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>147611-1</td>
<td>PLATE, ADAPTOR, DRIVE ASSY</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>146009-1</td>
<td>REDUCER, RV, POSITIONER</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>146020-1</td>
<td>GEAR, DRIVE, 125T</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>146023-1</td>
<td>BEARING, BALL, 190 OD X 150 ID X 20</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>146010-1</td>
<td>HOUSING, CAST, POSITIONER, DRIVE ASSY</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>146024-1</td>
<td>BEARING, BALL, 37 OD X 25 ID X 7</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>146017-1</td>
<td>SPACER, IDLER GEAR</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>146019-1</td>
<td>GEAR, COMPOUND, 90/30 T</td>
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<td>20</td>
<td>146018-1</td>
<td>GEAR, IDLER, 60T</td>
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<td>21</td>
<td>146978-1</td>
<td>BEARING, ANGULAR, CONTACT, 25 ID</td>
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<td>22</td>
<td>146971-1</td>
<td>HUB, IDLER, BEARING</td>
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<tr>
<td>23</td>
<td>134438-4</td>
<td>RING, RETAINING, EXTERNAL</td>
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</tr>
</tbody>
</table>
Figure 24  Optional Zone Ring
### Table 16  Parts List Optional Zone Ring

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Motoman P/N</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>147937-1</td>
<td>PLATE, MTG, LIMIT SWITCH</td>
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</tr>
<tr>
<td>2</td>
<td>147612-1</td>
<td>ZONE RING</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>143963-1</td>
<td>SWITCH, LIMIT, MINIATURE, ROLLER ACTIVATED</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>147613-1</td>
<td>BRACKET, MTG, LIMIT SWITCH</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>143789-1</td>
<td>PLATE, MTG, SWITCH, THREADED</td>
<td>2</td>
</tr>
</tbody>
</table>
### Table 17  Parts List Optional Hard Stop

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Motoman P/N</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>143963-1</td>
<td>SWITCH, LIMIT, MINIATURE, ROLLER ACTUATED</td>
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</tr>
<tr>
<td>2</td>
<td>148238-1</td>
<td>CLAMP, SHAFT, HARD STOP</td>
<td>1</td>
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<td>3</td>
<td>148239-1</td>
<td>SHAFT, HARD STOP</td>
<td>1</td>
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<td>4</td>
<td>148236-1</td>
<td>ACTUATOR, HARD STOP</td>
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<td>5</td>
<td>130077-5</td>
<td>RING, RETAINING, EXTERNAL, 20 MM</td>
<td>1</td>
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<tr>
<td>6</td>
<td>148655-1</td>
<td>CORD ASSY, BUNGEEN, MOTOSWEEP LIMIT STOP</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>148531-1</td>
<td>POST, TENSION SPRING</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>148240-1</td>
<td>BLOCK, MTG, HARD STOP</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>148882-1</td>
<td>BLOCK, STOP, HARD</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>148883-1</td>
<td>BUMPER, STOP, HARD</td>
<td>2</td>
</tr>
</tbody>
</table>
Appendix C

Options Installation

C.1 Remote Assist WireFeeder Kit

The optional remote Wire Feeder Kit (149858-1) includes a remote assist feed motor designed to be located at the bulk wire container and push the wire through a lengthy conduit to the welding wire feeder. Conduit Kit (149862-1) is also available. The conduit kit starts at the assist feeder and terminates at the robot. Refer to your system drawings for additional information. To install the remote wirefeeder kit, proceed as follows:

1. Lag stand in desired location.
2. Position bulk wire drum and install hood.
3. Mount Assist Feeder and adjust stand so inlet of feeder sets on hood.
4. Connect air and adjust per Assist Feeder instructions.
5. Place a 180° tight bend in the wire end before feeding into the conduit. The smooth, rounded end will feed better than the sharp cut end.

Figure 25 Feeder Assist
C.2 Conduit Kit

1. Install the spring female quick disconnect (QD) fitting, as follows:
   a. Remove spring nut and slide onto blue conduit.
   b. Slide split ferrel onto conduit.
   c. Push female QD connector onto conduit until it bottoms out.
   d. Tighten spring nut on the female QD.
2. Feed female QD and blue poly conduit through cable entrance at base of riser.
3. Continue to feed conduit up the riser, through the boom, and out the appropriate boom opening (lower for ceiling mount and upper for wall mount). Do not allow conduit to kink.
4. Install cable bracket using existing connector plate screws.
5. Position and clamp conduit just above spring as required on the support bracket.
6. Trim length as required by bulk wire placement.
7. Install male QD in the same manner as the female QD, and connect with Assist Feeder.
8. Install Miller feeder adapter.
9. Install high flex conduit QD connector per spring QD connections and connect high flex conduit to blue conduit.
10. Trim high flex conduit as required and remove internal burrs.
11. Route high flex conduit to wire feeder, and secure as appropriate for application.
12. Install high flex conduit QD connector per spring QD connectors.
13. Connect high flex conduit to wire feeder adapter.

C.3 Installing the Hard Stop

To install the optional hard stop, proceed as follows:

1. Jog the boom to the desired stop (end of travel) position.
2. Slide one hard stop bracket into the opening between the top of the riser and boom mounting plate.
Figure 26 Hard Stop Bracket

3. Locate bracket at the stop position and position the bumper so that it faces the operating zone.

4. Secure the bracket to the top plate of the riser column with two (2) M20 head cap screws. Drop the screws through the access hole and jog the boom to facilitate access to tighten screws.

5. Torque screws to 100 N \( \cdot \) m (73.7 lb. ft).

Repeat steps 1-5 to install the second hard stop bracket.

6. Insert the hard stop assembly through the access hole in the boom and position on the drive assembly mounting plate.

7. Install four (4) M12 screws with conical washers through the flange in the hard stop housing and torque to 100 N \( \cdot \) m (73.7 lb. ft).

Figure 27 Hard Stop Assembly
8. Install tension spring posts with hex nuts to the boom flange.

![Diagram of tension spring posts and bungee cord]

**Figure 28 Bungee Cord**

9. Attach the spring hook ends of the two (2) bungee cord assemblies to the spring posts as shown in Figure 4-12.

10. Slip the loop of the bungee cord over the shoulder bolt.

11. Connect the limit switch Turck cable (PL34) on the main MotoSweep harness assembly to the hard stop limit switch. See Figure 4-10 for location of limit switch.

12. Reset the soft limits to appropriate values. Refer to Concurrent I/O and Parameters manual for instructions for resetting soft limits.

## C.4 Installing the Zone Ring

To install the optional zone ring, proceed as follows:

1. Install the limit switch mounting plate on the drive gear mounting post using four (4) M6 screws as shown in Figure 4-13.

2. Install the zone ring on the drive assembly mounting plate using four (4) M16 screws as shown in Figure 4-13.
3. Assemble two (2) limit switch assemblies as shown in Figure 4-14. A limit switch assembly consists of two (2) zone limit switches, one (1) limit switch mounting bracket, one (1) threaded switch mounting plate, and two (2) M5 screws and conical spring washers.

4. Mount the two (2) zone limit switch assemblies on the zone ring using four (4) M6 screws as shown in Figures 4-13 and 4-14. Locate as required for zoning.

5. Connect limit switch Turck cables (PL35 and PL36) on the main MotoSweep harness assembly to one set of zone limit switches.

6. Connect limit switch Turck cables (PL37 and PL38) to the other set of zone limit switches. See Figure 4-13 for location of connections.
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