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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:

CHAPTER 1 - INTRODUCTION
Provides general information about the MotoSweep O HD Transporter and its components, a list of reference documents, and customer service information.

CHAPTER 2 - SAFETY
Provides information regarding the safe use and operation of the MotoSweep O HD transporter.

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

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

CHAPTER 5 - OPERATION
Provides instructions for basic operation of the MotoSweep O HD 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.

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

APPENDIX A - FOUNDATION DIAGRAM
Provides a detailed diagram of the foundation requirements for the MotoSweep O HD 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 HD options.
1.2 Overview

The MotoSweep O HD Robot Transporter is designed for heavy-duty or extended-boom applications required for large material handling, machine loading, welding or spot welding applications. The MotoSweep O HD Robot Transporter uses the HD drive module. Refer to the Motoman HD Drive Module manual (P/N 151521-1) for more information.

The MotoSweep O HD Robot Transporter uses a servo-driven boom that provides overhead support and motion for a number of standard NX100 robots (see table). There are three standard boom configurations: 2-meter (HP200T), 2.75-meter (HP50/HP50-20), and 3.5-meter (HP50/HP50-20). The boom is combined with one of two optional riser kits (straight and offset) or a custom riser, as required. Mounting holes are provided at the end of the boom for mounting required process control equipment.

The basic system includes the HD Drive Module, one of three standard boom configurations, external axis kit, 20 meter external axis cables, drive mounting hardware, and 20 meter robot cables. Depending on boom length, this provides controller placement within approximately 12-15 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 HD transporter 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).

Note: Appendix A drawings are suitable for standard Motoman riser options (152554-1 and 152653-1). Contact Motoman Engineering if you are using a non-standard riser.

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 a typical system layout of the MotoSweep O HD transporter.
Note: This manual is for a standard Motoman system. If your system is a custom or modified system, please use the drawing and Bill of Material (BOM) provided with the system for troubleshooting and spares provisioning.
1.3 **Reference to Other Documentation**

For additional information refer to the following:

- Motoman HP200T Manipulator Manual (P/N 151172-1)
- Motoman HP50 Manipulator Manual (P/N 151170-1)
- Motoman HP50-20 Manipulator Manual (P/N 149465-1)
- Motoman HP50-35 Manipulator Manual (P/N 151171-1)
- Motoman HD Drive Module Instructions Manual (P/N 151521-1)
- 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 (HP200T, HP50, HP50-20)
- System Type (MotoSweep O HD transporter)
- 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).
NOTES
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 1 Robot Specifications

<table>
<thead>
<tr>
<th>Robot Model</th>
<th>Payload</th>
<th>Reach</th>
<th>Repeatability</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP200T</td>
<td>200 kg (440.9 lbs.)</td>
<td>2,416 mm (95.1 inches)</td>
<td>±0.2 mm (±0.008 inch)</td>
</tr>
<tr>
<td>HP50</td>
<td>50 kg (110.3 lbs.)</td>
<td>2,046-mm (80.6 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 (122.3 inches)</td>
<td>±0.15 mm (±0.006 inch)</td>
</tr>
<tr>
<td>HP50-35</td>
<td>35 kg (77.2 lbs.)</td>
<td>2,525 mm (99.4 inches)</td>
<td>±0.07 mm (±0.003 inch)</td>
</tr>
</tbody>
</table>

3.2 NX100 Controller

The NX100 robotic controller, shown in Figure 2, 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 HD 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 3) 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 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 2 NX100 Controller
Figure 3 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, 1-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 4) 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.

Figure 4  Enable Switch
3.3 MotoSweep O HD Transporter

The MotoSweep O HD 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 mounting required process control equipment.

The MotoSweep O HD robot transporter includes:

- HD Drive Module (150901-1)
- Boom arm
- Motoman robot
- Robot Cables - 20 m (standard)
- External Axis cables 20 m (standard)
- Drive mounting hardware

3.3.1 Optional Equipment

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

- Offset Riser Kit (P/N 152554-1)
- Straight Riser Kit (P/N 152653-1)
- Zone Ring (P/N 149821-1) defines three zones that activate dynamically with boom motion.
- Over-Travel Switch Assembly (P/N 149820-1) works in conjunction with the robot's soft limits to constrain boom rotation to 30-degree increments. **Warning! The Over-Travel option does not provide “Hard Stop” capability!**
- Ballast - available as an alternative to excavated foundation - quoted per application.
- 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.
- The Conduit Kit for Miller (P/N 150589-3) for HP50/HP50-20, 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

Table 2 MotoSweep O HD Transporter Kits

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<tr>
<td>152553-1</td>
<td>2.0 m</td>
<td>HP200T</td>
<td>2000 mm</td>
<td>2415 mm</td>
<td>3050 mm</td>
<td>1980 mm</td>
<td>4415 mm</td>
</tr>
<tr>
<td>152553-2</td>
<td>2.75 m</td>
<td>HP50</td>
<td>2750 mm</td>
<td>2046 mm</td>
<td>2440 mm</td>
<td>2507 mm</td>
<td>4796 mm</td>
</tr>
<tr>
<td>152553-2</td>
<td>2.75 m</td>
<td>HP50-20</td>
<td>2750 mm</td>
<td>3106 mm</td>
<td>3501 mm</td>
<td>2140 mm</td>
<td>5856 mm</td>
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<tr>
<td>152553-2</td>
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<td>HP50-35</td>
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<td>2923 mm</td>
<td>2230 mm</td>
<td>5275 mm</td>
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<td>152553-3</td>
<td>3.5 m</td>
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<td>2525 mm</td>
<td>2923 mm</td>
<td>2230 mm</td>
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Figure 5 MotoSweep O HD
3.3.3 **MotoSweep O HD Specifications**

<table>
<thead>
<tr>
<th>Table 3 MotoSweep Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>MotoSweep Velocity</td>
</tr>
<tr>
<td>Servo Boom Rotation</td>
</tr>
<tr>
<td>Settling Time*</td>
</tr>
<tr>
<td>Repeatability (temperature-controlled environment) combined robot and boom X, Y, Z **</td>
</tr>
<tr>
<td>Boom E-Stop Time (typical with HP50)</td>
</tr>
<tr>
<td>Boom E-Stop Distance (typical with HP50)</td>
</tr>
</tbody>
</table>

* Time required for the TCP “bounce” to settle within the repeatability band. Measurement condition: 100% approach velocity to via point, 4-inch creep at 20% velocity to repeatability pose point.

** Based on 1S5253-3 with HP50

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 HD 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
Chapter 4
Installation

Because MotoSweep O HD is a modular system, it is not possible for us to give you specific installation instructions for your system. Use the following instructions as guidelines along with your specific system prints. For additional information, refer to the vendor manuals supplied with your system.

Note: It is recommended that you thoroughly read both the Motoman and vendor manuals before proceeding with the installation.

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 HD 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.

DANGER!
Due to the extreme size and weight of this system (over 15,000 lbs), Motoman highly recommends the use of professional riggers during installation. For more information, contact the Motoman service department at (937) 847-3200.

DANGER!
At no time during installation or operation, should any person or persons be in position underneath the suspended load.

Installation of MotoSweep O HD 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.
4.1 Materials Required

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.
- System foundation and/or anchors

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 HD must be firmly mounted on a foundation rigid enough to support the static and dynamic forces. Due to the high overhung (pull-out) and torsional (twist) floor loads, Motoman highly recommends that you prepare your foundation as instructed in the foundation diagram located in Appendix A. Review drawing package for specifications. If you after reviewing your drawing package, you determine that your existing floor is suitable for installation, proceed to Section 4.2.1, "Existing Floor Installation".

To prepare your site, proceed as follows:

1. Prepare the foundation as instructed in the foundation diagram located in Appendix A.

   Note: Appendix A drawings are suitable for standard Motoman riser options (152554-1 and 152653-1). Contact Motoman Engineering if you are using a non-standard riser.

   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 HD 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.
4.2.1 Existing Floor Installation

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

The MotoSweep O HD 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.).
4.2.1.1 Anchoring and Floor Requirements:

The following anchoring and floor requirements are intended as an example for a 3.5 meter boom with HP50 robot and offset riser. You must evaluate the structural capability of your floor and determine the anchoring and floor requirements for your specific system.

- Number of anchor holes: 12 (high quality chemical anchors are recommended)
- Anchor hole diameter: 24 mm (1”+)
- Dynamic Load Rating, per anchor, minimum: 2040 kgf (4500 lbf)
- Total System Weight, approximate: 6900 kgf (15,212 lbf)
- Bending Moment, Centered at Riser Base (c-frame): 56,000 Nm (41,300 lbf*ft)
- Peak Torsional Moment, Centered at Riser Base (c-frame): 146,250 Nm (107,970 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.

4.2.1.2 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 riser base, proceed as follows:

1. Carefully remove protective shipping material 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. Lift the riser into place, using option 1 or 2.

WARNING!

The Motoman offset riser weighs approximately 3422 kg. The Motoman vertical riser weighs approximately 3276 kg. Be sure that your lifting device is capable of handling this much weight or damage to the equipment or injury to personnel can result.

Metal shot can be used to fill the riser and thereby stabilize the system. The addition of metal shot dramatically increases the weight of the riser and changes the center of gravity. Choose one of the following procedures depending on whether your riser uses metal shot fill.

**Option 1: Riser without Shot Fill**

Use suitable lifting hardware in the M20 holes in the top of the riser.
Option 2: Riser with or without Shot Fill

Insert suitable lifting bars through the 57 mm (2 1/4") holes in the riser sides.

5. Raise the base upright.
6. Set the riser base in position on the foundation and level as required using the jacking screws located in each corner.
7. Build a temporary grout dam around the riser base. We recommend using mold release, grease, or tape.
8. Remove riser and set aside.
9. If using cast-in anchors, protect the threads from grout with tape or plastic tubing.
10. Fill the base dam with grout.
11. Lower riser and allow grout to cure. Remove excess grout as appropriate.
12. Once grout has cured, loosen jacking screws to allow the riser to settle directly onto the grout.
13. Remove thread protection from anchor bolts
14. Tighten anchor nuts to final torque according to anchor requirements.
15. If anchoring to existing floor - install anchors.
16. Remove lifting straps.

4.4 Attaching the Transporter to the Riser

To attach the MotoSweep O HD transporter on the riser base, proceed as follows:

1. Carefully remove protective plastic wrapping from transporter.
2. Inspect transporter and drive module for shipping damage.

\*Note: If any equipment is damaged, notify the shipper immediately.
WARNING!
Refer to Figure 8 for transporter mass. Be sure your lifting device is capable of handling this much weight or damage to the equipment or injury to personnel can result.

3. Using a suitable wrench, remove the bolts that fasten the transporter to the shipping skid.

4. Using a suitable lifting device, lift the transporter assembly. Refer to Figure 8 for approximate Center of Gravity (CG) location.

Note: Add shackles at the overhead crane hook as necessary to ensure the assembly is level as it is lifted.

![Figure 7 Shipping Brackets and Bolts](image)

![Figure 8 Center of Gravity](image)

<table>
<thead>
<tr>
<th></th>
<th>A (mm)</th>
<th>B (mm)</th>
<th>C (mm)</th>
<th>Approximate Mass (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>152553-1 (2.0 meter)</td>
<td>624</td>
<td>1398</td>
<td>215</td>
<td>2625</td>
</tr>
<tr>
<td>152553-2 (2.75 meter)</td>
<td>853</td>
<td>1918</td>
<td>188</td>
<td>2740</td>
</tr>
<tr>
<td>152553-3 (3.5 meter)</td>
<td>1065</td>
<td>2456</td>
<td>170</td>
<td>2830</td>
</tr>
</tbody>
</table>
5. The robot and external axis cables are packed inside the transporter boom during shipping. Locate and unpack the cables from inside the boom.
6. Remove any protective packaging from the cables and inspect for damage.
7. Position the transporter over the riser mounting plate. See Figure 9.
8. Carefully route the robot and external axis cables into the hole in the top of the riser.

**WARNING!**
Make certain that the cables are strain relieved at both the top and bottom of the HD Drive module or damage to the cables can occur. Use the brackets provided in the drive module and boom.

Figure 9 Installing the Transporter

9. Align the drive base with the riser top using the two M20 X 60 dowel pins provided.
10. Loosely install the eighteen (18) M20 X 80 socket head cap screws and ten (18) conical washers.
11. Torque the 18 M20 screws to 490 N • m.
12. The transporter assembly is now fully supported on the riser base. Lower the lifting device and remove the slings from the boom eye plates.
4.5 Installing the Robot

**WARNING!**
The robot can weigh up to approximately 1300 kg. Be sure the lifting device used to lift the robot is capable of handling this much weight or damage to equipment, or injury to personnel can result.

To install the Robot on the transporter, proceed as follows:

1. Lift the robot and, if required, invert it. Orient the robot on the boom mounting plate per the system drawings. Contact Motoman if assistance is required to invert the robot.
2. Refer to the manipulator manual for instructions on attaching the robot to the mounting plate.

4.6 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.

4.6.1 Connecting the Cables

Unpack controller/robot cables. Use Table 5 to identify cables.

<table>
<thead>
<tr>
<th>Cable Connections</th>
<th>Cable Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1BC-A</td>
<td>Robot encoder communication</td>
</tr>
<tr>
<td>2BC-A</td>
<td>Robot motor power and brakes</td>
</tr>
<tr>
<td>3BC-A</td>
<td>Robot motor power and brakes</td>
</tr>
<tr>
<td>4BC-A</td>
<td>Process I/O</td>
</tr>
<tr>
<td>CA-25</td>
<td>MotoSweep motor power and brakes</td>
</tr>
<tr>
<td>CA-26</td>
<td>MotoSweep encoder cables</td>
</tr>
</tbody>
</table>

**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 the robot and external axis cables from inside the riser down along the cable track and 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. Robot cables are packed inside the transporter boom during shipping. Locate and unpack the cables from inside the boom and route robot end of cables to the robot.

5. Carefully engaging connectors, connect one end of each cable (labeled 1BC, 2BC, etc.) to the connections on back of robot.

Figure 11 Robot Connections
4.6.2 Removing the Robot Shipping Bracket

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

Yellow brackets (see Figure 12) prevents the robot from moving during shipping. These brackets secures the lower arm assembly to the S-axis housing. After the robot is in place, remove all shipping brackets. Refer to your manipulator manual for detailed information.

![Figure 12 Location of Shipping Brackets](image)

4.7 Connecting the Power

After all of the system components have been properly installed, connect the power to the MotoSweep O HD 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 6.
3. Install an M5 lug on incoming ground wire.
4. Terminate ground wire to frame ground stud with hardware provided.
Note: MotoSweep O HD 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 6  \(\text{Incoming Power Specifications (Decal)}\)

<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>

#### 4.8 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 shipping brackets have 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 HD 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.

#### 4.9 Installation of Tooling and Fixtures

Your MotoSweep O HD 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.
Notes
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 **System Home Position**

Refer to Section 6.4, "Resetting the Positioner To Home Position (Servo)" for instructions on how to adjust the transporter Home position.

To move the robot 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.
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 HD cell is now ready for operation.

5.2.3 **Shutdown**

Use the following procedure to shut down the MotoSweep O HD 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 teach pendant.
3. Select TEACH mode on the programming pendant.
4. Set controller Main Power switch to OFF position.

MotoSweep O HD 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 HD 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.
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 HD 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 MotoSweep O HD 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. Refer to the HD Drive Module Instructions manual (P/N 151521-1) for recommended spare parts and Motoman part numbers.

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.
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 HD drive 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.
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 stationary edge of drive module frame. If you jog the positioner too far, the pin will bend, causing an inaccuracy. Slowly jog the boom in reverse until pin is straight, but still touching the edge of the drive module frame.
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.
6.5 Inspecting/Adjusting Brake Pads

Refer to Section 4.5 of the HD Drive Module manual (P/N 151521-1).

6.6 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>
<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 HD Drive Module manual P/N 151521-1).</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>Brakes</td>
<td>Inspect/replace the brake pads (see HD Drive Module manual P/N 151521-1).</td>
<td></td>
</tr>
</tbody>
</table>
Appendix A

Anchor Requirements

The following drawing is suitable for the standard Motoman riser options (152554-1, and 152653-1). Contact Motoman Engineering if you are using a non-standard riser.
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 HD 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
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