Upon receipt of the product and prior to initial operation, read these instructions thoroughly and retain for future reference.

MOTOMAN INSTRUCTIONS
MOTOMAN-□□□ INSTRUCTIONS
NX100 INSTRUCTIONS
NX100 OPERATOR'S MANUAL
NX100 MAINTENANCE MANUAL

Part Number: 152565-2CD
Revision: 2
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 (RIA) by requesting ANSI/RIA R15.06-2012.

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
1.734.994.6088 (voice)
1.734.994.3338 (fax)
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 ROBOTIC SYSTEM 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.

MANDATORY

- This manual explains the MRM2-750-M3X SIGMA III. Read this manual carefully and be sure to understand its contents before handling the NX100 the the positioner.
- General items related to safety are listed in Chapter 1: Safety of the NX100 INSTRUCTIONS. To ensure correct and safe operation, carefully read the NX100 Instructions before reading this manual.
CAUTION

• Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.

• The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.

• YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.

• If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

• YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the NX100.

In this manual, the Notes for Safe Operation are classified as “WARNING”, “CAUTION”, “MANDATORY”, or “PROHIBITED”.

**WARNING**
- Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.

**CAUTION**
- Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

**MANDATORY**
- Always be sure to follow explicitly the items listed under this heading.

**PROHIBITED**
- Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

**NOTE**
- To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “CAUTION” and “WARNING”.

Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the playback panel or programming pendant are pressed. When the servo power is turned off, the SERVO ON READY lamp on the playback panel and the SERVO ON LED on the programming pendant are turned off.

Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

**Emergency Stop Button**

Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

**Release of Emergency Stop**

Always set the Teach Lock before entering the robot work envelope to teach a job.

Operator injury can occur if the Teach Lock is not set and the manipulator is started from the playback panel.

Observe the following precautions when performing teaching operations within the working envelope of the manipulator:
- View the manipulator from the front whenever possible.
- Always follow the predetermined operating procedure.
- Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

Confirm that no persons are present in the manipulator’s work envelope and that you are in a safe location before:
- Turning on the NX100 power
- Moving the manipulator with the programming pendant
- Running check operations
- Performing automatic operations

Injury may result if anyone enters the working envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems. The emergency stop button is located on the right side of both the NX100 playback panel and programming pendant.
CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
  - Check for problems in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the NX100 cabinet after use.

The programming pendant can be damaged if it is left in the P-point maximum envelope of the manipulator, on the floor, or near fixtures.

- Read and understand the Explanation of Warning Labels in the NX100 Instructions before operating the manipulator.
Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN usually consists of the manipulator, the controller, the programming pendant, and supply cables.

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX100 Controller</td>
<td>Controller</td>
</tr>
<tr>
<td>NX100 Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the NX100</td>
<td>Manipulator Cable</td>
</tr>
</tbody>
</table>

Descriptions of the programming pendant keys, buttons, and displays are shown as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td>Character Keys</td>
</tr>
</tbody>
</table>
|                           | The keys which have characters printed on them are denoted with [ ]. 
|                           | ex. [ENTER]                                            |
| Symbol Keys               | The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. 
|                           | ex. page key                                           |
|                           | The cursor key is an exception, and a picture is not shown. |
| Axis Keys Number Keys     | "Axis Keys" and "Number Keys" are generic names for the keys for axis operation and number input. |
| Keys pressed simultaneously| When two keys are to be pressed simultaneously, the keys are shown with a "+" sign between them, ex. [SHIFT]+[COORD] |
| Displays                  | The menu displayed in the programming pendant is denoted with ( ). ex. (JOB) |

Description of the Operation Procedure

In the explanation of the operation procedure, the expression "Select • • • " means that the cursor is moved to the object item and the SELECT key is pressed, or that the item is directly selected by touching the screen.

Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or brand names for each company or corporation. The indications of (R) and TM are omitted.
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1  Introduction

1.1  About This Document

This manual provides information about the MRM2–750–M3X SIGMA III positioner, and is organized as follows –

■ Chapter 1 – Introduction
Chapter 1 introduces this Positioner Manual, and provides an overview of the MRM2–750–M3X SIGMA III positioner, contact information for Motoman 24-Hour Customer Support, and a table of MRM2–750–M3X SIGMA III technical and operational specifications.

■ Chapter 2 – Safety
Chapter 2 provides general information regarding the safe installation, maintenance, and operation of the MRM2–750–M3X SIGMA III positioner.

■ Chapter 3 – Installation
Chapter 3 provides instructions and procedures for MRM2–750–M3X SIGMA III positioner installation and set-up.

■ Chapter 4 – Maintenance
Chapter 4 provides suggested basic and preventive maintenance procedures for the MRM2–750–M3X SIGMA III positioner.

■ Appendix A – Illustrated Parts List
Appendix A contains the Illustrated Parts List (IPL). The IPL provides detailed views (with part numbers) of MRM2–750–M3X SIGMA III positioner components.

■ Appendix B – Revision History
Appendix B contains the revision history of this manual.
1.2 Positioner Overview

The MRM2–750–M3X SIGMA III positioner can be used with a variety of applications that require precise parts movement. Typically, the MRM2–750–M3X SIGMA III positioner is integrated with a Motoman robot and controller in a work cell arrangement.

The MRM2–750–M3X SIGMA III positioner is a two station headstock/tailstock (HS/TS) positioner. Because of certain operational dynamics, this type of positioner is often referred to as a "Ferris wheel" positioner.

The main (sweep) axis and both tooling plate (orbital) axes are rotated by individual SIGMA III AC servomotors (working through gear reduction units) that are controlled by circuitry in the controller.

All three axes can be driven simultaneously during a sweep motion. In addition, movement of the MRM2–750–M3X SIGMA III positioner can be coordinated with robot motion to allow complex jobs such as the welding of circumferential joints.

Fig. 1-1: MRM2-750- M3X SIGMA III
The main drive swingarm, the tooling drive swingarm, and the arc shield rotate around a main (sweep) axis and are limited in rotation by hardstops located on the tooling drive swing arm.

Dual "in position" switches are mounted in the headstock housing (see Fig. 1-2). These provide switch closures, as a backup to encoder data, to indicate to safety circuitry whether or not the swingarm assemblies are in the correct and safe position after a positioner sweep.

Fig. 1-2: Main (Sweep) Axis — Side-A and Side-B "In Position" Safety Switches
A tooling plate multiple angle control feature allows the programmer to define the angle of the tooling presented to the operator (with a resolution of approximately 2.5°). This improves load station ergonomics and part tacking (see Fig. 1-3).

Fig. 1-3: Tooling (Orbital) Axis — Tooling Plate Multiple Angle Control Components

SECTION A-A
A Light Emitting Diode (LED) is installed at each end of the tooling drive swing arm. When illuminated (green), each LED indicates that the associated tooling plate has reached the desired, operator-selected rotation angle (see Fig. 1-4).

Fig. 1-4: Tooling ( Orbital ) Axis — Tooling Plate "In-Position" Indicators
All MRM2–750–M3X SIGMA III positioner tooling plates are fitted with the MotoMount™ flexible tool mounting system as the tooling interface (see Fig. 1-1 "MRM2–750–M3X SIGMA III" on page 1-2 and Fig. 1-3 "Tooling (Orbital) Axis — Tooling Plate Multiple Angle Control Components" on page 1-4).

Each AC servomotor incorporates a small Lithium-Ion “keep alive” battery pack that maintains servo positioning data in memory, should the main cables between the positioner and controller be disconnected. This battery pack is a part of each cable assembly (internal to the MRM2–750–M3X SIGMA III positioner) that connects each AC servomotor to its associated multi-pin plug on the positioner base (see Fig. 2-6 "MRM2–750–M3X Positioner — External Data / Power Connectors and Cables" on page 2-8). These battery packs have a very long life. However, if they drop below a certain charge level, a "low battery" indication appears on the Programming Pendant LCD display screen.

Refer to Table 1-1 "MRM2–750–M3X SIGMA III Positioner Technical and Operational Specifications" on page 1-9 for the MRM2–750–M3X SIGMA III positioner technical specifications.

1.2.1 MRM2–750–M3X SIGMA III Positioner Configuration

The MRM2–750–M3X SIGMA III positioner assembly is available in two configurations (–3 or –4). Both are identical except for some dimensional differences (see Fig. 2-1 "MRM2–750–M3X SIGMA III Positioner — Plan View" on page 2-2).

The main (sweep) axis AC servomotor is located at the tailstock end of the positioner, while the tooling (orbital) axis AC servomotors are located at the headstock end of the positioner. This configuration, along with other proprietary features, endow the MRM2–750–M3X SIGMA III positioner with an exceptional Total Index Time (refer to Table 1-1 "MRM2–750–M3X SIGMA III Positioner Technical and Operational Specifications" on page 1-9 for a complete listing of MRM2–750–M3X SIGMA III positioner specifications).

1.2.2 Welding Ground System

The MRM2–750–M3X SIGMA III positioner incorporates spring-loaded carbon brushes to connect each tooling plate to the welding ground system. A gang of 3 carbon brushes contact the posterior side of each tooling plate. The negative (–) ground cable to the welding power source is connected to a ground block located inside the MRM2–750–M3X SIGMA III positioner headstock assembly.

1.2.3 Major Components

The MRM2–750–M3X SIGMA III positioner includes the following major components –

- One tooling drive housing assembly (headstock)
- One main drive housing assembly (tailstock)
- One main (sweep) axis SIGMA III AC servomotor (and associated gear reduction unit)
- Two tooling (orbital) axes SIGMA III AC servomotors (and associated gear reduction units)
- One arc screen
- Three positioner-to-controller interconnect cables (2 data, 1 power)
• One assembly kit for the controller (servo packs, etc.)

1.3 Optional Equipment

This manual documents a standard Motoman positioner assembly. If your positioner assembly is modified or incorporates optional equipment, you should refer to the Engineering Drawing Package and associated Bill of Materials (BOM) in addition to this manual. The Engineering Drawing Package and BOM are included with your positioner shipment. Please refer to those documents, along with this manual, when troubleshooting or provisioning spare parts for your positioner assembly.

The following optional equipment is available for use with the MRM2–750–M3X SIGMA III positioner –

1.3.1 Air Supply Options

Air Supply, Tailstock, ¾ inch ID 148927-1
Air Supply, Tailstock, 10 mm ID 151823-1

1.3.2 Input/Output (I/O) Options

Slip Ring Kit, Tailstock, 12-Channel I/O, 10 Amps 148926-1
Slip Ring Kit, Tailstock, 12-Channel I/O, 10 Amps w/ 10 mm ID Air 151823-1
Slip Ring Kit, Tailstock, 12-Channel I/O, 10 Amps w/ ¾ inch ID Air 148896-2
1.4 Customer Support Contact Information

If you need assistance with any aspect of your MRM2–750–M3X SIGMA III positioner, please contact Motoman Customer Support at the following 24-hour telephone number –

**1.937.847.3200**

For routine technical inquiries, you can also contact Motoman Customer Support at the following e-mail address –

[techsupport@motoman.com](mailto:techsupport@motoman.com)

When using e-mail to contact Motoman Customer Support, please provide a detailed description of your issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response to your inquiry.

**NOTE** Please use e-mail for routine inquiries, only. If you have an urgent or emergency need for service, replacement parts, or information, you must contact Motoman Customer Support at the telephone number shown above.

Please have the following information ready before you call –

<table>
<thead>
<tr>
<th>Positioner</th>
<th>MRM2–750–M3X SIGMA III with MotoMount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial Number</td>
<td>Located on positioner data plate</td>
</tr>
<tr>
<td>Controller Type</td>
<td>Located on front of controller</td>
</tr>
<tr>
<td>Primary Application</td>
<td>Arc Welding</td>
</tr>
</tbody>
</table>
1.5 Technical Specifications

Table 1-1: MRM2–750–M3X SIGMA III Positioner Technical and Operational Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Units</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model P/N</td>
<td>—</td>
<td>151442 –3, –4</td>
</tr>
<tr>
<td>Rated Payload</td>
<td>kg (lb)</td>
<td>750 (1653)</td>
</tr>
<tr>
<td>Load Height (floor to centerline)</td>
<td>mm (in)</td>
<td>900 (35.4)</td>
</tr>
<tr>
<td>Maximum Cg Offset</td>
<td>mm (in)</td>
<td>76 (3.0)</td>
</tr>
<tr>
<td>Maximum Load Imbalance (Side A – Side B)</td>
<td>kg (lb)</td>
<td>250 (551)</td>
</tr>
<tr>
<td>Number of SIGMA III AC Servomotors</td>
<td>—</td>
<td>3</td>
</tr>
<tr>
<td>Index Motor Power</td>
<td>kW</td>
<td>4.4</td>
</tr>
<tr>
<td>Tooling Motor Power</td>
<td>kW</td>
<td>1.2</td>
</tr>
<tr>
<td>Side A–Side B Sweep Time</td>
<td>sec</td>
<td>2.25</td>
</tr>
<tr>
<td>Index Axis Speed</td>
<td>rpm</td>
<td>17.5</td>
</tr>
<tr>
<td>Index Torque</td>
<td>N·m (ft·lbf)</td>
<td>2428 (1791.0)</td>
</tr>
<tr>
<td>Tooling Index Time</td>
<td>sec</td>
<td>1.89</td>
</tr>
<tr>
<td>Tooling Axis Speed</td>
<td>rpm</td>
<td>0 – 21.6</td>
</tr>
<tr>
<td>Tooling Torque</td>
<td>N·m (ft·lbf)</td>
<td>420 (309.8)</td>
</tr>
<tr>
<td>Total Index Time</td>
<td>sec</td>
<td>2.25</td>
</tr>
<tr>
<td>Max Fixture Diameter</td>
<td>mm (in)</td>
<td>1300 (51.2)*</td>
</tr>
<tr>
<td>Standard Fixture Length</td>
<td>mm (in)</td>
<td>151442–3 2000 (78.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>151442–4 3000 (118.1)</td>
</tr>
<tr>
<td>Position Accuracy</td>
<td>mm (in)</td>
<td>± 0.1 (± 0.004)</td>
</tr>
<tr>
<td>Thru-Hole Headstock</td>
<td>—</td>
<td>No</td>
</tr>
<tr>
<td>Thru-Hole Tailstock</td>
<td>—</td>
<td>Yes</td>
</tr>
<tr>
<td>E-Stop Time</td>
<td>sec</td>
<td>0.660</td>
</tr>
<tr>
<td>E-Stop Angle</td>
<td>degrees</td>
<td>43.66</td>
</tr>
<tr>
<td>Tooling Axis Weld Ground Capacity (100%)</td>
<td>Amps</td>
<td>1200</td>
</tr>
<tr>
<td>Positioner Weight</td>
<td>kg (lb)</td>
<td>2550 (5622)</td>
</tr>
</tbody>
</table>

* Tooling fixture that passes under is limited to a MAXIMUM depth of 450 mm (35.8 in). See Figure 6 for a graphical representation of this requirement.
2  Installation

2.1  Required Materials

All positioner components and most of the hardware items required for installation of the MRM2–750–M3X SIGMA III positioner are included with your shipment. There are, however, some required items that the customer must supply, such as typical installation and maintenance tools (refer to Section 2.1.2 “Recommended List of Hand Tools and Equipment” on page 2-2) and special anchor bolts.

2.1.1 Customer-Supplied Items

- Local electrical service for the controller (all power to the MRM2–750–M3X SIGMA III positioner is supplied by the controller)
- Earth ground wires
- Earth ground rods and/or buried copper sheeting (quantity and placement depth as required to achieve specified resistance-to-ground reading of 100 ohms or less)
- Chemical (optional) to increase conductivity of soil in the vicinity of the earth ground system
- Forklifts (two)

WARNING

- The MRM2–750–M3X SIGMA III positioner must be installed by qualified personnel who are familiar with the installation and set-up of this type of parts positioner.
- Always comply with established safety procedures during installation of the MRM2–750–M3X SIGMA III positioner.

NOTE

All anchoring hardware for the MRM2–750–M3X SIGMA III positioner must be supplied by the customer.
2.2 Site Preparation

Procedure –

1. Clear floor and overhead space needed for the MRM2–750–M3X SIGMA III positioner (see Fig. 2-1 MRM2–750–M3X SIGMA III Positioner — Plan View and Fig. 2-2 "MRM-750-M3X SIGMA III Positioner - Elevation View" on page 2-3). Allow an additional 1.2 – 1.5m (4 – 5 ft) on all sides of the positioner to provide the clearances needed for installation.

2. Gather all customer-supplied items and required tools (refer to Section 2.1 “Required Materials” on page 2-1)

Fig. 2-1: MRM2–750–M3X SIGMA III Positioner — Plan View

2.1.2 Recommended List of Hand Tools and Equipment

- Safety glasses or full-face shield
- Air nozzle (OSHA-approved, pressure-limited)
- Gloves (heavy-duty leather recommended)
- Level (short and long)
- Adjustable wrench (large and small)
- Air impact wrench / hammer drill with concrete drill bits
- Phillips and flat-blade screwdrivers
- Ratchet handle and breaker bar (3/8-inch and 1/2-inch drive)
- Socket set, 3/8-inch and 1/2-inch drive (SAE and Metric)
2. Installation

2.2 Site Preparation

Fig. 2-2: MRM-750-M3X SIGMA III Positioner - Elevation View

- OPERATOR SIDE
- ROBOT SIDE

Dimensions:
- 2510 mm (98.8 in)
- 1470 mm (57.9 in)
- 900 mm (35.4 in)
- 450 mm (17.7 in)
2.3 Remove the Positioner from Shipping Skid

The MRM2–750–M3X SIGMA III positioner is attached to a wooden shipping skid at the factory, prior to shipment to the customer. The customer is responsible for removing the positioner from the shipping skid and inspecting for shipping damage.

Procedure –

1. Unbolt the positioner from the shipping skid using a ¾-inch socket (see Fig. 2-3 "Typical Shipping Bolt Removal").

Fig. 2-3: Typical Shipping Bolt Removal

2. Remove protective plastic, cardboard, etc. shipping material from the MRM2–750–M3X SIGMA III positioner.

WARNING

• Ensure that all forklift operators are licensed and trained in correct forklift operation and safety. An untrained or inexperienced operator could cause extensive equipment damage and injury to personnel.

• Never place any part of your body under a suspended load or move a suspended load over any part of another person’s body. A shifted or dropped load could result in serious injury or death.

CAUTION

Ensure that your forklifts are rated to handle the weight of the MRM2–750–M3X SIGMA III positioner. The positioner weighs approximately 2550 kg (5622 lb).
2 Installation
2.3 Remove the Positioner from Shipping Skid

NOTE: The following procedures require two forklifts and two forklift operators.

3. Carefully position forklift tangs under the lifting points on the headstock and tailstock end of the MRM2–750–M3X SIGMA III positioner (see Fig. 2-4 "Forklift Lift Points — MRM2–750–M3X SIGMA III Positioner").

Fig. 2-4: Forklift Lift Points — MRM2–750–M3X SIGMA III Positioner

4. In a coordinated effort, slowly lift the MRM2–750–M3X SIGMA III positioner up and away from the wooden shipping skid.

5. Discard or recycle the wooden shipping skid and all shipping materials.
2.4 Place and Anchor the Positioner

CAUTION

- Place the MRM2–750–M3X SIGMA III positioner on a base plate or foundation that is strong enough to support positioner weight and withstand repulsion forces. Make sure that the foundation surface is level and even.
- Minimum thickness of a concrete foundation for the MRM2–750–MRX SIGMA III positioner is 150 mm (6 in)
- Ensure that your forklifts are rated to handle the weight of the MRM2–750–M3X SIGMA III positioner. The positioner weighs approximately 2550 kg (5622 lb).

1. Use two forklifts to lift and place the MRM2–750–M3X SIGMA III positioner in the desired installation location and position (see Fig. 2-4 “Forklift Lift Points — MRM2–750–M3X SIGMA III Positioner”).

2. Adjust the stabilizing bolts, as required, to stabilize the positioner (see Fig. 2-5 "Lag Points and Stabilizing Bolts — MRM2–750–M3X SIGMA III Positioner (Plan View)").

Fig. 2-5: Lag Points and Stabilizing Bolts — MRM2–750–M3X SIGMA III Positioner (Plan View)

WARNING

Use protective eye wear during the anchoring process. Lack of protective eye wear could result in permanent eye damage for the installation technician.
2 Installation

2.4 Place and Anchor the Positioner

Be absolutely certain of the desired installation location for the MRM2–750–M3X SIGMA III positioner before anchoring it to the foundation.

3. Insert an M20 concrete drill bit into one of the lag point holes (see Fig. 2-5 "Lag Points and Stabilizing Bolts — MRM2–750–M3X SIGMA III Positioner (Plan View)" on page 2-6).

4. Drill a hole in the foundation to a minimum depth of 102 mm (4 in) to accept an anchor bolt. Repeat this process for all lag point holes shown in Fig. 2-5 "Lag Points and Stabilizing Bolts — MRM2–750–M3X SIGMA III Positioner (Plan View)" on page 2-6.

5. Use compressed air and OSHA-approved nozzle to remove all concrete dust from the drilled holes.

6. Use M20 or 3/4-inch anchor bolts to anchor the MRM2–750–M3X SIGMA III positioner to the foundation.
2.5 Connect the Positioner to the Controller

Three multi-pin connectors are installed on the MRM2–750–M3X SIGMA III positioner base (see Fig. 2-6 "MRM2–750–M3X Positioner — External Data / Power Connectors and Cables"). These connectors accept cables (2 data, 1 power) that interconnect the positioner with a Motoman controller.

When the MRM2–750–M3X SIGMA III positioner is delivered with a complete Motoman robotic welding system, additional documentation of data and power interconnects is included in the robotic welding system documentation package.
2.6 Customer-Supplied Tooling Fixtures

The MRM2–750–M3X SIGMA III positioner is equipped with the MotoMount™ tool mounting system (see Fig. 1-1 "MRM2-750- M3X SIGMA III" on page 1-2 and Fig. 1-3 "Tooling (Orbital) Axis — Tooling Plate Multiple Angle Control Components" on page 1-4). MotoMount is a flexible tool mounting system for headstock / tailstock style positioners, such as the MRM2–750–M3X SIGMA III. MotoMount provides improved part presentation repeatability compared to traditional hard-mounted systems.

The MotoMount system also minimizes headstock / tailstock bearing loads induced by tooling and headstock / tailstock misalignment (up to a maximum of ± 2 degrees), transmitting only the predictable moment loads resulting from simple beam loading.

For additional information on the correct use and care of the MotoMount tool mounting system, please contact Motoman Customer Support (refer to Section 1.4 “Customer Support Contact Information” on page 1-8).

- The customer shall supply all tooling fixtures for the MRM2–750–M3X SIGMA III positioner.
- Motoman recommends application of a corrosion/rust preventive compound to tooling fixtures located in a high-humidity environment.
3 Maintenance

3.1 General

**WARNING**

- Make sure that all sources of hazardous energies are de-energized / disconnected before inspecting or servicing the MRM2–750–M3X SIGMA III positioner. Because of typical interconnections between the positioner and related peripheral equipment (such as an NX100 controller), more than one source of hazardous energy can exist.
- Ensure that servo power is off before performing the following procedures. Observe standard lockout / tagout practices.

MRM2–750–M3X SIGMA III positioner maintenance should be performed by Motoman service technicians or authorized personnel, who are familiar with the design and construction of this type of positioner. The following procedures should be performed only as necessary (on condition). Read through the instructions completely, or contact Motoman Customer Service (refer to Section 1.4 “Customer Support Contact Information” on page 1-8) before performing any maintenance procedure. Be sure that you understand the procedure, have the proper tools, and comply with all safety precautions.

3.2 Recommended Spare Parts List

**Table 3-1: Recommended Spare Parts List**

<table>
<thead>
<tr>
<th>Component</th>
<th>Motoman Part Number</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brush, Ground, Metal / Graphite (GR-K076, Style QP5)</td>
<td>144371-1</td>
<td>6</td>
</tr>
<tr>
<td>Terminal, Quick Disconnect, Weld Ground</td>
<td>144370-1</td>
<td>4</td>
</tr>
<tr>
<td>Homing Pin</td>
<td>145896-1</td>
<td>2</td>
</tr>
<tr>
<td>Battery Assy, Encoder Backup</td>
<td>479348-2</td>
<td>3</td>
</tr>
</tbody>
</table>

3.3 How to Order Spare or Replacement Parts

To order spare parts or replacement parts for the MRM2–750–M3X SIGMA III positioner, please contact Motoman Customer Support (refer to Section 1.4 “Customer Support Contact Information” on page 1-8).

3.3.1 General Cleaning

The MRM2–750–M3X SIGMA III positioner requires only occasional cleaning to remove dust and welding by-products. Use compressed air or vacuum, and a bristle brush (if required).

**NOTE** Motoman recommends application of a corrosion/rust preventive compound to tooling fixtures located in a high-humidity environment.
3.4 **SIGMA III AC Servomotors**

The SIGMA III AC servomotors (1 sweep axis, 2 tooling plate axis) are sealed units and have no parts that need inspection or replacement on a regular basis. **Do NOT disassemble a SIGMA III AC servomotor.** If you suspect that a servomotor requires maintenance or overhaul, please contact Motoman Customer Support (refer to *Section 1.4 “Customer Support Contact Information” on page 1-8*).

3.5 **Servo Pack**

The servo pack (located in the controller) does not require customer maintenance. If you suspect a problem with the servo pack, please contact Motoman Customer Support (refer to *Section 1.4 “Customer Support Contact Information” on page 1-8*).

3.6 **Main (Sweep) Axis Reduction Gear Unit (RV–320E–171)**

The main (sweep) axis Reduction Gear Unit (RV–320E–171) is located on the Main Drive Housing Assembly (see Fig. 1-1 "MRM2-750- M3X SIGMA III" on page 1-2). This unit is sealed and contains no parts that need inspection or replacement on a regular basis. **Do NOT disassemble the reduction gear unit or remove it from its associated AC servomotor.** If you suspect that the Reduction Gear Unit requires maintenance or overhaul, please contact Motoman Customer Support (refer to *Section 1.4 “Customer Support Contact Information” on page 1-8*).

3.7 **Tooling (Orbital) Axis Reduction Gear Units (RV–80E–153)**

Two Reduction Gear Units (RV–80E–153) are located in the Tooling Drive Swingarm Assembly, one for each tooling plate (see Figure). These units are sealed and contain no parts that need inspection or replacement on a regular basis. **Do NOT disassemble the reduction gear unit or remove it from its associated AC servomotor.** If you suspect that the Reduction Gear Unit requires maintenance or overhaul, please contact Motoman Customer Support (refer to *Section 1.4 “Customer Support Contact Information” on page 1-8*).

3.8 **Main (Swing) Axis Hardstops**

The MRM2–750–M3X SIGMA III positioner incorporates two buffered hardstops that are welded to the Tooling Drive Swingarm Assembly. The hardstops provide a positive stop for the Tooling Drive Swingarm Assembly (and thus the Arc Shield and Main Axis Swingarm Assembly) during a sweep cycle. The hardstops are preset at the factory for correct performance, and should need no further adjustment. **Should you suspect that the hardstops need replacement or adjustment, please contact Motoman Customer Support** (refer to *Section 1.4 “Customer Support Contact Information” on page 1-8*).
3.9 Welding Ground System

3.9.1 Inspection and Cleaning of Carbon Brushes
Inspect the ground brushes where they contact the rear of tooling drive plates. Make sure that the contact area is clean and free of dust and welding by-products. Use compressed air and a small bristle brush to clean the ground brushes where they contact the tooling plates.

3.9.2 Ground Brush Replacement

3.9.2.1 Ground Brush Removal

Procedure –

1. Remove all hazardous energies from the MRM2–750–M3X SIGMA III positioner and other system components.

Each ground brush is enclosed in a box-shaped brush holder that is attached to a mounting plate. The brush holder incorporates a spring tensioner device that holds the ground brush, under spring tension, against the rear of the tooling plate when locked into position (see IPL Figure A-3).

2. Release the spring tensioner by squeezing together both of the black levers that are visible on each brush holder. While squeezing the levers together, pull out and away from the the brush holder. This should produce the ground brush.

3. Each ground brush has two braided copper leads that connect to silver-plated, high current quick disconnect posts on the ground brush mounting plate (see IPL Figure A-3). After the ground brush is free and clear of the brush holder, use a flat blade screwdriver or needle nose pliers to disconnect each of the braided copper brush leads from the quick disconnect posts.

NOTE Always ensure that welding ground connections and brushes in the MRM2–750–M3X SIGMA III positioner are clean and tight. If the ground points are not properly made and kept clean and secure, high welding currents can bypass the normal return path and, instead, pass through the drive components of the positioner. This is especially hard on positioner drive bearings when they are under load. The high welding current, if allowed to pass through the drive components, can result in increased bearing wear and premature need for replacement.
3.9.2.2 Ground Brush Installation

1. Connect braided copper brush cables (from the new brush) to the quick disconnect posts on the ground brush mounting plate (see IPL Figure A-3).

   ![Note]
   This is a good time to check the cleanliness and condition of the quick disconnect posts. If you notice dirt or grease buildup on the posts, clean them. Use a small bristle brush (toothbrush size) and compressed air.

2. Make sure that the spring tensioner in the brush holder is released and pulled as far back as possible.

3. Insert the new brush into the brush holder and push forward as far as possible.

4. Lock the new brush into position by squeezing together the black tensioner levers and pushing the tensioner forward into the brush holder until it "clicks" into the locked position.

3.9.3 Inspection of Welding Ground Connections

Inspect all welding ground cable connections for cleanliness and security.

   ![Note]
   Ground cable connections must be clean and tight. A loose or dirty connection can cause excess heat (high resistance connection) or arcing. Either of these conditions can damage the cable and cable connection point.
3.10 AC Servomotor Encoder Back-Up Battery

The main (sweep) axis and tooling (orbital) axes SIGMA III AC servomotors all incorporate an external Lithium-Ion "keep alive" battery pack that maintains encoder positioning data in system memory, should the main cables between the positioner and controller be disconnected (see Fig.3-1 "Typical Encoder “Keep-Alive” Battery Location").

The "keep alive" batteries have a long life in this particular application. However, should one or more of these batteries drop below a certain charge level, an indication will appear on the Programming Pendant display screen, indicating the need for battery renewal.

To replace a depleted encoder "keep alive" battery pack, gain access to the encoder plug on the applicable SIGMA III AC servomotor, locate the depleted battery pack, and replace it with a new battery pack of the same type (see Fig.3-1 "Typical Encoder “Keep-Alive” Battery Location").
3.11 Setting a Tooling Plate to Home (Zero) Position

Procedure –

1. Use the Programming Pendant to place the robotic system into TEACH mode.

2. Slowly rotate the tooling plate until the homing pin hole in the tooling plate is accessible.

3. Install the plastic homing pin (see Fig. 3-2 "Homing Pin Details") into the homing pin hole in the tooling plate (see Fig. 3-3 "Tooling Plate Home (Zero) Position" on page 3-6).

Fig. 3-2: Homing Pin Details

MATERIAL: Delrin™ Polymer

Fig. 3-3: Tooling Plate Home (Zero) Position

NOTE: Portions of Tooling Drive Swingarm Housing are cut away for graphic clarity. MotoMount™ assembly removed for graphic clarity.
3.11 Setting a Tooling Plate to Home (Zero) Position

4. Slowly jog the tooling plate in the direction indicated in Fig. 3-3 "Tooling Plate Home (Zero) Position" on page 3-6 until the homing pin just contacts the tooling drive swingarm housing.

If you go too far with the tooling plate rotation, the plastic alignment pin will bend and result in an inaccurate adjustment. If this happens, slowly reverse the tooling plate rotation until the pin returns to a straight position.

5. Use the Programming Pendant to place the system in MAINTENANCE mode.

6. Press the Programming Pendant TOP MENU key.

7. Cursor to ROBOT and press SELECT.

8. Cursor to HOME POSITION and press SELECT.

9. Press the PAGE OVER key to the desired station (indicated in top right corner of Programming Pendant display panel).

10. Press SELECT.

11. Cursor to YES, then press SELECT.

The tooling plate is now reset to zero.

12. Remove the homing pin from the tooling plate.
## 3.12 MRM2–750–M3X SIGMA III Positioner Inspection Schedule

Table 3-2: Inspection Schedule

<table>
<thead>
<tr>
<th>Inspection Item</th>
<th>Frequency</th>
<th>Inspection Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positioner</td>
<td>Daily</td>
<td>Check for physical damage that could indicate a load collision and/or evidence of misuse.</td>
</tr>
<tr>
<td>Positioner</td>
<td>Daily</td>
<td>Listen for unusual noise. If present, contact Motoman Customer Support (refer to Section 1.4 “Customer Support Contact Information” on page 1-8).</td>
</tr>
<tr>
<td>Positioner</td>
<td>On condition</td>
<td>Clean with dry cloth, bristle brush, and compressed air.</td>
</tr>
<tr>
<td>Ground brushes</td>
<td>Weekly</td>
<td>Check for dirt between brushes and tooling plates. Check for full contact with the tooling plates.</td>
</tr>
<tr>
<td>AC servomotor</td>
<td>Daily</td>
<td>Check manually for excess vibration. If present, contact Motoman Customer Support (refer to Section 1.4 “Customer Support Contact Information” on page 1-8).</td>
</tr>
<tr>
<td>AC servomotor</td>
<td>Daily</td>
<td>Listen for unusual or excessive noise. If present, contact Motoman Customer Support (refer to Section 1.4 “Customer Support Contact Information” on page 1-8).</td>
</tr>
<tr>
<td>AC servomotor</td>
<td>Every 20,000 hours or 5 years</td>
<td>Check for wear or damage. If present, contact Motoman Customer Support (refer to Section 1.4 “Customer Support Contact Information” on page 1-8).</td>
</tr>
<tr>
<td>Anchor bolts</td>
<td>6 months (or on condition)</td>
<td>Visual inspection; Check torque and security.</td>
</tr>
<tr>
<td>Cables and hoses</td>
<td>6 months (or on condition)</td>
<td>Check visually and manually (bend cables and hoses to check for cracks, checking, scuffing, etc).</td>
</tr>
</tbody>
</table>
Appendix A     Illustrated Parts List

A.1 Introduction

A.1.1 Arrangement
Appendix A is arranged as follows –
• Appendix A.1 – Introduction
• Appendix A.2 – Illustrated Parts List (IPL)

A.1.2 General
The Illustrated Parts List (IPL) identifies, describes, and illustrates detail parts of the MRM2–750–M3X SIGMA III positioner.

A.1.3 Purpose
The IPL provides parts identification and descriptive information for use in provisioning, purchasing, storing, and issuing spare parts.

A.1.4 Illustrated Parts List (IPL)
The Illustrated Parts List contains illustrations (exploded views) and associated parts list tables that show detail parts of a particular component, assembly, or subassembly.

A.1.5 IPL Layout
The IPL is arranged so that the illustration (exploded view) for an assembly appears directly above the parts list table for that illustration. When this is not possible, due to a large illustration or an extensive parts list table, the parts list table will be listed on the facing page. This format always attempts to present the illustration and its associated parts list table to the reader in one view, regardless of viewing format (PDF or printed).

A.1.6 Item Categories Not Included in the IPL
The following item categories are not included in the IPL –
1. Standard hardware items (attaching parts) such as nuts, screws, washers, etc. These are commercially available to the customer.
2. Bulk items and consumables such as wire, cable, sleeving, tubing, certain fluids, etc. These are commercially available to the customer.
3. Permanently attached parts that lose their identity because they are welded, soldered, riveted, etc., to other parts, assemblies, or subassemblies.
A.1.7 Parts List Table Structure

Each figure’s parts list table contains the following data columns –

- **FIGURE AND ITEM NUMBER**
  An entry in this column gives the item number for a part shown in the associated illustration (exploded view). The item number listed in this column is the same as the item number shown on the illustration. Item numbers on the illustration are identified by a circled number and leader line that points to the particular part (item) on the illustration.

- **MOTOMAN PART NUMBER**
  An entry in this column gives the Motoman part number for an item. Refer to this number when ordering or referencing the part.

- **DESCRIPTION**
  An entry in this column gives the description (nomenclature) for an item number or part number.

- **QTY**
  An entry in this column gives the total quantity of an item or part number required for an assembly or subassembly in which the part appears. The quantity given in this column may or may not be the total quantity required for the complete end item. The letters "REF" in this column indicate a reference to the top assembly in the figure.

*NOTE*

Items not shown in the illustration are indicated by a dash (–) prefix to the item number. An examples could include a right-hand (RH) part that is otherwise identical to the illustrated left-hand (LH) part.
A.1 Introduction

Fig. A-1: Major Assemblies — MRM2–750–M3X SIGMA III Positioner

<table>
<thead>
<tr>
<th>FIGURE &amp; ITEM No</th>
<th>MOTOMAN PART No</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1 – 1</td>
<td>151442-3</td>
<td>MRM2–750–M3X, 2 METER</td>
<td>REF</td>
</tr>
<tr>
<td>– 2</td>
<td>151442-4</td>
<td>MRM2–750–M3X, 3 METER</td>
<td>REF</td>
</tr>
<tr>
<td>3</td>
<td>151515-1</td>
<td>HOUSING ASSY, TOOLING DRIVE</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>151444-2</td>
<td>HOUSING ASSY, SWINGARM, TOOLING DRIVE</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>151449-1</td>
<td>BEAM SPREADER (ARC SHIELD), 2 METER</td>
<td>1</td>
</tr>
<tr>
<td>– 5A</td>
<td>151449-2</td>
<td>BEAM SPREADER (ARC SHIELD), 3 METER</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>151514-2</td>
<td>HOUSING ASSY, MAIN DRIVE</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>151443-1</td>
<td>HOUSING ASSY, SWINGARM, MAIN DRIVE</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>151453-1</td>
<td>BASE, POSITIONER, 2 METER</td>
<td>1</td>
</tr>
<tr>
<td>– 8A</td>
<td>151453-2</td>
<td>BASE, POSITIONER, 3 METER</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>151395-3</td>
<td>CABLE ASSY, INTERNAL, I/O, 24-PIN, BKHD MOUNT,NX100</td>
<td>1</td>
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<tr>
<td>– 10</td>
<td>151878-1</td>
<td>CABLE ASSY, INTERNAL, POWER, SIGMA III, BKHD MOUNT,NX100</td>
<td>1</td>
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<tr>
<td>– 11</td>
<td>151940-1</td>
<td>CABLE ASSY, INTERNAL, ENCODER, SIGMA III, BKHD MOUNT,NX100</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>479348-2</td>
<td>BATTERY ASSEMBLY, ENCODER BACKUP</td>
<td>3</td>
</tr>
</tbody>
</table>
Appendix A  Illustrated Parts List
A.1 Introduction

Fig. A-2: Components — Housing Assembly, Tooling Drive

<table>
<thead>
<tr>
<th>FIGURE &amp; ITEM No</th>
<th>MOTOMAN PART No</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.2 –1</td>
<td>151515-1</td>
<td>HOUSING ASSY, TOOLING DRIVE</td>
<td>REF</td>
</tr>
<tr>
<td>2</td>
<td>151452-1</td>
<td>HOUSING, TOOLING DRIVE</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>151697-1</td>
<td>BEARING, 6-BOLT FLANGE, 4½ inch</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>148748-1</td>
<td>SWITCH ASSY, TOP ROLLER PLUNGER, 2 N.C. CONTACTS</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>151450-1</td>
<td>ACTUATOR DISK, A–B SIDE</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>151843-1</td>
<td>HANGAR, SUPPORT, CABLE</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>151603-1</td>
<td>COVER, HEAD / TAIL STOCK</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>131278-6</td>
<td>SCREW, HHC, ¾–10 X 2-½ inch, ZP, GR 5</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>479147-10</td>
<td>WASHER, FLAT, M18, ZP</td>
<td>6</td>
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<tr>
<td>–10</td>
<td>151516-1</td>
<td>BRACKET, MOUNTING, LIMIT SWITCHES</td>
<td>1</td>
</tr>
</tbody>
</table>

NOTE – Limit switch mounting bracket not shown in this view. Refer to Item 10 in IPL Table A.2 for part number. Also, refer to Figure 2 in Chapter 1 of this manual.
**Fig. A-3: Components — Housing Assy, Swingarm, Tooling Drive**

<table>
<thead>
<tr>
<th>FIGURE &amp; ITEM NO</th>
<th>MOTOMAN PART NO</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.3 –1</td>
<td>151444-2</td>
<td>HOUSING ASSEMBLY, SWINGARM, TOOLING DRIVE</td>
<td>REF</td>
</tr>
<tr>
<td>2</td>
<td>151448-1</td>
<td>HOUSING, SWINGARM, TOOLING</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>151583-2</td>
<td>COVER, TOOLING AXIS</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>149568-5</td>
<td>MOTOR, AC SERVO, SIGMA III, 1.2 KW</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>151595-5</td>
<td>GEAR, INPUT, PINION (RV-80E-153)</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>144370-1</td>
<td>TERMINAL, QUICK DISC, WELD GRND</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>144372-1</td>
<td>BRUSH HOLDER (1”X1.5”X2”) WELD GRND</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>144371-1</td>
<td>BRUSH, GRND, METAL GRAPHITE (GR-KO76, STYLE QP5)</td>
<td>6</td>
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<tr>
<td>9</td>
<td>151594-5</td>
<td>REDUCER, RV (RV-80E-153)</td>
<td>2</td>
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<tr>
<td>10</td>
<td>148090-4</td>
<td>ACTUATOR, SENSOR</td>
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<tr>
<td>11</td>
<td>145896-1</td>
<td>HOMING PIN</td>
<td>2</td>
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<td>151583-1</td>
<td>COVER, TOOLING DRIVE</td>
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<td>13</td>
<td>151451-1</td>
<td>FACE PLATE, TOOLING</td>
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<td>14</td>
<td>149202-2</td>
<td>BLOCK ASSY, HEADSTOCK, MotoMount™</td>
<td>2</td>
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<td>15</td>
<td>151584-1</td>
<td>BRACKET, MTG, LOAD POSITION SENSOR</td>
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<td>16</td>
<td>148093-2</td>
<td>SENSOR, SLOT, 10–30V, 15 mm RANGE</td>
<td>4</td>
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</tbody>
</table>
### Appendix A Illustrated Parts List

#### A.4 Components — Housing Assembly, Main Drive

<table>
<thead>
<tr>
<th>FIGURE &amp; ITEM No</th>
<th>MOTOMAN PART No</th>
<th>DESCRIPTION</th>
<th>QTY</th>
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</thead>
<tbody>
<tr>
<td>A.4 –1</td>
<td>151514-1</td>
<td>HOUSING ASSY, MAIN DRIVE (MRM2-250-M3X)</td>
<td>REF</td>
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<td>2</td>
<td>151603-1</td>
<td>COVER, HEAD / TAIL STOCK</td>
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<td>REDUCER, RV</td>
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### Illustrated Parts List

#### A.5 – Introduction

#### FIGURE & ITEM NO  
MOTOMAN PART NO  
DESCRIPTION  
QTY

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<th>MOTOMAN PART NO</th>
<th>DESCRIPTION</th>
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<td>ADAPTER ASSEMBLY, TAILSTOCK</td>
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**Fig. A-5: Components — Housing Assembly, Swingarm, Main Drive**
### B Revision History

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<th>Reason For Revision</th>
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<td>4/15/2014</td>
<td>14-0450M</td>
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<td>1. Revised IPL Components - Housing Assembly, Main Drive part number for Gear, Input Pinion from 151593-3 to 151593-6 and part number for Reducer, RV from 151592-3 to 151592-6. 2. Changed address in Manual 3. Updated Logo 4. Updated with ANSI 2013 standard</td>
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MRM2–750–M3X SIGMA III Positioner Manual

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for ongoing product modifications and improvements.