

**Motoman® NXC100 Controller**

# **MotoTrack 7-3 System Manual**

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## Chapter 1

# Introduction

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MotoTrack 7-3 is a pre-engineered, linear robot transporter designed for small payload material handling applications, particularly as required by Life Sciences and automated laboratory applications. Reflecting the laboratory environment, typical component finish is white-painted steel and anodized aluminum with stainless steel fasteners. The “7” represents 7 axes or degrees of freedom (6 robot axes plus 1 linear axis), providing optimum flexibility. This flexibility includes maximum reach on both sides of the track and beyond the track end.

The transporter is designed to carry the HP3JC robot. The length of the manipulator cables in the robot kit must match the length of the cables in the transporter kit. Ordering example: the 152530-3 HP3JC robot that includes 5-meter cables must be ordered with the 152292-3 transporter kit with 5-meter external axis cables. The standard system is designed to be free standing. Features are provided to permit easy attachment to a laboratory table for additional stability.

The transporter kit includes track, track motor, servo amp, high-flex manipulator cables, track J-box, and support structure. The robot includes HP3JC manipulator (CE-painted white) NXC100 controller (CE) configured to accept track servo amp, and fixed manipulator cables. MotoTrack 7-3 is fully supported by Motoman, Inc.

## 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 the HP3JC Motoman robot model. For more detailed information, refer to the manuals listed in Section 1.3. This manual contains the following sections:



*Note: This manual documents a standard Motoman system. If your system is custom or modified, please use this manual in conjunction with the drawings, schematics, and parts listing (Bill of Material) for your specific system. The drawings, schematics, and parts listing are included in the documentation package supplied with your Motoman system.*

This manual contains the following chapters –

### **CHAPTER 1 - INTRODUCTION**

This chapter introduces the MotoTrack 7-3 System Manual, provides an overview of the system, lists reference documents that are included with the documentation package, and provides Motoman Customer Support contact information.

### **CHAPTER 2 - SAFETY**

This chapter provides information regarding the safe use and operation of the MotoTrack 7-3.

### **CHAPTER 3 - EQUIPMENT DESCRIPTION**

This chapter provides a detailed description of the major components available with the MotoTrack 7-3 system. This chapter also includes a table of component specifications.

### **CHAPTER 4 - INSTALLATION**

This chapter provides instructions for set up and installation of the MotoTrack 7-3 system.

### **CHAPTER 5 - OPERATION**

This chapter provides instructions for basic operation of the MotoTrack 7-3 system. This chapter provides procedures for start-up, loading, normal operation, fault recovery, and shutdown.

### **CHAPTER 6 - MAINTENANCE**

This chapter contains a table listing periodic maintenance requirements for the components of the MotoTrack 7-3 system.

### **APPENDIX A - ANCHORING**

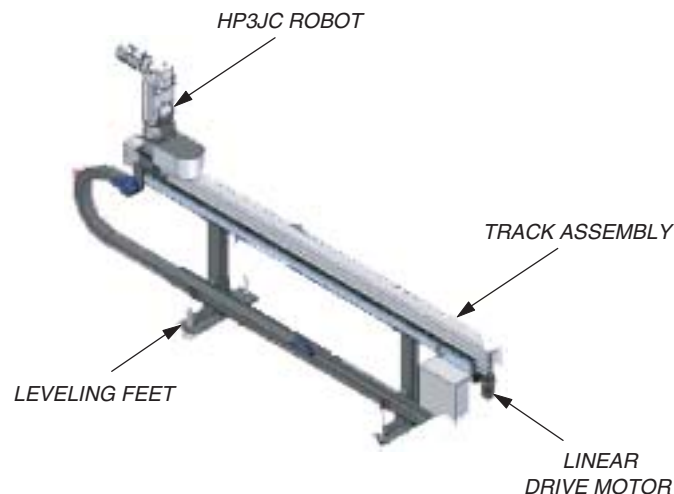
This chapter recommended anchoring and foundation suggestions.

### **APPENDIX B - ILLUSTRATED PARTS LIST**

This chapter contains the illustrated parts list for the MotoTrack 7-3.

## **1.2 System Overview**

The MotoTrack 7-3 is designed for the HP3JC robot. The legs provide free standing support, which is adequate on most factory floors without any additional foundation work. The standard MotoTrack 7-3 configuration includes a 2.5 meter beam, legs, carriage, and carriage control assemblies. The robot must be ordered separately. External axis cable lengths should be matched with the robot cables at 2, 4, 5, 6, and 8 meters.



**Figure 1** System Layout

## 1.2.1 Major Components

The MotoTrack 7-3 includes the following major components:

- Track assembly
- Track motor
- Servo amplifier
- High-flex manipulator cables
- Track junction box
- Support structure

## 1.2.2 Optional Equipment

The following optional equipment is available for use with the MotoTrack 7-3:

- Digital I/O cable for NXC100 controller (available in 1, 2, and 3 meter lengths)
- Interlock I/O cable for NXC100 controller (available in 1, 2, and 3 meter lengths)
- Power cable assembly for NXC100 controller, 6 meter length
- Conveyor Tracking

## 1.3 Reference to Other Documentation

For additional information refer to the following:

- Motoman HP3JC Manipulator Manual (P/N 151562-1)
- Motoman NXC100 Controller Manual (P/N 150975-1)
- Motoman NX100 Maintenance Manual (P/N 150133-1)
- Motoman NX100 Operator's Manual for Handling (P/N 149231-1)
- Motoman NX100 Operator's Manual for General (P/N 150077-1)
- Motoman NX100 Concurrent I/O Parameter Manual (P/N 149230-1)
- Motoman NX100 Independent/Coordinated Control Function Manual (P/N 149648-1)
- Motoman INFORM User's Manual (P/N 150078-1)
- Vendor manuals for system components not manufactured by Motoman

## 1.4 Customer Service Information

If you need assistance with any aspect of your MotoTrack 7-3 system, please contact Motoman Customer Support at the following 24-hour telephone number –

**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 –

- SYSTEM — PalletWorld®
- ROBOTS — HP3JC
- CONTROLLER — NXC100
- PRIMARY APPLICATION — Handling
- SOFTWARE VERSION — Access this information on the Programming Pendant display screen by selecting MAIN MENU > SYSTEM INFO > VERSION
- ROBOT SERIAL No — Located on data plate of robot
- ROBOT SALES ORDER No — Located on data plate of NX100 controller
- WARRANTY ID CODE — Located on back of the Programming Pendant



## Chapter 2

# Safety

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### 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 (ANSI/RIA R15.06-1999). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

Robotic Industries Association  
900 Victors Way  
P.O. Box 3724  
Ann Arbor, Michigan 48106  
TEL: (734) 994-6088  
FAX: (734) 994-3338  
[www.roboticsonline.com](http://www.roboticsonline.com)

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the robot system. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the robot cell. **NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE ROBOT SYSTEM!**

We recommend approved Motoman training courses for all personnel involved with the operation, programming, or repair of the robot system. This training is designed to familiarize personnel with the safe and correct operation of the robot 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 Important Advisory Information

Throughout this manual you will find advisory paragraphs (denoted by graphic symbols and bold typeface). All of these (except “NOTE”) direct the reader’s attention to information and procedures that are essential to the safety of personnel or protection of equipment.

The type of information contained in the various advisories is described below. These are listed here in descending order of importance to the safety of personnel and protection of equipment.



### **DANGER!**

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



### **WARNING!**

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



### **CAUTION!**

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



*Note: Information appearing in a Note caption provides additional information that can be 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

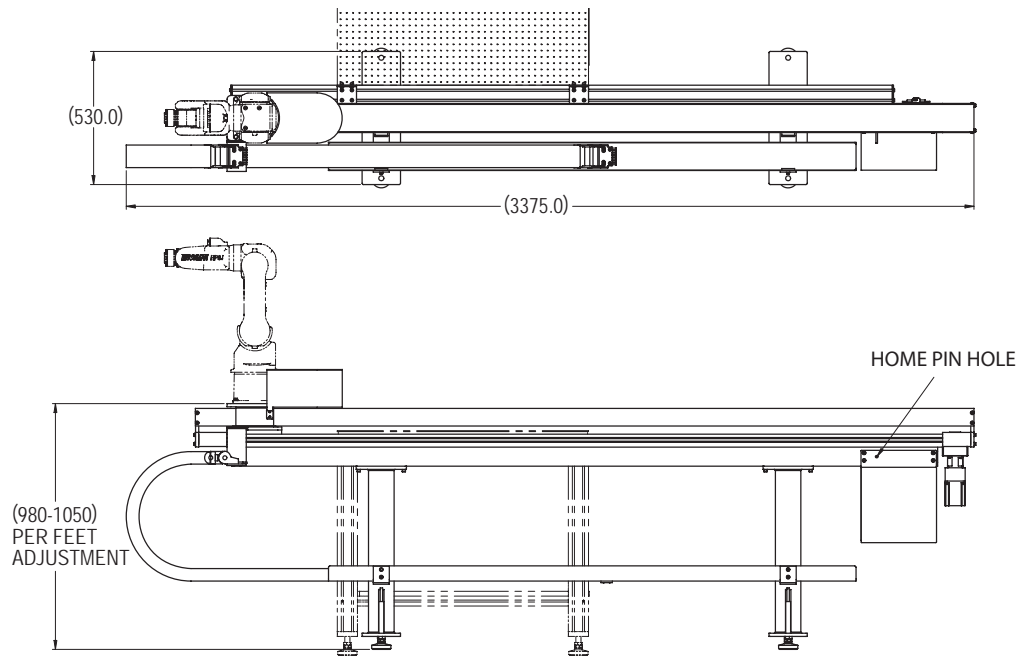
# Equipment Description

### 3.1 MotoTrack 7-3

The MotoTrack 7-3 system is designed to provide linear transport of the Motoman HP3JC robot. The additional linear axis gives the robot an expanded work envelope with a linear traverse speed of 1.5 meters per second and a repeatability of 0.1 mm (0.004 in.). Standard rail length is 2.5 meters with cable lengths from 2 to 8 meters in length. See Table 4 for additional specifications.

**Table 4** MotoTrack 7-3 Specifications

|                                  | <b>MotoTrack 7-3</b>                    |
|----------------------------------|---|
| Maximum Carriage Velocity        | 1500 mm/sec                             |
| Available Travel                 | 2.5 meters                              |
| Repeatability (robot and track)  | +/- 0.10 mm (temperature stable system) |
| E-Stop Response Time (Track)     | 0.4 seconds                             |
| E-Stop Response Distance (Track) | 250 mm                                  |



**Figure 2** MotoTrack 7-3 System Dimensions

### 3.1.1 Track Assembly

The track assembly uses a linear drive with toothed belt, integrated roller guide, gearbox, and motor. Typical component finish is white-painted steel and anodized aluminum with stainless steel fasteners. Refer to vendor manuals for additional information.

### 3.1.2 Carriage Assembly

The carriage rides along the track on the linear drive via an integrated roller guide. The carriage is transferred along the beam using a rack and pinion drive system. The high precision of the system allows for travels up to 2,500 mm with velocities up to 1500 mm/sec.

#### Energy Chain

The energy chain provides a consistent means to manage the cables as the robot travels along the track.

#### Carriage Homing

Carriage homing is achieved by aligning a plastic pin with the carriage. See Section 6.3 for detailed instructions.

## 3.2 Robot Description

The MotoTrack 7-3 system uses the HP3JC robot. The HP3JC has a payload capability of 3 kg. The HP3JC features a horizontal reach of 532 mm. Relative positioning accuracy is  $\pm 0.03$  mm.

For additional information on the HP3JC robot, please refer to the *HP3JC Manipulator Manual* that is included with your MotoTrack 7-3 system documentation package (refer to Section 1.3).



### 3.3 Controller - NXC100

The NXC100 robotic controller is one of the smallest controllers in its class. It features a Windows CE programming pendant with color touch screen, high speed processing, unmatched memory, built-in Ethernet, and robust PC architecture. The NXC100 controller coordinates the operation of the MotoTrack 7-3 system. It controls manipulator and track movement and processes input and output signals. It maintains variable data and performs numeric processing to convert to and from different coordinate systems. In addition, the controller provides the following: main logic functions, servo control, program and constant data memory, and power distribution. For more information, refer to the NXC100 Controller manual (P/N 150975-1) that came with your system.

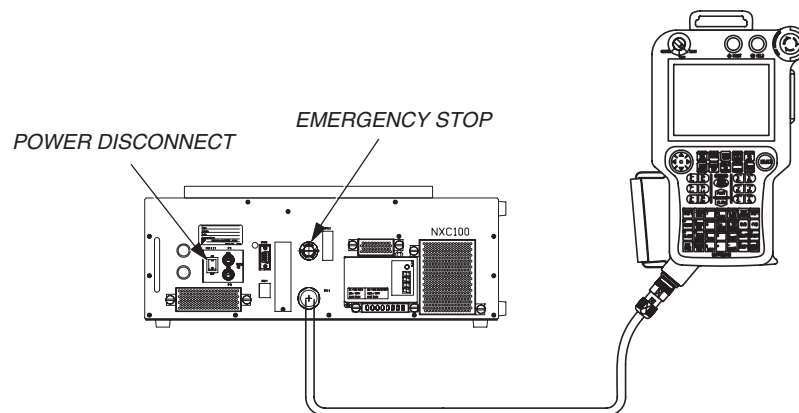





Figure 3 NXC100 Controller

### 3.4 Safety Features

The MotoTrack 7-3 system incorporates a host of safety equipment. When all standard safety precautions are taken, the safety equipment helps to ensure safe operation of the robotic cell. The ANSI/RIA R15.06 Robot Safety Standard stipulates the user is responsible for safeguarding. *Users are responsible for determining whether the provided safeguards are adequate for plant conditions. Users must also ensure that safeguards are maintained in working order.*

 *Note: MotoTrack 7-3 safety features are independent of program logic. All safeguards are “hard wired” and provide protection that is independent of any software program. System safeguards do not depend upon a programmer correctly inputting an instruction in the operating program.*

 *Note: MotoTrack 7-3 system safeguards are interfaced with normally closed (NC) “fail-to-safe” switch contacts. These components will stop work cell operation if they are disconnected or damaged.*

 *Note: Users are responsible for determining that the safeguards provided with the MotoTrack 7-3 system are adequate for their plant conditions. Users must also ensure that all safeguards are maintained in working order.*

### 3.4.1 Emergency Stops (E-Stops)

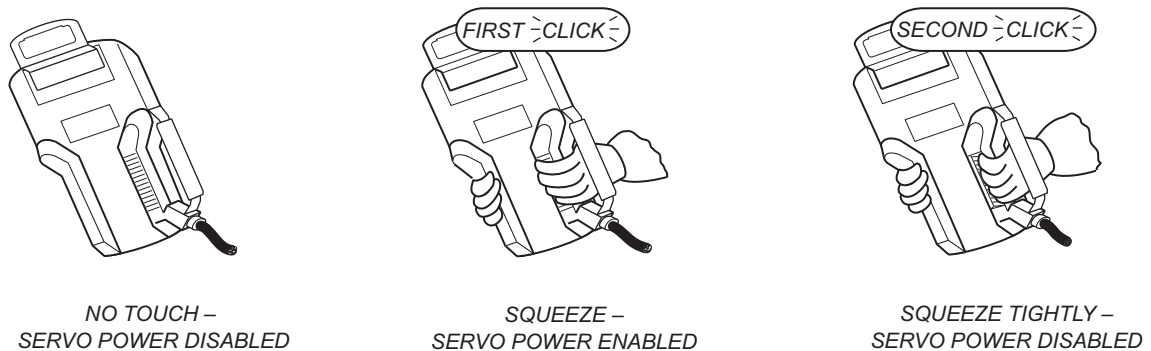
E-Stop is a primary safety feature of the MotoTrack 7-3 system. Robot impact (collision) detection circuitry, and E-Stop push buttons can all trigger an E-Stop condition. An E-Stop condition immediately de-energizes the control system and activates the robot braking system. The E-Stop push buttons are used for an intentional shutdown of the MotoTrack 7-3 system, and are installed at the following locations –

- Programming Pendant
- NXC100

To resume operation after an E-Stop system shutdown, the operator must clear and reset the action that caused the E-Stop condition.

### 3.4.2 Programming Pendant ENABLE Switch

The ENABLE switch is part of the Programming Pendant, and provides a safety feature that controls servo power while the system is in TEACH mode (see Figure 3 and Figure 4). When pressed in, this switch allows the operator to enable servo power. However, should the operator release the switch or grasp it too tightly, servo power is immediately disabled, thus preventing further robot movement. For detailed information about the operation of the ENABLE switch, refer to the *NX100 Operator's Manual for Handling* that is included with your MotoTrack 7-3 system documentation package (refer to Section 1.3).



**Figure 4** Programming Pendant ENABLE Switch – Location and Operation

## 3.5 Optional Equipment

- 150997- Digital I/O Cable, NXC 1,2,3 meter versions
- 150998- Interlock, I/O Cable, NXC 1,2,3 meter versions
- 152222-1 Cable Assembly, Power, XC100, 208 VAC, 6-M

## Chapter 4

# Installation

---

MotoTrack 7-3 is designed to be free standing. However, the system can be attached to a laboratory table using the T-slotted extrusion attached to the main beam. Use the following instructions as a guide along with your specific system prints. For additional information, refer to the vendor manuals supplied with your system.



### **CAUTION!**

**The MOTO TRACK 7-3 system should be installed by qualified personnel who are familiar with the installation and set-up of a robotic system.**



### **CAUTION!**

**Handle all system components with care. The MOTO TRACK 7-3 system is not extremely fragile, but it is a sophisticated robotic system that can be damaged by rough handling.**



*Note: The customer shall supply all anchoring hardware for the MotoTrack 7-3 system. Please refer to Appendix A of this document for suggested anchoring hardware and foundation specifications.*

Two to three qualified technicians can install the MotoTrack 7-3 system in a reasonable amount of time. Always comply with established safety procedures throughout installation process (refer to Chapter 2).

## 4.1 Safeguarding

To insure safety, be sure to install safety guards. They prevent unforeseen accidents with personnel and damage to equipment. The following is quoted for your information and guidance:

ISO10218 Responsibility for Safeguarding

*The user of a manipulator or robot system shall ensure that safeguards are provided and used in accordance with Sections 6, 7, and 8 of this standard. The means and degree of safeguarding, including any redundancies, shall correspond directly to the type and level of hazard presented by the robot system consistent with the robot application. Safeguarding may include but not be limited to safeguarding devices, barriers, interlock barriers, perimeter guarding, awareness barriers, and awareness signals.*

## 4.2 Required Materials

All system components and most of the materials and fasteners needed for installation of the MotoTrack 7-3 system are included with shipment from the factory. However, the customer must supply some required items and installation tools (refer to Section 4.2.1 and Section 4.2.2).

### 4.2.1 Customer-Supplied Items

- Local electrical service
- Earth ground wires for the robot and the NXC100 controller
- 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
- Forklift(s) and/or overhead crane
- Special anchor bolts and drill bits (refer to Appendix A for suggested anchoring hardware)

### 4.2.2 Recommended Hand Tools and Equipment

|   |   |
|---|---|
| <ul style="list-style-type: none"><li>• Safety glasses</li><li>• Face shields</li><li>• Gloves</li><li>• Level</li><li>• Ratchet with 3/4-in. socket</li><li>• Adjustable wrench set</li><li>• Hammer drill with appropriate concrete bits</li><li>• Phillips and flat screwdrivers</li></ul> | <ul style="list-style-type: none"><li>• Hammer</li><li>• Socket set (SAE and Metric)</li><li>• Forklift and/or overhead crane</li><li>• Air-impact gun with 3/4-in. socket</li><li>• Open-end wrench set (SAE and Metric)</li><li>• “Allen” wrench set (SAE and Metric)</li><li>• Open-end wrench sets (SAE and Metric)</li></ul> |
|---|---|

## 4.3 Site Preparation

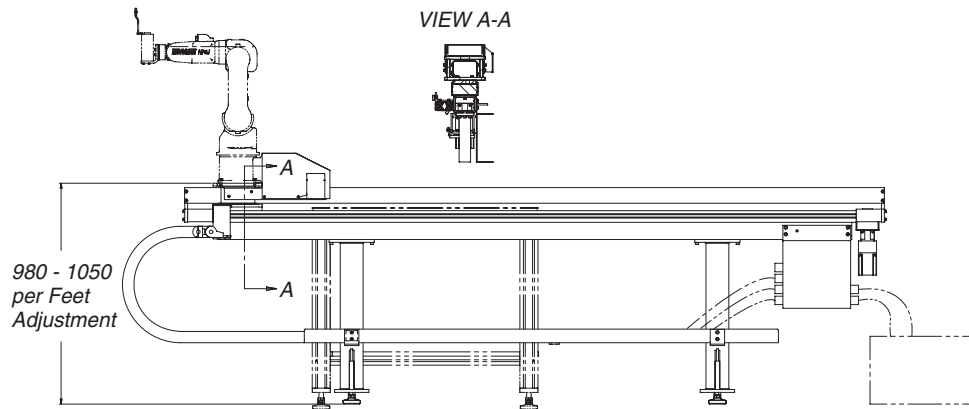


### **WARNING!**

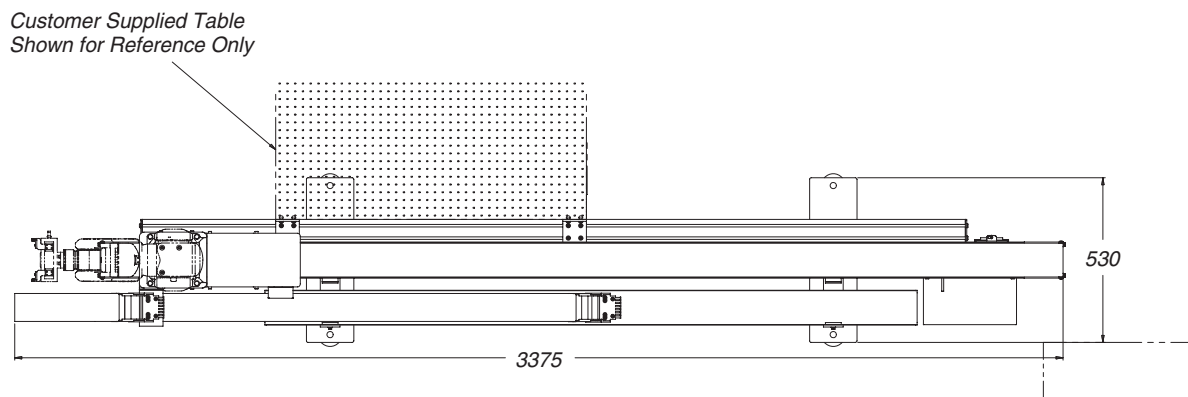
**During installation planning, allow sufficient room for access to the work cell. Failure to observe this warning could result in injury to personnel during system operation and maintenance.**

To prepare your site, proceed as follows:

1. Clear floor space and overhead area needed for the MotoTrack 7-3 system (refer to the drawings, schematics, and parts listing provided with your system). Allow an additional 1.2 - 1.5 m (4 to 5 ft) on all sides of the work cell to provide the clearance needed for installation.
2. Gather all customer-supplied items and required tools (refer to Section 4.2, "Required Materials").



**Figure 5** MotoTrack 7-3 – Example Installation Dimensions and Component Locations (Elevation View)



**Figure 6** MotoTrack 7-3 – Example Installation Dimensions and Component Locations (Plan View)

## 4.4 Removal of System Components from Shipping Skids

System components are attached to wooden shipping skids and/or wooden blocks at the factory, prior to shipment to the customer. The customer is responsible for removing the shipping skids and/or blocks and inspecting the components for shipping damage.



### **WARNING!**

**Be sure your crane or forklift is capable of handling the riser or damage to equipment or injury to personnel can result.**



*Note: If you notice any equipment damage, notify your shipping contractor as soon as possible.*

1. Unbolt the track from its shipping skid or block.
2. Use forklift(s) or overhead crane to lift the track away from its shipping skid.
3. Unpack robot and controller from shipping crates.
4. Discard or recycle the shipping skids and other shipping materials.

## 4.5 Component Installation

To make sure the MotoTrack 7-3 work cell is complete and to verify the correct amount of floor space for the installation, Motoman recommends that all system components be set in place prior to anchoring the components to the foundation. Refer to the system drawings supplied with your MotoTrack 7-3 system, to correctly place system components.



*Note: Refer to Appendix A for anchor bolt requirements.*

### 4.5.1 Place System Components

Before permanently anchoring the cell components to the floor, set all pieces in place in the following order –

1. Position and level the track in the specified location (refer to system drawings supplied).
2. If necessary, remove the cable cover from the riser.



#### **WARNING!**

**Always attach the lifting device to the robot before removing shipping bolts to prevent the robot from toppling.**

3. Unbolt robot from shipping skid using a 3/4 in. socket.
  - The robot weighs 27 kg. Be sure your crane or forklift is capable of handling this much weight or damage to equipment or injury to personnel can result.
  - Be sure to use a spreader bar to keep the chains from pulling against the robot assembly and damaging it.
4. Place the robot carefully on the carriage riser
5. Mount the robot to the carriage riser using the hardware provided.
6. Place the NXC100 controller (refer to your system drawings for the correct location).



*Note: Do not place the NXC100 controller any closer than 152.4 mm (6 in) to work cell fencing, walls, or other objects.*

## 4.6 Cable Connections

After the MotoTrack 7-3 system components are anchored in their correct locations, locate the interconnect cables for the system components and route them according to the system drawings and schematics included in the MotoTrack 7-3 system documentation package. All cables and connectors are labelled to ensure correct connection to the mating connectors on the applicable system component.



### CAUTION!

**Route wires and cables away from hazardous work areas to avoid wire breakage and unnecessary interruption of cell operation.**

### 4.6.1 Connection to Earth Ground



### WARNING!

**Do not use the MotoTrack 7-3 system unless specified components are connected to a low-resistance earth ground. Do not connect the earth ground wire with the wires for the other high voltage equipment. The low-resistance earth ground must be a “dedicated” ground that is a direct connection between a component and the earth ground point. Operator injury or death, as well as equipment damage, can result from an inadequate or defective earth ground system.**

The robot and NXC100 controller must be connected to a low-resistance earth ground. If a ground stake is used, it should be driven at least 2.43 m (8 ft) into the soil. The soil surrounding the driven ground stake should be treated with a chemical that increases the soil conductivity in the vicinity of the driven ground stake. The earth ground may require more than a single driven ground rod, depending on soil conditions. Often, multiple ground rods (bonded together) or even a bonded network of buried copper sheeting (plus conduction-enhancing chemicals) may be required, depending on local soil condition. In any event, the “low-resistance earth ground” must indicate a resistance of **100 ohms or less** (when measured directly between grounded equipment and the earth ground system). Specialized electronic measuring equipment is usually required to get an accurate “resistance-to-ground” reading. Consult a specialist in this field, if required.



*Note: The customer shall supply all wires associated with the earth ground. The customer is responsible for establishing the correct gauge of all wires associated with the earth ground and maintaining an adequate earth ground (measured resistance of 100 ohms or less).*

Connect the robot and NXC100 controller to the earth ground as follows –

1. Connect one end of an earth ground wire to the lug marked EARTH GROUND on the connector panel of robot. Connect the other end of the earth ground wire to the low-resistance earth ground. See Figure 5 for location of robot.
2. Connect one end of an earth ground wire to the COMMON GROUND BUS BAR located inside NXC100 controller. Connect the other end of the earth ground wire to the low-resistance earth ground.

## 4.6.2 Connecting the Robot Cables

MotoTrack 7-3 will have been set up and tested prior to shipment. The manipulator cables are already installed in the e-chain and connected to the output side of the J-box.

1. Remove cable cover.
2. Carefully engaging connectors, connect the two cables (labeled 1BC and 2BC) to the 1BC and 2BC connections on back of robot.
3. Adjust cables as required in the e-chain.
4. Re-install cable cover.

## 4.6.3 Connection to Local Electrical Service



### WARNING!

**Local electrical service connection to the MotoTrack 7-3 system must be performed by a qualified, licensed electrician. Electrical and grounding connections must comply with the National Electrical Code (NEC), as well as all local electrical codes.**



*Note: The MotoTrack 7-3 system is configured for single-phase 208/240V AC primary power. For additional information, refer to the electrical drawings and schematics that are included with your system documentation package (refer to Section 1.3).*

After all of the system components have been properly installed and interconnected, connect local electrical service to the NXC100 controller (refer to Section 4.6.3.1).

### 4.6.3.1 NXC100 Controller

For detailed electrical service interconnect procedures for the NXC100 controller assembly, refer to the *NXC100 Controller Manual* and MotoTrack 7-3 system drawings / schematics that are included with your system documentation package (refer to Section 1.3).

## 4.7 Safety/Operation Check

Before operating the MotoTrack 7-3, take a few minutes to perform a safety/operation check:

1. Check that all shipping brackets have been removed from robot.
2. Check that all cable connections are tight.
3. Verify that local electrical service complies with the power requirements for your MotoTrack 7-3 system.
4. Verify that local electrical service is correctly wired into the NXC100 controller.



### CAUTION!

**The MOTOTRACK 7-3 system is now ready for power-up. Qualified, trained personnel, who are familiar with this system, should perform the power-up sequence.**

5. Rotate the POWER ON-OFF Switch on NXC100 controller to ON.





*Note: An electrical service disconnect box for the NX100 controller assembly shall be supplied (if desired) by the customer. It is not part of the MotoTrack 7-3 system shipment.*



**WARNING!**

**Before operating the robots, verify that each E-Stop push button disables servo power when activated (pushed in). Each E-Stop push button must immediately stop robot and positioner movement when activated (pushed in).**

6. Check for correct operation of all E-Stop push buttons (refer to Section 3.4.1).
7. Check for correct operation of the system HOLD button on the Programming Pendant.
8. Check for correct operation of all safeguarding.
9. Remove power from the MotoTrack 7-3 system after completion of the safety / operation check.

## 4.8 Installation of Tooling and Fixtures

All tooling and fixtures are supplied by the customer. Your MotoTrack 7-3 system is now ready for installation of tooling and fixtures for your application. Only personnel who are familiar with the operation of this system should perform the installation. After tooling installation, test the system for proper operation.

# NOTES

## Chapter 5

# Operation

---



### CAUTION!

The customer is responsible for providing trained operators to run the equipment. The customer is also responsible for making sure that the equipment is operated in accordance with the ANSI/RIA R15.06-1999 Robot Safety standard, as well as any other local or state standards.

This chapter provides a brief overview of the operating procedures and precautions for your MotoTrack 7-3 system. For more detailed operating information, refer to specific component manuals that are part of the MotoTrack 7-3 system documentation package (refer to Section 1.3).

## 5.1 Programming

The operation of the MotoTrack 7-3 system is programming dependent. The following operating instructions are based on one possible configuration for 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 procedures and information, refer to the NXC100 controller documentation that is included with your MotoTrack 7-3 system documentation package (refer to Section 1.3).

Any changes made to your system configuration or job structure will alter the operation of the system. Motoman recommends that you DO NOT modify the original jobs and system configuration of your MotoTrack 7-3 system. If you determine a need to modify the original jobs and system configuration, make any modifications to a copy of the original. Keep the original as a backup. Do not modify the original. Modifications must be performed by trained and experienced personnel who are familiar with the operation of the MotoTrack 7-3 system. If you have questions concerning the configuration of your system, please contact Motoman 24 hour Customer Support (refer to 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 (refer to Section 5.2.1).
- Move robot to Home position (refer to Section 5.2.2).
- Select Master Job (refer to Section 5.2.3).
- Perform shutdown procedures (refer to Section 5.2.4)

### 5.2.1 Start-Up

To start up the MotoTrack 7-3 work cell from a power-off condition, proceed as follows –



*Note: Electrical service disconnect boxes shall be supplied (if desired) by the customer. They are not part of the MotoTrack 7-3 system shipment.*

1. Rotate the NXC100 controller POWER ON-OFF switch to ON (see Figure 2).
2. Make sure that the work cell access door is closed and door safety interlock engaged.
3. Make sure all E-Stop push buttons are released. E-Stop push buttons are installed at the following locations –
  - Programming Pendant
  - NXC100
4. Select TEACH mode on the Programming Pendant.
5. Place robot in Home position (refer to Section 5.2.2).

### 5.2.2 Robot 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).
5. Use the navigation cursor key to move the cursor to R1 SAFE job and press SELECT (the job appears on the display screen).
6. Turn servo power ON by pressing SERVO ON and holding in the ENABLE switch.
7. Use the FWD button on Programming Pendant to jog robot (R1) to Home position.

### 5.2.3 Master Job

With the system powered up and in TEACH mode, call up the Master Job –

1. Select JOB on Programming Pendant touch screen.
2. Select CTRL MASTER on Programming Pendant touch screen. Press SELECT twice to activate the Master Job.
3. Select PLAY mode on Programming Pendant and press the PLAY ENABLE button on the NXC100 controller door (job playback operation is enabled).
4. Press SERVO ON button on the Programming Pendant.
5. Press START button on Programming Pendant.

The MotoTrack 7-3 work cell is now ready for operation.

### 5.2.4 Shutdown

Use the following procedure to perform a normal shut down of the MotoTrack 7-3 system –

1. Make sure the robot is in Home position.
2. Turn off system servo power by pressing the E-Stop button on operator station or programming pendant.
3. Select TEACH mode on the programming pendant.
4. Rotate NXC100 controller POWER ON-OFF switch to OFF (see Figure 2).

The MotoTrack 7-3 system is now shut down.

## 5.3 System Recovery

Under certain conditions you will be required to clear an alarm or error. Clearing an alarm or error requires different operator actions depending on the type. The paragraphs below describe the different types of alarms and errors you may encounter and how to remedy them when you do.

### 5.3.1 Alarms and Errors

Alarms and errors will cause the program to stop. There are three levels of alarms and errors: Error Messages, Minor Alarms, and Major Alarms. For more detailed information about alarm recovery, refer to manipulator manual that came with your system.

#### Error Messages

These are simple errors such as pressing the START button when the robot is not in PLAY mode, or enabling the programming pendant without the servo power being live. Errors like these are cleared by pressing the CANCEL button on the programming pendant.

#### Minor Alarms

Minor alarms are usually programming errors. Minor alarms might occur if a circle has been programmed with fewer than three circular points, etc. These alarms are cleared by pressing the RESET (F5) soft key on the programming pendant.

#### Major Alarms

Major alarms are hardware failures. Major alarms might occur because of a servo tracking error or an abnormal speed and are usually associated with crashes. To clear these alarms, you must turn off the controller and then turn it on again.

### 5.3.2 E-Stop Recovery

An E-Stop can occur under any of the following conditions:

- Pressing the E-Stop button on the programming pendant, or playback panel.

To restart the PalletWorld cell after an E-Stop condition occurs, follow the procedure below.

1. To clear E-Stop condition, perform any of the following actions that apply:
  - Release the E-Stop button on programming pendant, or playback panel.
2. Press SERVO ON button on or playback panel.
3. Press START button on playback panel.

The PalletWorld cell is now ready to continue operation.

## Chapter 6

# Maintenance

---

Maintenance of the MotoTrack 7-3 system and components must be performed by authorized personnel who are familiar with the MotoTrack 7-3 system. Perform the procedures given in this chapter only as needed (on condition). Be sure to read and understand the documentation for a particular component before doing repair maintenance or preventive maintenance on that component. Be sure that you understand the maintenance procedures, have the proper tools at hand, and comply with safety precautions given in Chapter 2.

Maintenance intervals given in this chapter are recommendations, only. Adjust the frequency and level of repair maintenance and preventive maintenance to suit your specific equipment schedules and shop environment.

For periodic maintenance procedures and schedules for the individual components of your MotoTrack 7-3 system, refer to the documentation package that is included with your system (refer to Section 1.3).

### 6.1 Parts Ordering

To order replacement parts, contact the Motoman service staff at:

Motoman Customer Service  
805 Liberty Lane  
West Carrollton, Ohio 45449  
Telephone: 937.847.3200  
Fax: 937.847.3211

## 6.2 Maintenance

For maintenance and troubleshooting procedures, please refer to the manipulator manual for your robot model and the vendor manuals provided with this system.

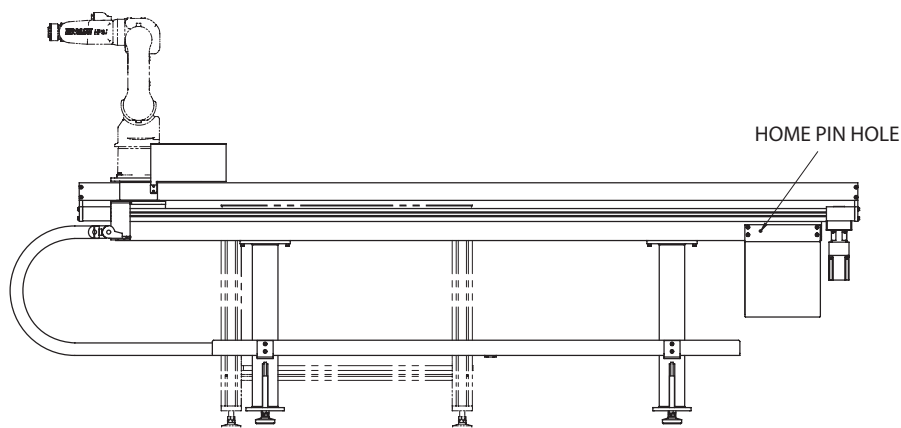
**Table 5** Periodic and Preventive Maintenance

| FREQUENCY                     | COMPONENT   | PROCEDURE   |
|-------------------------------|---|---|
| Daily<br>(or on condition)    | All safeguard items – work cell door interlocks, E-Stop push buttons, safety light curtains, arc curtains, etc. | Check physical condition of safeguard items and ensure that the safeguard items are working correctly |
| Monthly<br>(or on condition)  | MotoTrack 7-3 work cell   | Remove accumulated dirt, grease, and debris from inside and outside the work cell.                    |
| 6 Months<br>(or on condition) | Robot Equipment   | Check torque of threaded hardware securing equipment  |

## 6.3 Resetting the Robot Carrier to Home Position

Resetting of the Home position is typically done after a motor has been serviced. This procedure uses a plastic pin inserted into the main beam to determine the Home location. To reset Home position, proceed as follows:

1. Locate the homing hole in the main beam just above the J-box.
2. Install the homing pin into the homing pin hole (see figure 6-1) located in the main beam. The pin may need to be gently tapped in with a hammer.



**Figure 7**

3. Place the robot in TEACH MODE and job the robot carrier slowly until it is just touching the homing pin. If you to too far, the pin will bend, causing an inaccuracy. Slowly job the carrier in reverse until the pin is straight but is still touching the carrier.
4. Place the programming pendant in MAINTENANCE MODE.
5. Press 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 robot carrier is in the position that you want to teach as Home and press SELECT.
10. Cursor to YES and press SELECT. The carrier is now reset to zero.
11. Remove the alignment pin from the hard stop.

## 6.4 Linear Track

Refer to the vendor literature for standard maintenance. For bearing lubrication, refer to the following:



### Lubrication

#### Information

**Only use roller bearing grease for subsequent lubrication of the carriages.**

There are grease nipples at the front of the carriers (1) for re-lubrication.

The re-lubrication intervals depend on the environmental influences such as dirt, use of cooling lubricants, vibrations, impact load etc.

Determine the lubrication intervals in accordance with your individual case of application thus ensuring that there is always enough grease in the carriers. Make sure that there is always a grease film on the visible on the running surfaces of the guide rail.

We recommend to use a grease in accordance with DIN 51825 with the consistency class NLGI 2 in accordance with DIN 51818.

Lubricants with solids contents (such as Grafit or MoS<sub>2</sub>) must not be used.



*Note: Typical lubrication interval for an average 8 hour, 5 days a week work load would be approximately 2000 hrs.*

To lubricate, use grease nipple adaptor DIN 3405.

## 6.5 Troubleshooting

The following table identifies common problems that can 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 certain no other problems exist.

**Table 6** Troubleshooting

| <b>Problem</b>         | <b>Probable Cause</b>         | <b>Corrective Action</b>  |
|------------------------|-------------------------------|---|
| No track movement      | Loose connection              | Check all wire connections.   |
|                        | Incorrect wiring              | Check that system has been wired correctly. Refer to system prints.   |
| Unstable operation     | Loose mounting                | Check all mounting bolts and tighten as needed.   |
| Motor overheats        | Excessive ambient temperature | Reduce ambient temperature below 45 C (104 F). Positioner has an operating range of 0 to 45 C (32 to 113 F) |
|                        | Motor surface is dirty        | Clean motor surface   |
|                        | Motor overloaded              | 1. Check track for binding<br>2. Check motor connections and correct as needed.                             |
| Unusual noise          | Motor is going bad            | Call Motoman Service  |
| Squeaking/ Noisy track | Track                         | Refer to track vendor manual for maintenance information.   |

## Appendix A

# Illustrated Parts List

---

### A.1 Introduction

The Illustrated Parts List identifies, and illustrates detail parts of the main assemblies for the PalletWorld positioner. This list provides parts identification and descriptive information for use in provisioning, requesting, purchasing, storing, and issuing spare parts.

#### 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., 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  
The 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. Item numbers also appear on the illustration. Each item number is connected to the part to which it pertains by a leader line and arrow. 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  
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 reflect the total used in the complete end item.

## A.2 Parts List

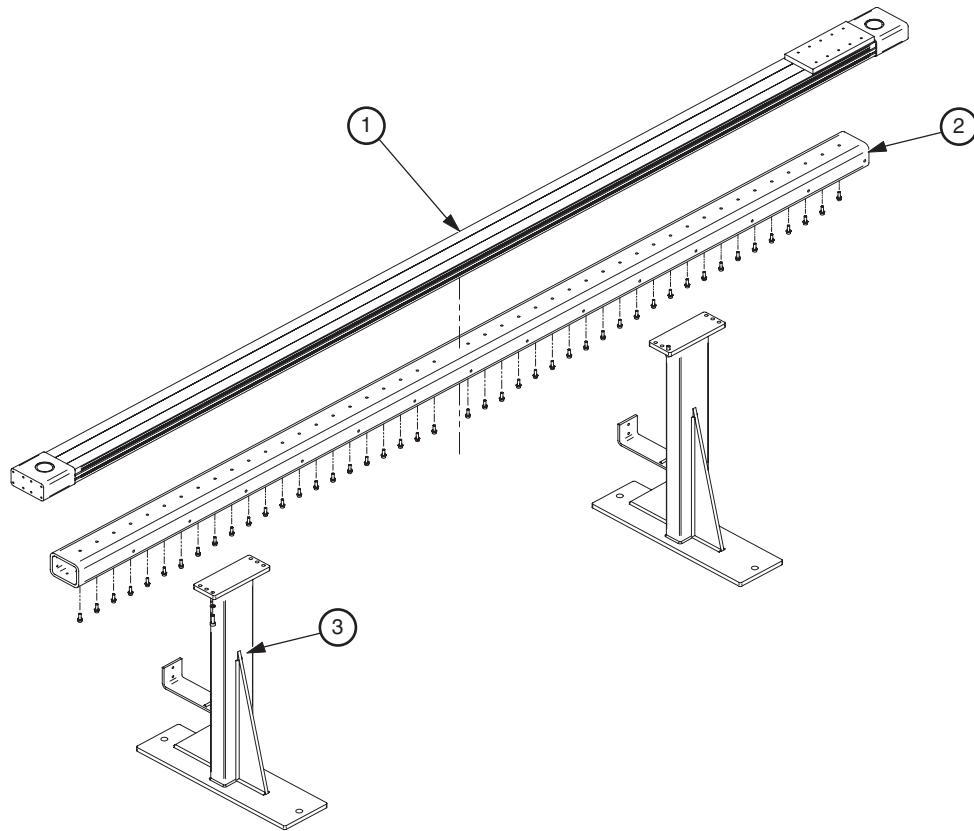
### A.2.1 Explanation of Parts List Arrangement

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.

### A.2.2 Symbols and Abbreviations

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

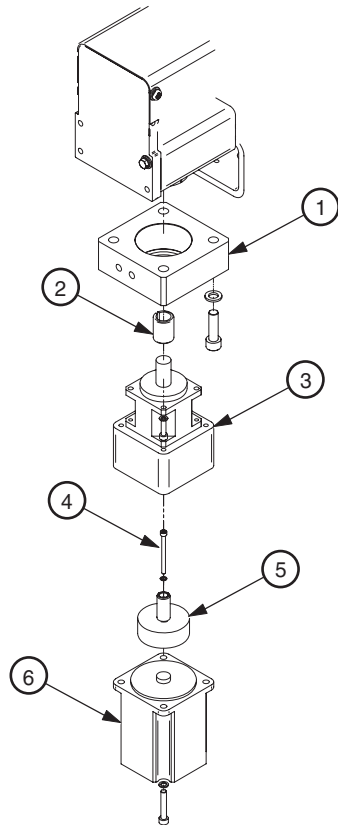
- amp – ampere
- AC – alternating current
- cyl – cylinder
- DC – direct current
- fig – figure
- hex – hexagon
- ID – inside diameter
- in. – inch
- m – meter
- mm – millimeter
- No. – number
- psi – pounds per square inch
- v – voltage



**Figure A.1** MotoTrack 7-3

**Table A.1** Parts List

| Item No. | Part No. | Description                                 | QTY |
|----------|----------|---|-----|
| 1        | 151544-2 | Track, Servo, Motorail 7-3 2.5M, C2 Preload | 1   |
| 2        | 152270-1 | Beam, Main, Motorail 7-3                    | 1   |
| 3        | 152275-1 | Bracket, Base, Motorail 7-3                 | 2   |



**Figure A.2** MotoTrack 7-3

**Table A.2** Parts List

| Item No. | Part No.  | Description                      | QTY |
|----------|-----------|----------------------------------|-----|
| 1        | 152272-1  | Adaptor, Clamp, Gear Ox          | 1   |
| 2        | 152273-1  | Sleeve, Coupling, Gear Box       | 1   |
| 3        | 152291-1  | Reducer, Speed, Gearbox, HP3JC   | 1   |
| 4        | 479295-12 | Screw, SHC, M4x45                | 1   |
| 5        | 152274-1  | Adapter, Flywheel, Motor         | 1   |
| 6        | 149568-3  | Motor, AC Servo, Sigma III, 200W | 1   |

**Table A.3** Cable List

| <b>Part No.</b> | <b>Description</b>                       |
|-----------------|--|
| 152591-1        | Cable, Manipulator, 1BC, HP3-NXC, CE, 2M |
| 152591-2        | Cable, Manipulator, 1BC, HP3-NXC, CE, 4M |
| 152591-3        | Cable, Manipulator, 1BC, HP3-NXC, CE, 5M |
| 152591-4        | Cable, Manipulator, 1BC, HP3-NXC, CE, 6M |
| 152591-5        | Cable, Manipulator, 1BC, HP3-NXC, CE, 8M |
| 152592-1        | Cable, Manipulator, 2BC, HP3-NXC, CE, 2M |
| 152592-2        | Cable, Manipulator, 2BC, HP3-NXC, CE, 4M |
| 152592-3        | Cable, Manipulator, 2BC, HP3-NXC, CE, 5M |
| 152592-4        | Cable, Manipulator, 2BC, HP3-NXC, CE, 6M |
| 152592-5        | Cable, Manipulator, 2BC, HP3-NXC, CE, 8M |
| 152589-1        | Cable, Ext Axis, PG, NXC, CE 2M          |
| 152589-2        | Cable, Ext Axis, PG, NXC, CE 4M          |
| 152589-3        | Cable, Ext Axis, PG, NXC, CE 5M          |
| 152589-4        | Cable, Ext Axis, PG, NXC, CE 6M          |
| 152589-5        | Cable, Ext Axis, PG, NXC, CE 8M          |
| 152590-1        | Cable, Ext Axis, PW, NXC, CE 2M          |
| 152590-2        | Cable, Ext Axis, PW, NXC, CE 4M          |
| 152590-3        | Cable, Ext Axis, PW, NXC, CE 5M          |
| 152590-4        | Cable, Ext Axis, PW, NXC, CE 6M          |
| 152590-5        | Cable, Ext Axis, PW, NXC, CE 8M          |

**Table A.4** Additional Components Not Shown

| <b>Part No.</b> | <b>Description</b>  |
|-----------------|---|
| 151590-1        | E-Chain Links   |
| 151709-1        | E-Chain Separators  |
| 151591-1        | E-Chain End Brackets  |
| 153170-1        | Cover, Cables, Manipulator, HP3JC, MotoTrack 7-3              |
| 152267-1        | Riser, HP3JC  |
| 152268-1        | Cover, Linear Actuator, MotoRail 7-3                          |
| 152269-1        | Plate, MTG Cover, MotoRail 7-3                                |
| 152352-1        | Plate, Nut, MTG, E-Chain, MotoRail 7-3                        |
| 152271-1        | Tray, Support, E-Chain, MotoRail 7-3                          |
| 151591-1        | Bracket, MTG, Energy Chain, Table Rail 7-3                    |
| 152293-1        | Plate, MTG, J-Box, Table Rail 7-3                             |
| 145896-1        | Pin, Homing   |
| 152501-1        | Foot, Leveling, M20 x 100                                     |
| 152531-()       | Control, Carrier, MotoRail 7-3 W/2M External Axis Cables      |
| 152362-1        | Enclosure Assy, Junction Box, w/ Split Foam Gland Plate 4x4x4 |
| 152992-1        | Plate, MTG, Cover, MotoTrack 7-3                              |
| 150418-2        | Clamp, Conduit, 5/8" OD Rubber Cushioned, One Hole MTG        |
| 150418-3        | Clamp, Conduit, 3/4" OD Rubber Cushioned, One Hole MTG        |
| SGDR-SDCCA04AAB | External Axis Board   |



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