Biomek® NX Multichannel Liquid Handler

Hardware User's Manual

Beckman Coulter PN 987892
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Beckman Coulter, Inc
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All standard Beckman Coulter, Inc. policies governing returned goods apply to this product. Subject to the exceptions and upon the conditions stated below, the Company warrants that the products sold under this sales agreement shall be free from defects in workmanship and materials for one year after delivery of the products to the original Purchaser by the Company, and if any such product should prove to be defective within such one year period, the Company agrees, at its option, either (1) to correct by repair or at the Company's election by replacement, any such defective product provided that investigation and factory inspection discloses that such defect developed under normal and proper use, or (2) to refund the purchase price. The exceptions and conditions mentioned above are as follows:

a. Components or accessories manufactured by the Company which by their nature are not intended to and will not function for one year are warranted only to reasonable service for a reasonable time. What constitutes a reasonable time and a reasonable service shall be determined solely by the Company. A complete list of such components and accessories is maintained at the factory.

b. The Company makes no warranty with respect to components or accessories not manufactured by it. In the event of defect in any such component or accessory, the Company will give reasonable assistance to Purchaser in obtaining from the manufacturer's own warranty.

c. Any product claimed to be defective must, if required by the Company, be returned to the factory, transportation charges prepaid, and will be returned to Purchaser with transportation charges collect unless the product is found to be defective, in which case the product must be properly decontaminated of any chemical, biological, or radioactive hazardous material.

d. The Company shall be released from all obligations under all warranties, either expressed or implied, if any product covered hereby is repaired or modified by persons other than its own authorized service personnel, unless such repair by others is made with the written consent of the Company.

e. If the product is a reagent or the like, it is warranted only to conform to the quantity and content and for the period (but not in excess of one year) stated on the label at the time of delivery.

It is expressly agreed that the above warranty shall be in lieu of all warranties of fitness and of the warranty of merchantability, and that the company shall have no liability for special or consequential damages of any kind or from any cause whatsoever arising out of the manufacture, use, sale, handling, repair, maintenance, or replacement of any of the products sold under the sales agreement.

Representatives and warranties made by any person, including dealers and representatives of the Company, which are consistent or in conflict with the terms of this warranty, shall not be binding upon the Company unless reduced in writing and approved by an expressly authorized officer of the Company.

Parts replaced during the warranty period are warranted to the end of the instrument warranty.

Note: Performance characteristics and specifications are only warranted when Beckman Coulter replacement parts are used.

Safety Information

All Warnings and Cautions in this document include an exclamation point, a lightning bolt, or a light burst symbol framed within a triangle. Please pay special attention to the specific safety information associated with these symbols.

Warning and Caution Definitions

The exclamation point symbol is an international symbol which serves as a reminder that all safety instructions should be read and understood before installation, use, maintenance, and servicing is attempted.

When this symbol is displayed in this manual, pay special attention to the specific safety information associated with the symbol.

WARNING

A WARNING calls attention to a condition or possible situation that could cause injury to the operator.

CAUTION

A CAUTION calls attention to a condition or possible situation that could damage or destroy the product or the operator's work.

Electrical Safety

To prevent electrically related injuries and property damage, properly inspect all electrical equipment prior to use and immediately report any electrical deficiencies. Contact an Beckman Coulter service representative for any servicing of equipment requiring the removal of covers or panels.

High Voltage

This symbol indicates the potential of an electrical shock hazard existing from a high voltage source and that all safety instructions should be read and understood before proceeding with the installation, maintenance, and servicing of all modules.

Do not remove system covers. To avoid electrical shock, use supplied power cords only and connect to properly grounded (three-holed) wall outlets. Do not use multiplug power strips.

Laser Light

This symbol indicates that a potential hazard to personal safety exists from a laser source. When this symbol is displayed in this manual, pay special attention to the specific safety information associated with the symbol.

Laser Specifications

Laser Type: Class II Laser Diode

Maximum Output:11 mW

Wavelength: 670

Chemical and Biological Safety

Normal operation of the Biomek NX liquid handler may involve the use of materials that are toxic, flammable, or otherwise biologically harmful. When using such materials, observe the following precautions:

- Handle infectious samples according to good laboratory procedures and methods to prevent the spread of disease.
- Observe all cautionary information printed on the original solutions containers prior to their use.
- Dispose of all waste solutions according to your facility's waste disposal procedures.
- Operate the Biomek NX liquid handler in accordance with the instructions outlined in this manual, and take all the necessary precautions when using pathological, toxic, or radioactive materials.
- Splashing of liquids may occur; therefore, take appropriate safety precautions, such as using safety glasses and wearing protective clothing, when working with potentially hazardous liquids.
- Use an appropriately contained environment when using hazardous materials.
- Observe the appropriate cautionary procedures as defined by your safety officer when using flammable solvents in or near a powered-up instrument.
- Observe the appropriate cautionary procedures as defined by your safety officer when using toxic, pathological, or radioactive materials.

Note: Observe all warnings and cautions listed for any external devices attached or used during operation of the Biomek NX liquid handler. Refer to applicable external device user's manuals for operating procedures of that device.

Moving Parts

To avoid injury due to moving parts, observe the following:

- Never attempt to exchange labware, reagents, or tools while the instrument is operating.
- Never attempt to physically restrict any of the moving components of the Biomek NX liquid handler.
- Keep the Biomek NX liquid handler work area clear to prevent obstruction of the movement.

Cleaning

Observe the cleaning procedures outlined in this user's manual for the Biomek NX liquid handler. Prior to cleaning equipment that has been exposed to hazardous material:

- Appropriate Chemical and Biological Safety personnel should be contacted.
- The Chemical and Biological Safety information contained in this user's manual should be reviewed.

Maintenance

Perform only the maintenance described in this manual. Maintenance other than that specified in this manual should be performed only by Beckman Coulter service representatives.

Important It is your responsibility to decontaminate components of the Biomek NX liquid handler before requesting service by a Beckman Coulter service representative or returning parts to Beckman Coulter for repair. Beckman Coulter will NOT accept any items which have not been decontaminated where it is appropriate to do so. If any parts are returned, they must be enclosed in a sealed plastic bag stating that the contents are safe to handle and are not contaminated.

Warnings and Cautions Found in this Manual

Please read and observe all cautions and instructions. Remember, the most important key to safety is to operate the Biomek NX liquid handler with care.

The WARNINGs and CAUTIONs found within this document are listed below.

WARNING: Dark non-reflective material affects the sensitivity of the light curtain and adversely impact its effectiveness. Typical lab dress, such as lab coats and latex gloves, do not degrade light curtain operation; however, it is advisable to test the impact of the all lab dress on light curtain sensitivity before operating the Biomek NX. Verify lab dress impact on light curtain sensitivity as follows: Use Manual Control in Biomek Software and insert the material no more than 1" past and approximately 21" above the light curtain panel. Make sure the solid amber indicator light changes to blinking amber.

WARNING: To reduce the risk of personal injury, operate the Biomek NX instrument only with all protective shields in place.

CAUTION: If service is required, contact a Beckman Coulter Service Engineer.

WARNING: Do not remove tower covers to access electrical wiring or fuses. Change only the fuses that are accessed from the outside of the instrument, without removing covers. Contact a Beckman Coulter Service Engineer if further access is required.

WARNING: Turn off and unplug power to the instrument before changing fuses. Failure to do so can cause electrical shock or equipment damage.

WARNING: To prevent injury, use proper decontamination procedures.

CAUTION: To prevent damage due to electrical static discharge (ESD), wear a wrist ground strap when removing a multichannel head.

CAUTION: Before removing the fourth shoulder screw, take hold of the head firmly to make sure it does not fall once all screws are removed.

CAUTION: To prevent damage due to electrical static discharge (ESD), wear a wrist ground strap when installing a multichannel head.

WARNING: Grippers may bend if not taught (framed) properly with the AccuFrame.

WARNING: Do not connect or disconnect any cable while power is applied to the Biomek NX.

WARNING: Avoid all labware on the Biomek NX deck when removing or installing grippers. It is recommended that all labware in the vicinity of the pod be moved or removed to avoid spills and contact with labware.

CAUTION: Use caution when removing grippers. Since grippers mount tightly into the Multichannel Pod, they pull free of the Multichannel Pod suddenly.

CAUTION: Do not make any changes to the pod axes limits in Hardware Setup without contacting a Beckman Coulter Service Engineer or Beckman Coulter Technical Support.

CAUTION: If the hardware configuration is not updated using Hardware Setup, hardware crashes or inaccurate liquid transfer may occur.

CAUTION: To avoid hardware crashes, a new D-axis limit must be established and the grippers framed in the Biomek Software after the head has been configured in Hardware Setup.

CAUTION: Always ensure that the grippers are retracted before homing.

CAUTION: Before selecting OK to home all axes, the following conditions must be met:

- **Make sure there is no liquid present in the tips**
- **Make sure there are no disposable tips loaded**
- **Make sure the Framing Probe is NOT installed on the Multichannel Pod.**
- **Make sure the grippers on the Multichannel Pod are retracted.**

WARNING: Turn off power to the Biomek NX instrument before attaching or removing AccuFrame from the instrument deck.

WARNING: Make sure the light curtain is not violated by the AccuFrame cable. If the light curtain is violated, the framing process halts immediately.

WARNING: Make sure the AccuFrame cable does not interfere with pod movement.

CAUTION: Use Shift deck only before other ALPs or positions are taught. Shift deck shifts all ALPs and positions, resulting in incorrect coordinates if applied to previously framed ALPs and positions.

CAUTION: Select Move Z-Max to move the pod to its highest point before extending the grippers. To avoid breaking labware or bending the grippers, make sure the grippers will not hit any labware when extended.

CAUTION: Do not retract grippers when they are holding labware.

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1 Biomek® NX Multichannel Instrument Introduction

1.1 Instrument Overview

The Biomek® NX Multichannel liquid handler is a multiaxis liquid-handling instrument used in the drug discovery laboratory. The open-architecture design, along with the extensible operating software, provides a foundation for integrating current and future specific-use components. The design of the Biomek NX provides the foundation for continual evolution and expansion of liquid-handling systems.

The Biomek NX Multichannel is equipped with a Multichannel Pod with a pair of grippers for grasping and moving labware (Figure 1-1). A variety of labware and hardware adapt the deck of the Biomek NX Multichannel to accomplish multiple tasks, ranging from performing simple labware positioning and liquid transfers to completing complex activities that typically require additional devices in the laboratory.

Note: For detailed information on the Multichannel Pod and interchangeable heads, refer to Chapter 2, *Multichannel Pod*.

The capabilities of the Biomek NX Multichannel liquid handler depend on the components installed, including the pod configuration, ALPs, and third party devices.

1.1.1 Control Modes

The Biomek NX Multichannel liquid handler is controlled using Biomek Software operated from the host computer. The Biomek NX Multichannel can be:

- Operated as a standalone instrument, gripping and moving microplates without the assistance of a laboratory robot using the gripper tool.
- Integrated into an automated robotic system.
- Operated using a combination of these capabilities.

1.2 System Components

The system components described below correspond to the configurations in Figure 1-1.

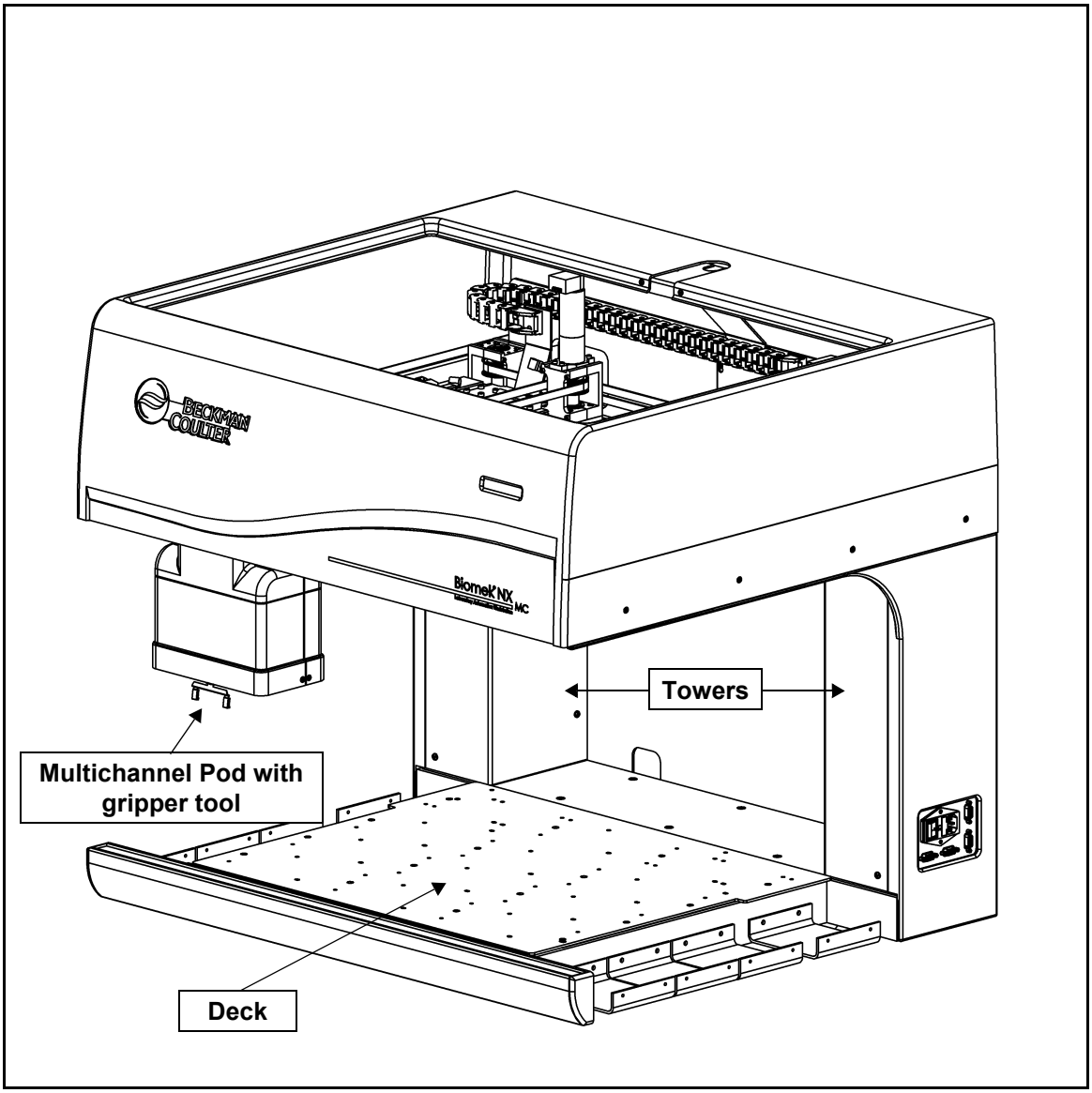

Figure 1-1. Biomek NX with Multichannel Pod

1.2.1 Towers

The Biomek NX Multichannel towers (Figure 1-1) form the two upright sections of the base unit along which the pod travels on the X-axis. The links for master control of the Biomek NX system, plus utility hook-ups and ALP connections, are located on the towers. Green and amber indicator lights are built into the main cover and keep users aware of the current operational status of the liquid handler.

The towers house the following connections (Figure 1-2), (Figure 1-3), and (Figure 1-4):

- Main power switch on the outside of the right tower.
- Communication hookup to host computer via RS232 on the outside of the right tower.
- Electrical plug-ins and CAN connections for active ALPs on the inside of the right tower and outside of both towers.

- Pneumatically regulated air supply ports outside of the left tower for active ALPs.
- Main power fuses for the instrument on the outside of the right tower.

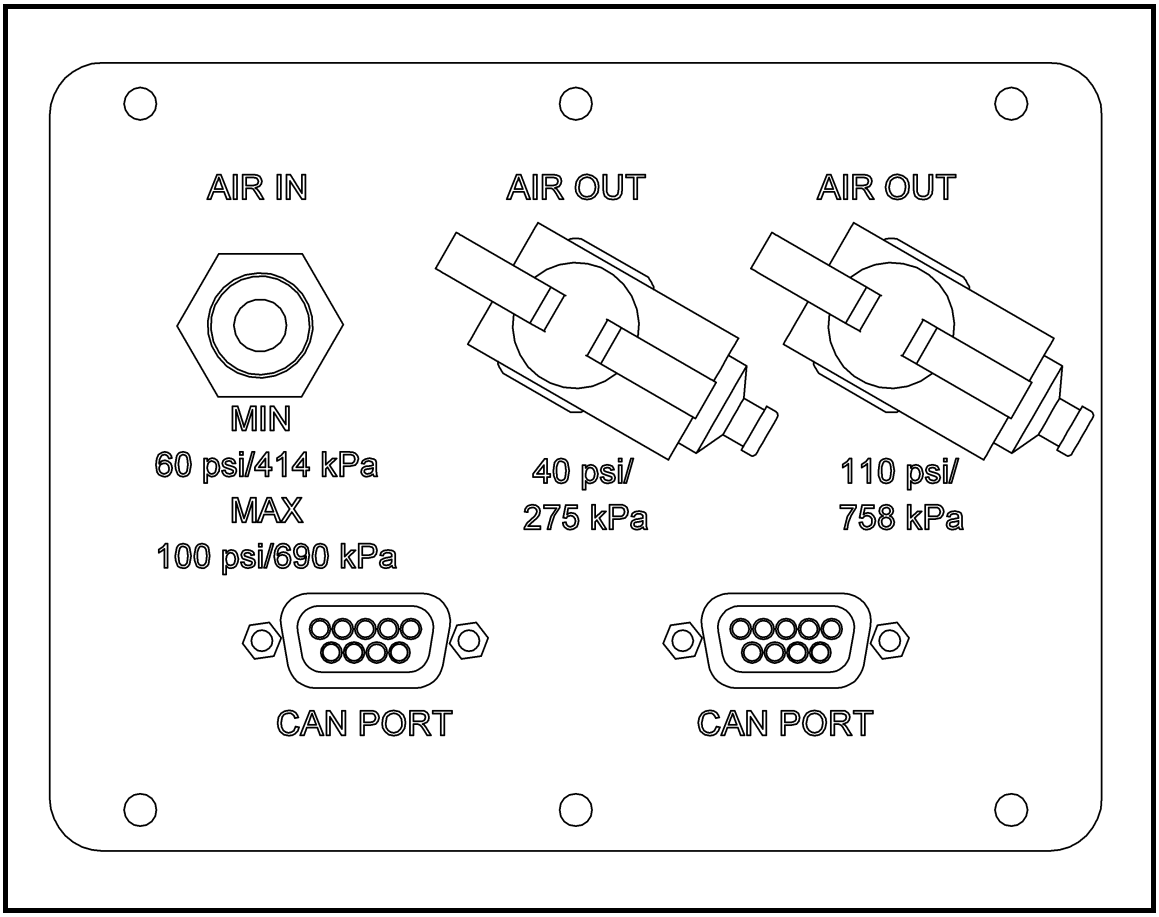

Figure 1-2. Left outside tower

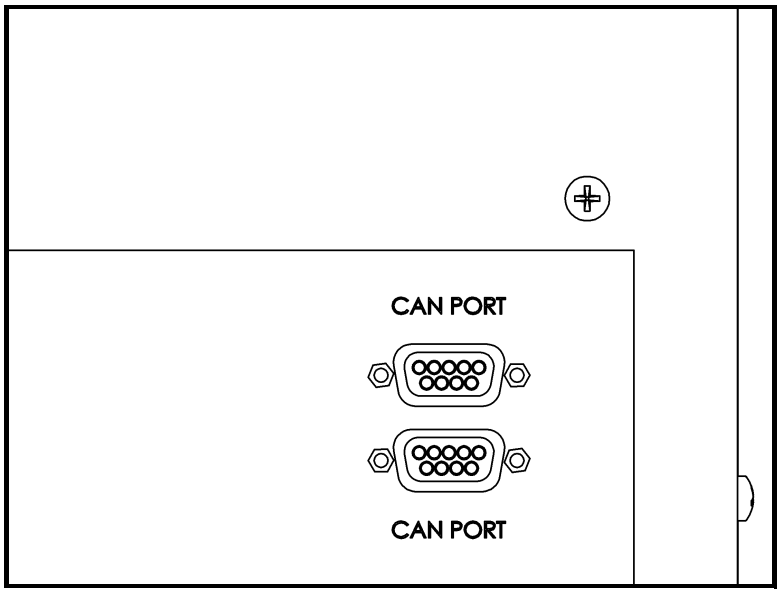

Figure 1-3. Right tower inside

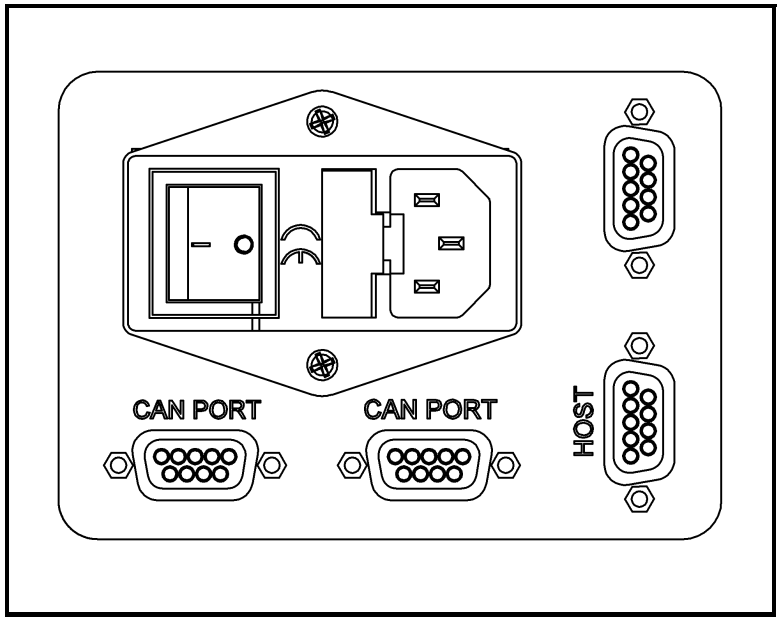

Figure 1-4. Right tower outside

1.2.2 Multichannel Pod

The Multichannel Pod is a self-contained component and holds various removable and interchangeable heads, such as the 96-Channel 200 µL Head, that perform liquid-handling operations, and a pair of grippers for labware movement operations. Refer to Chapter 2, *Multichannel Pod*, for more information on the Multichannel Pod.

The operation of the pod and probes are controlled by Biomek Software from the host computer.

1.2.3 Deck

The deck (Figure 1-1) is the worksurface of the Biomek NX instrument. The deck is laser-etched with standard deck positions. The deck also contains predrilled locating holes used to precisely position ALPs (refer to Section 1.2.4, *ALPs*).

Note: Some ALPs and devices require a Device Controller (refer to Section 1.2.5, *Device Controller*) to provide power and communications between the device and Biomek NX instrument.

1.2.4 ALPs

Automated Labware Positioners (ALPs) are interchangeable structures that are installed on the Biomek NX deck in suitable positions to accommodate a wide variety of labware. ALPs are either active or passive:

- *Passive ALPs* hold labware in place or act as receptacles for method by-products or consumables.
- *Active ALPS* contain mechanisms that may use power and/or air sources for various mechanical operations.

Note: Refer to the ALPs User's Manual for more information on ALPs.

1.2.5 Device Controller

A Device Controller is a peripheral box attached to the Biomek NX that provides a means to control a number of high voltage (110VAC-220VAC) digital devices, low voltage (24VDC) digital devices, and low voltage digital inputs. High voltage devices receive power through an AC Power Input, while low voltage devices receive power through one of the two Controller Area Network (CAN) interfaces located on the back of the Device Controller.

Note: Refer to the *ALPs User's Manual,* Appendix A:, *Device Controller*, for more information on the Device Controller.

1.2.6 Optional Devices

Optional devices, such as a stacker carousel, can be added to the Biomek NX Multichannel instrument to accommodate specific operations. Refer to Appendix B:, Using a Stacker Carousel

1.2.7 Protective Barriers

The Biomek NX Multichannel instrument has safety measures to protect the Biomek NX operator. Safety features of the Biomek NX liquid handler include a front light curtain and side safety shields (Figure 1-5).

Note: An optional side safety shield allowing device integrations is available.

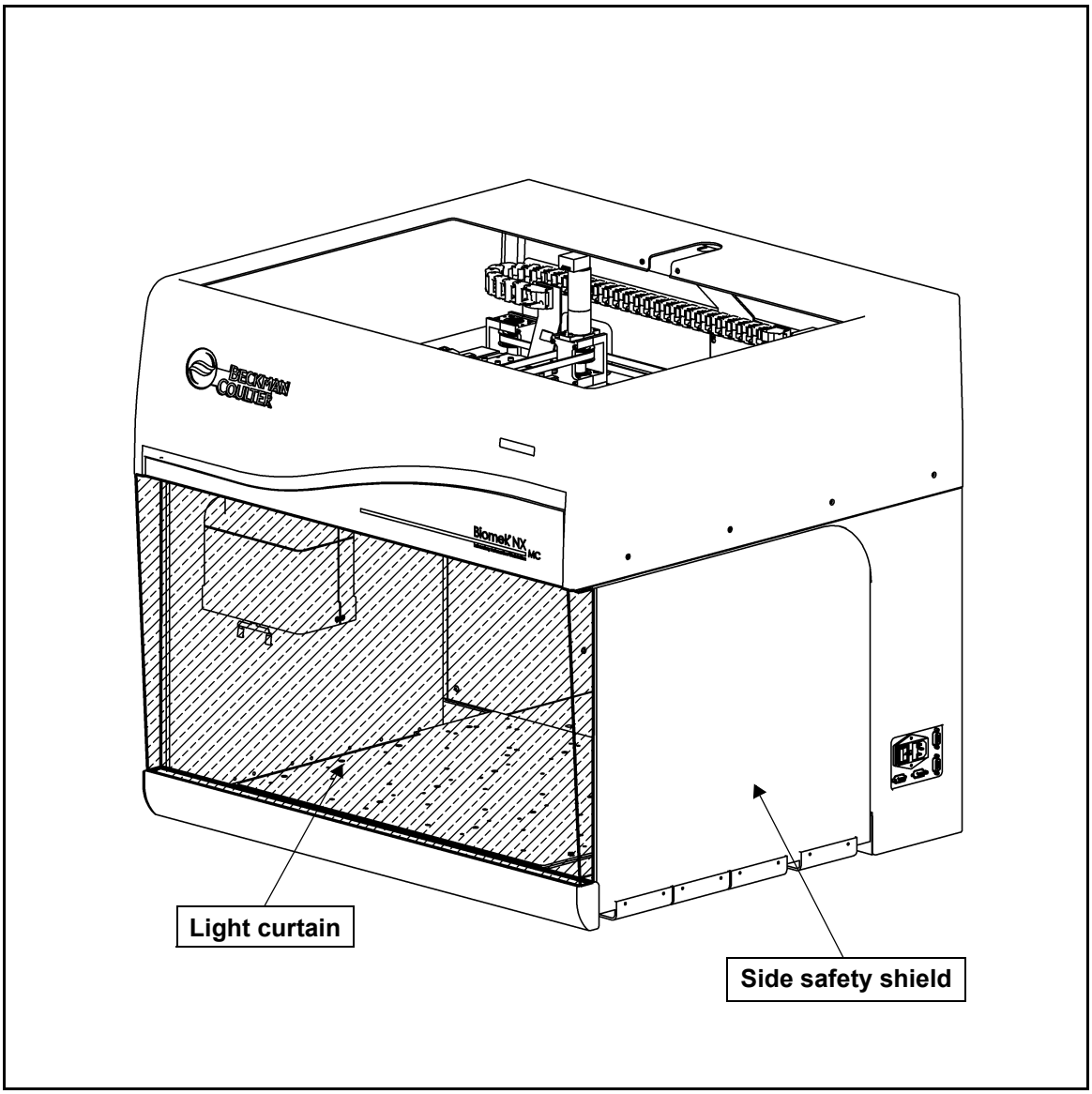

Figure 1-5. Protective barriers for the Biomek NX Instrument

1.2.7.1 Light Curtain Protection System

WARNING: Dark non-reflective material affects the sensitivity of the light curtain and adversely impact its effectiveness. Typical lab dress, such as lab coats and latex gloves, do not degrade light curtain operation; however, it is advisable to test the impact of the all lab dress on light curtain sensitivity before operating the Biomek NX. Verify lab dress impact on light curtain sensitivity as follows: Use Manual Control in Biomek Software and insert the material no more than 1” past and approximately 21” above the light curtain panel. Make sure the solid amber indicator light changes to blinking amber.

The diffuse-reflective perimeter light curtain along the front edge of the Biomek NX instrument is a standard component.

Note: Side safety shields are installed by a Beckman Coulter Service Engineer when the Biomek NX instrument is installed.

The light curtain projects a diffused array of infrared light, rather than a vertical laser-like beam (Figure 1-5). When a part of the human body or an object larger than approximately 1" in diameter (such as labware and large cables) penetrates this protective zone, the instrument shuts down immediately, stopping all pod and head operations. Some ALP operations, such as shaking or stirring, continue.

ALPs respond to a violation according to safety and operational requirements specific to each ALP. For example, a refilling reservoir may continue to operate if user safety is not compromised. ALPs that operate with a motion that could present a danger to the operator go to a safe state when the light curtain is violated.

Note: When active ALPs or optional devices are operating and the light curtain is violated, an error message may not appear until after the ALP or optional device operation is complete.

Note: It is important to become familiar with this protected zone. This reduces the possibility of causing the instrument to shut down accidentally during operation by unintentionally violating the light curtain zone.

When the instrument is sitting idle or in the paused mode, no violations are registered when the protective zone is penetrated. This allows full access to instrument components, ALPs, and labware on the Biomek NX deck during a pause or system idle time.

1.2.7.2 Side Safety Shields

WARNING: To reduce the risk of personal injury, operate the Biomek NX instrument only with all protective shields in place.

Side safety shields are installed by the Beckman Coulter Service Engineer on the Biomek NX instrument. If the instrument overhangs the table work surface on either side, a protective bottom shield is also installed on the side of the instrument overhanging the instrument envelope.

1.3 Troubleshooting

CAUTION: If service is required, contact a Beckman Coulter Service Engineer.

Perform the troubleshooting techniques provided in Table 1-1 when necessary.

In the case of any other instrument-related problems, contact a Beckman Coulter Service Engineer.

Note: For troubleshooting information regarding the specific pods, refer to the Troubleshooting section in those respective chapters.

Table 1-1. Troubleshooting the Biomek NX Instrument

If	Then
All indicator lights are out	Check fuses
The power is on, but system does not run	Check fuses
The fuses appear burned or filaments are broken	Change fuses (refer to Section 1.3.1, *Changing Fuses*)
All indicator lights are out, the power is on, the fuses are okay, and the system does not run	Contact a Beckman Coulter Service Engineer
Power is lost to pod	Contact a Beckman Coulter Service Engineer.
Y-axis motion is choppy	Contact a Beckman Coulter Service Engineer.
A grinding or growling noise is heard	Contact a Beckman Coulter Service Engineer.
Experiencing problems relating to the Multichannel Pod	Refer to Section 2.6, Troubleshooting in Chapter 2, *Multichannel Pod*, for more information.
Constant light curtain errors, even when no violation	Contact your Beckman Coulter Service Engineer.

1.3.1 Changing Fuses

WARNING: Do not remove tower covers to access electrical wiring or fuses. Change only the fuses that are accessed from the outside of the instrument, without removing covers. Contact a Beckman Coulter Service Engineer if further access is required.

WARNING: Turn off and unplug power to the instrument before changing fuses. Failure to do so can cause electrical shock or equipment damage.

The Biomek NX instrument uses any AC power source between 100V and 240V. The fuse holder holds two European fuses and one North American fuse.

Fuses are located in the outside right tower (Figure 1-6). If power is lost, check the fuses that are accessed from the outside of the instrument.

If fuses appear burned, change them by completing the following:

1. Turn off the instrument power switch.
2. Unplug the instrument from the power source.

3. Using a small flathead screwdriver, pry open the fuse carrier containing two fuses (Figure 1-6) from the AC power input module.

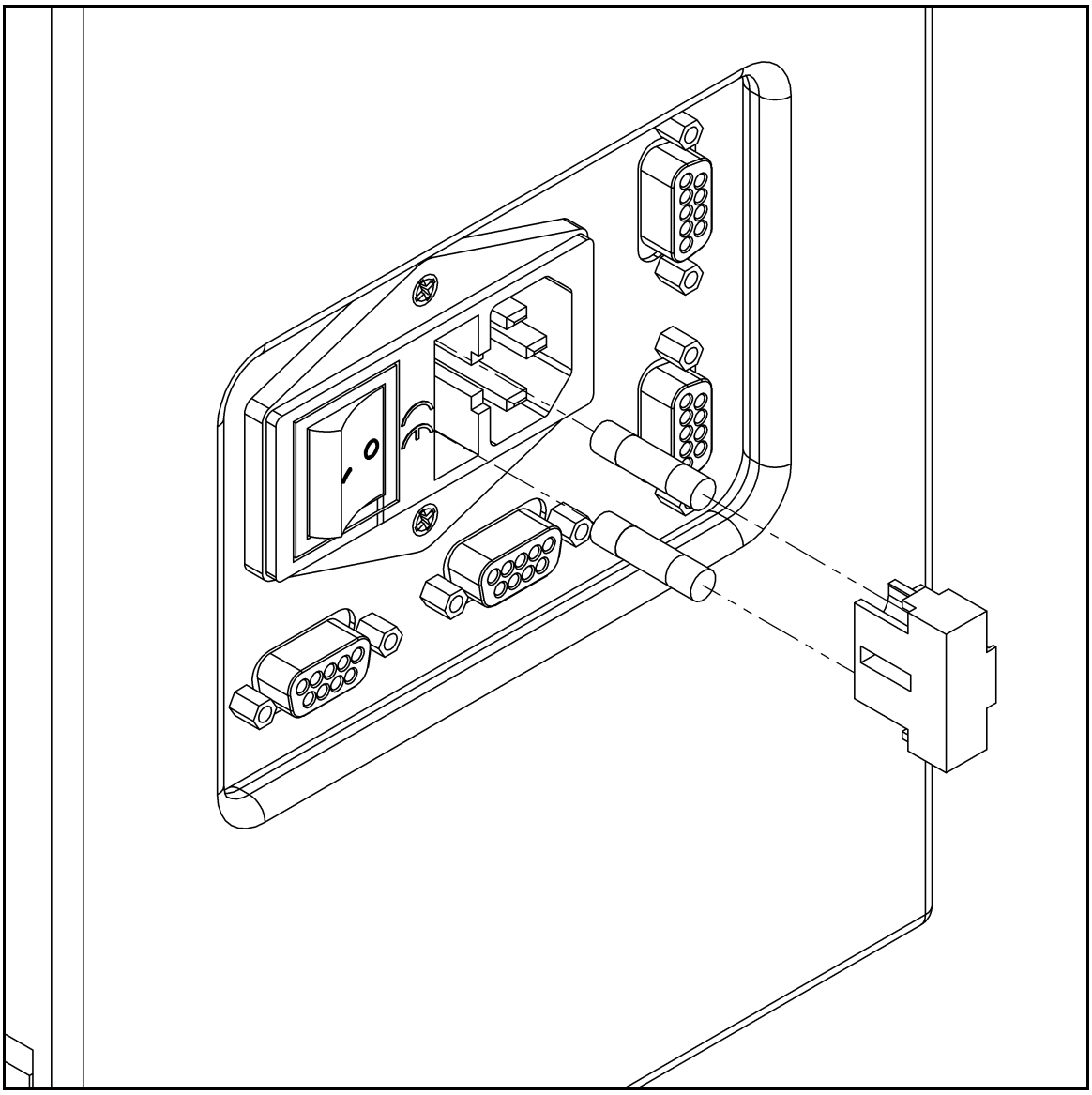

Figure 1-6. Replacing fuses in tower

4. Gently pull old fuses from the carrier by hand.
5. Gently place new fuses into carrier by hand.

Note: Use 250v 3.15 amp 5x20 Slow-Blow type fuses for replacement.

6. Replace the fuse carrier into the AC power input module.
7. Plug the instrument into the power source.
8. Turn on the instrument power switch.

1.4 Preventive Maintenance

To ensure optimum operation of the Biomek NX liquid handler, perform the following maintenance procedures as necessary.

WARNING: To prevent injury, use proper decontamination procedures.

- Wipe up all spills on the deck immediately.
- Approximately every 100 km of travel, or every six to twelve months, schedule a Beckman Coulter service call to lubricate the linear rail.
- Once a week, verify proper operation of light curtain using Manual Control in the software (refer to Chapter 5, *Manually Controlling the Biomek NX in Biomek Software*) and the light curtain test rod supplied with Biomek NX. Insert the test rod no more than 1" past and approximately 21" above the front light curtain panel. Check to make sure the solid amber indicator light changes to blinking amber each time the light curtain is violated. If not, contact a Beckman Coulter Service Engineer.
- When necessary, clean light curtain panels with a lint-free cloth.
- Once every 2-3 months, clean light curtain panels with a non-abrasive cleaner, making sure not to scratch the strip.

2 Multichannel Pod

2.1 Overview

The Multichannel Pod is a self-contained working unit on the Biomek NX Multichannel liquid handler (Figure 2-1). The Multichannel Pod is a full-microplate replication tool incorporating a gripper and interchangeable heads to accommodate a variety of functions (refer to Section 2.3, *Interchangeable Heads*).

The Multichannel Pod contains its own electrical cabling, communication, and pneumatic connections with the base unit, and it interacts with ALPs located over the entire deck area of the Biomek NX.

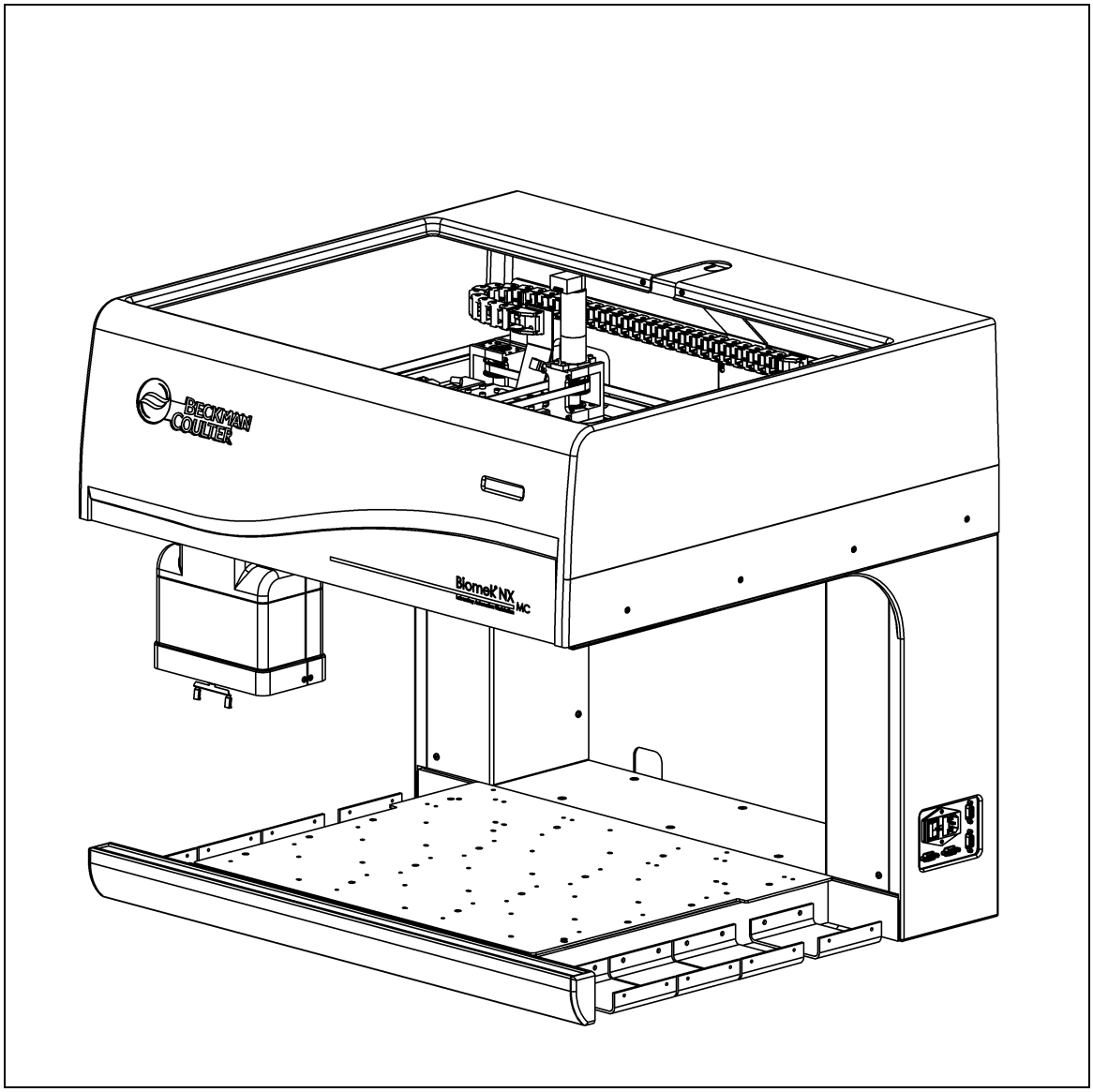

Figure 2-1. Multichannel Pod installed on Biomek NX

2.1.1 Main Components of the Multichannel Pod

The main components of the Multichannel Pod are (Figure 2-2):

- Pod — Houses operating mechanism, pneumatic air line, communication and electrical power connections to the base unit, and moves in the Y, Z, and D axes for liquid-handling functions (refer to Section 2.2, *Pod*).
- Head — Holds mandrels and tips for performing full-plate replication (refer to Section 2.3, *Interchangeable Heads*).
- Grippers — Grip and reposition labware by gripping along the long side of the labware (refer to Section 2.4, *Grippers*).

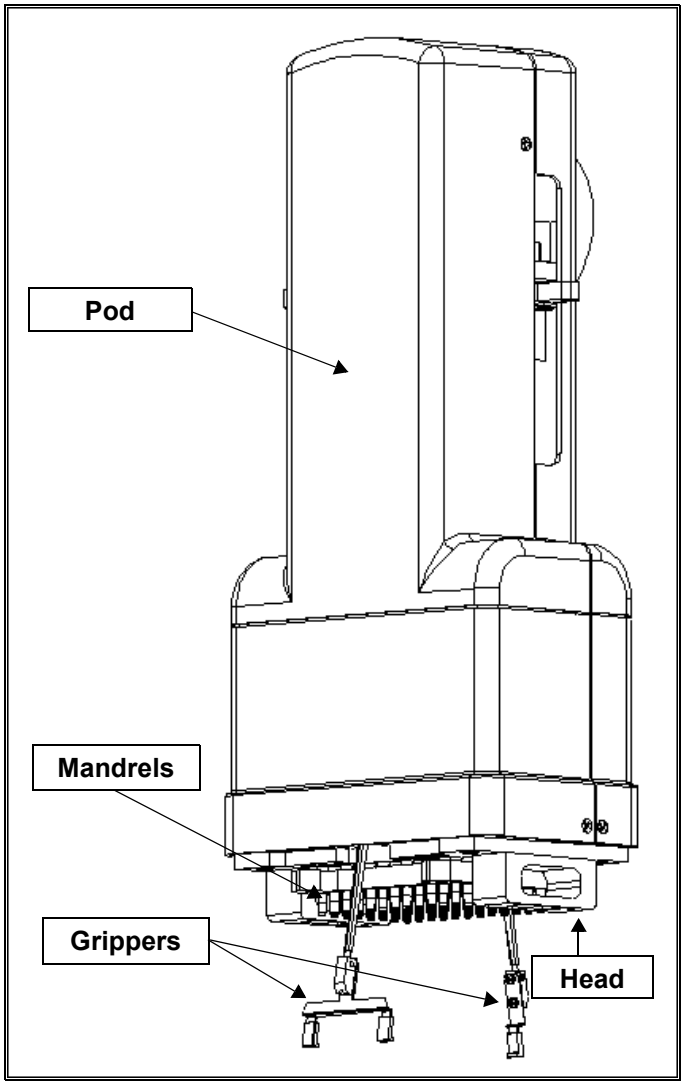

Figure 2-2. Multichannel Pod — main components

2.2 Pod

The Multichannel Pod is a full-microplate replication tool incorporating a gripper and interchangeable heads to accommodate a variety of functions.

2.2.1 Pod Movements

The Multichannel Pod performs movements in the Y-, Z-, and D-axes (see Table 2-1).

Table 2-1. Multichannel Pod Axes Movement

Axis	Movement
Y-	Entire pod moves front-to-back.
Z-	Entire pod moves up-and-down.
D-	Up-and-down aspirate/dispense, disposable tip shucking, and close/open gripper.

2.2.2 Control Modes

Commands entered via Biomek Software on the host computer control the operations of the Multichannel Pod. Manual control associated with the operation of the Multichannel Pod is accessed through Biomek Software.

Note: Refer to Chapter 5, *Manually Controlling the Biomek NX in Biomek Software*, for information on manually controlling the Multichannel Pod.

2.3 Interchangeable Heads

An interchangeable, multichannel head is attached to the bottom of the pod to perform a specific liquid-handling procedure. Depending on the head and the desired liquid-handling procedure, different tip types may be used.

Presently, there are three types of heads that can be attached to the Multichannel Pod:

- 96-Channel 20 µL Head
- 96-Channel 200 µL Head
- 384-Channel 30 µL Head

Interchangeable heads installed on the Multichannel Pod aspirate and dispense liquid using disposable tips. The tips compatible and the maximum volume that may be aspirated and dispensed with those tips varies for each head, as described in Table 2-2..

Table 2-2. Tip compatibility and max volumes on Multichannel Heads

Head / Tip Type	P20	P20_Barrier	P30	P200	P200_Barrier
96-Channel 20 µL Head	55 µL	20 µL	--	55 µL	50 µL
96-Channel 200 µL Head	120 µL	20 µL	--	225 µL	125 µL
384-Channel 30 µL Head	--	--	35 µL	--	--

2.3.1 Changing Heads

Each Multichannel head can be removed and replaced to accommodate the needs of a particular method.

Note: When a head is changed, the Hardware Setup must be changed appropriately. If the hardware configuration is not updated using Hardware Setup, inaccurate pipetting may occur (refer to Section 3.3, Configuring a Multichannel Pod).

2.3.1.1 Removing Heads

CAUTION: To prevent damage due to electrical static discharge (ESD), wear a wrist ground strap when removing a multichannel head.

Note: A wrist ground strap, which must be attached to the instrument deck (base plate) using the "alligator" clip, is supplied with the Biomek NX instrument (Figure 2-3).

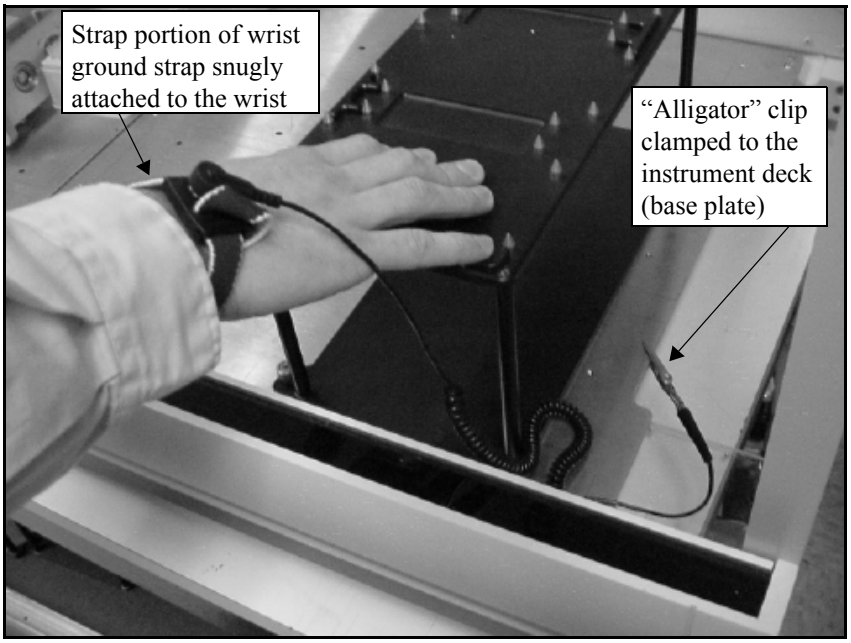

Figure 2-3. Wrist ground strap attached to the deck

The same method is used to remove the 96-Channel 20 µL Head, 96-Channel 200 µL Head, and 384-Channel 30 µL Head.

Removing a head from the Multichannel Pod includes:

- removing the bottom cover.
- removing the head.

2.3.1.1.1 Removing the Bottom Cover

To remove the bottom cover to expose the head:

1. In Hardware Setup, select the appropriate Multichannel **Pod**.

   Note: A Multichannel Pod is identified with a 96 or 384

2. Choose **Change Head**.

   Note: Choosing Change Head moves the D-axis to –0.6 cm and extends the grippers.

3. Turn off power to the Biomek NX instrument.
4. Position the strap portion of the wrist ground strap snugly around the wrist.
5. Clamp the "alligator" clip of the wrist ground strap to the instrument deck (base plate) (Figure 2-3).

6. Using a Phillips screwdriver, remove the three screws from the plastic bottom cover (Figure 2-4).

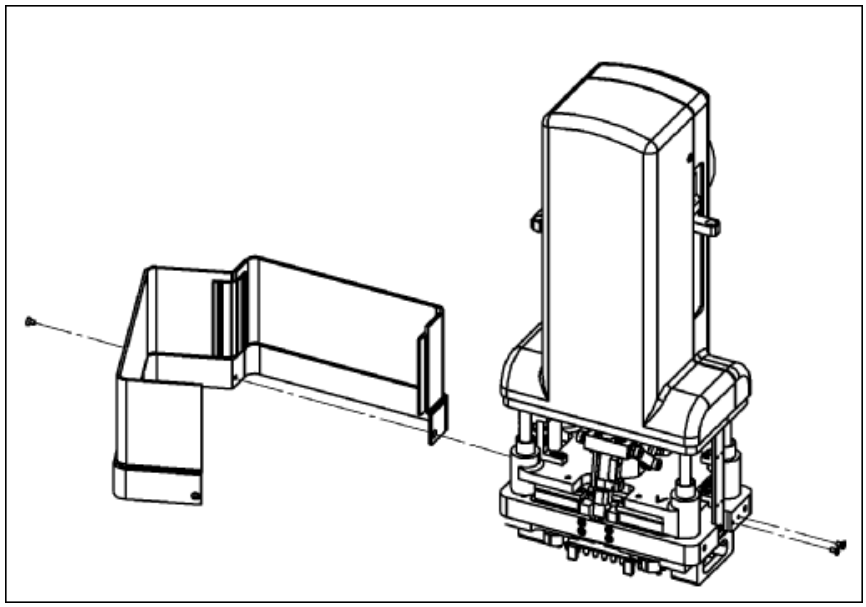

Figure 2-4. Bottom cover removed from the pod

7. Carefully open and remove the bottom cover.

Note: Do not remove top cover.

2.3.1.1.2 Removing the Head

To remove the head from the pod:

1. Make sure the head is completely in the down position (D-axis) before proceeding with removing the head. This helps to ensure that the seals are protected during removal.
2. Using the 9/64 Allen wrench provided, remove the four plunger screws from the plunger plate (Figure 2-5) in the sequence designated in Figure 2-6.

CAUTION: Before removing the fourth shoulder screw, take hold of the head firmly to make sure it does not fall once all screws are removed.

Note: It is very important to remove the plunger screws in the correct sequence *before* removing the shoulder screws in the correct sequence.

3. With the same 9/64 Allen wrench, remove the four shoulder screws from the mandrel plate (Figure 2-5) in the sequence designated in Figure 2-6.

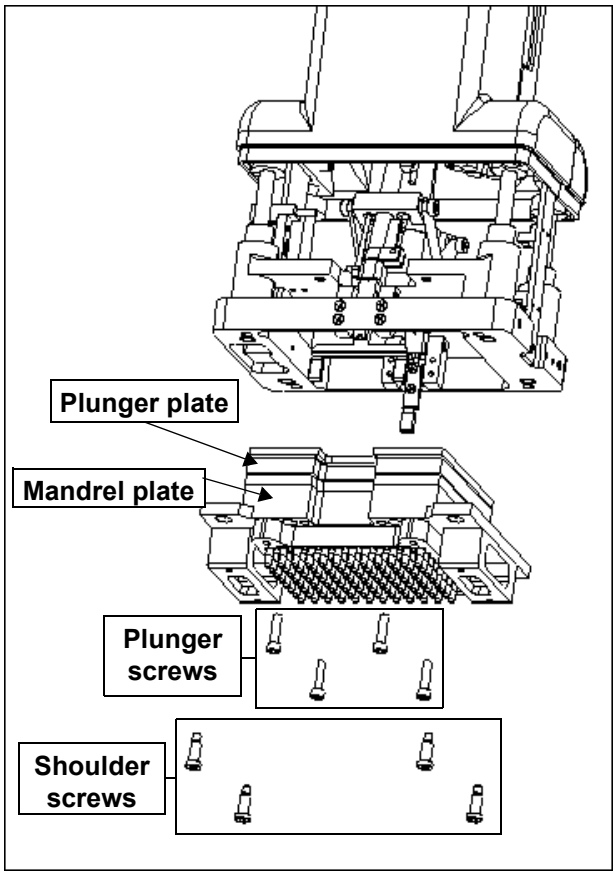

Figure 2-5. Plunger screws and shoulder screws removed from multichannel head

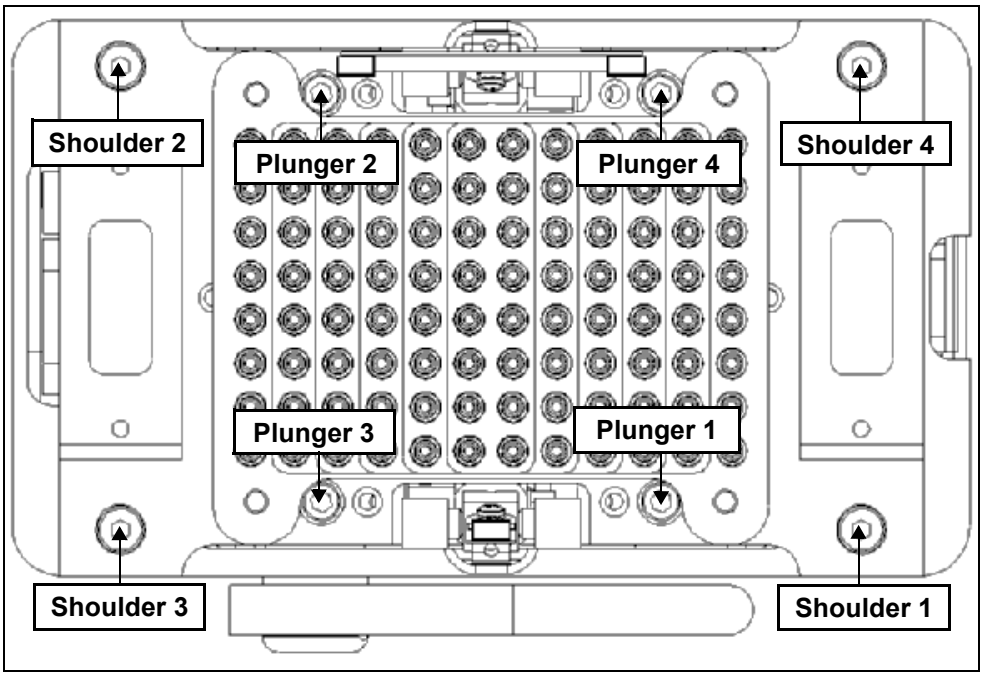

Figure 2-6. Sequence for removing four plunger screws and four shoulder screws on all multichannel heads

4. Slide the head down and out of the pod. Due to the weight of the head (approximately five pounds), maintain a firm grasp on the head while sliding the head out.
5. Cover and store the head flat side down in a clean, cool, dry place.

2.3.1.2 Installing Multichannel Heads

CAUTION: To prevent damage due to electrical static discharge (ESD), wear a wrist ground strap when installing a multichannel head.

Note: A wrist ground strap, which must be attached to the instrument deck (base plate) using the "alligator" clip, is supplied with the Biomek NX instrument.

The same method is used to install the 96-Channel 20 µL Head, 96-Channel 200 µL Head, and 384-Channel 30 µL Head.

To install a head:

1. In Hardware Setup, select the appropriate Multichannel **Pod**.

   Note: A Multichannel Pod is identified with a 96 or 384.

2. Choose **Change Head**.

   Note: Choosing Change Head moves the D-axis to –0.6 cm and extends the grippers.

3. Turn off power and make sure the plastic bottom cover is removed (Figure 2-4).

   Note: Do not remove top cover.

4. Position the strap portion of the wrist ground strap snugly around the wrist (Figure 2-3).

5. Clamp the “alligator” clip of the wrist ground strap to the instrument deck (base plate) (Figure 2-3).
6. With the chamfers (Figure 2-7) pointed to the back of the instrument, carefully slide the head up into the pod.

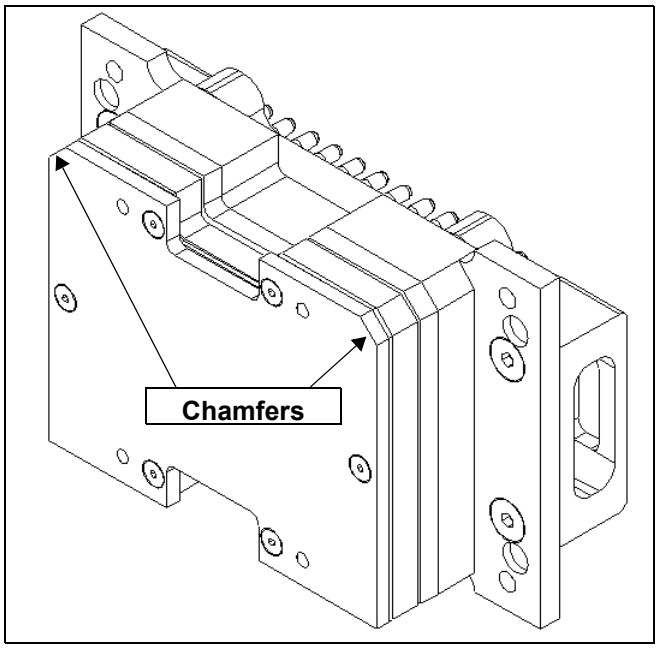

Figure 2-7. Chamfer location on a Multichannel head

7. Slide the first shoulder screw (Shoulder 1) into the head (Figure 2-6). Make sure the shoulder screw is in far enough to engage the threads.

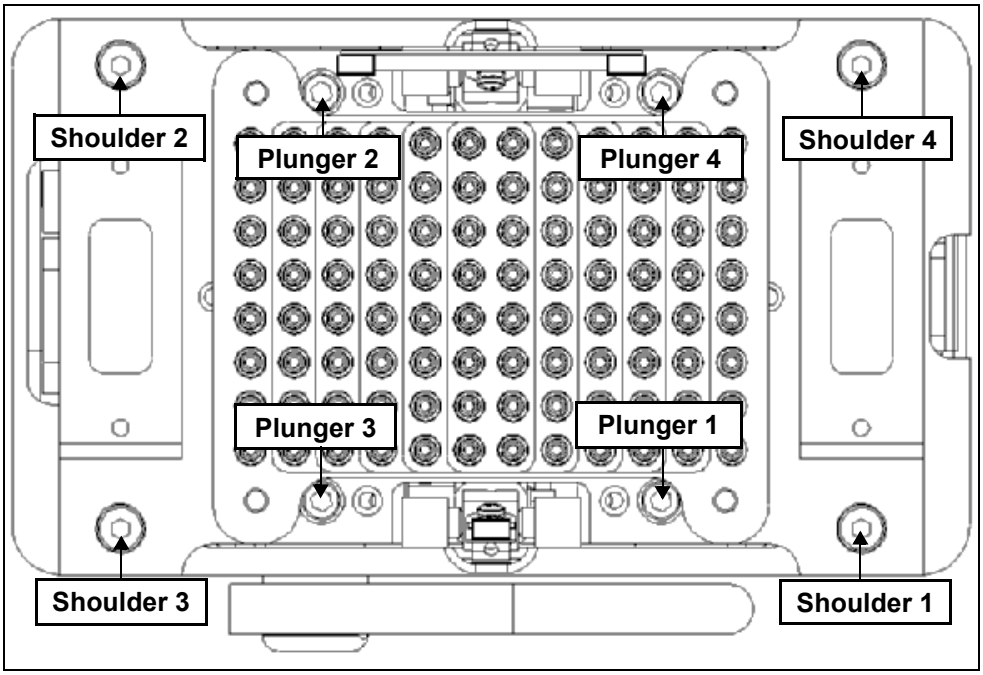

Figure 2-8. Sequence for installing four plunger screws and four shoulder screws on all multichannel heads

8. Using a 9/64 Allen wrench, tighten the first shoulder screw until it is snug, then back it off (loosen it) 1/2 turn.

   Note: This 1/2 turn allows the other three shoulder screws to be installed without skewing the head.

9. Using the sequence designated in (Figure 2-8), follow the procedure in step 6 to install the remaining three shoulder screws.
10. After all four shoulder screws are installed, go back and tighten them securely in the same order.
11. Using a 9/64 Allen wrench, follow the installation sequence designated in Figure 34-8 to install the four plunger screws. Turn each plunger screw until barely snug.
12. After all four plunger screws are installed, go back and tighten all of them securely in the same order.
13. Replace the bottom pod cover and tighten the three screws.
14. Turn on the power.
15. Retract the grippers using Advanced Manual Control.

Note: After installing a multichannel head on a Multichannel Pod, Hardware Setup must be updated (refer to Section 3.3, Configuring a Multichannel Pod).

2.4 Grippers

The Multichannel Pod incorporates a gripper tool (grippers) (Figure 2-9) that grasps and moves labware from one location on the Biomek NX deck to another.

Grippers can:

- move labware no taller than 2.35 inches in height.
- move stacks of standard height labware no more than four plates high (maximum 2.35 inches).

Note: Grippers stack and unstack groups of labware from the bottom. If a stack containing four pieces of labware is being unstacked, the grippers grasp the top three and move them to a new position. Then, the grippers grasp the top two of that stack and move them; finally, the grippers grasp the top piece of labware in that stack and move it to a new location.

- place lids on and remove lids from labware.
- remove lids from tip boxes.

Note: Grippers do not place lids on tip boxes.

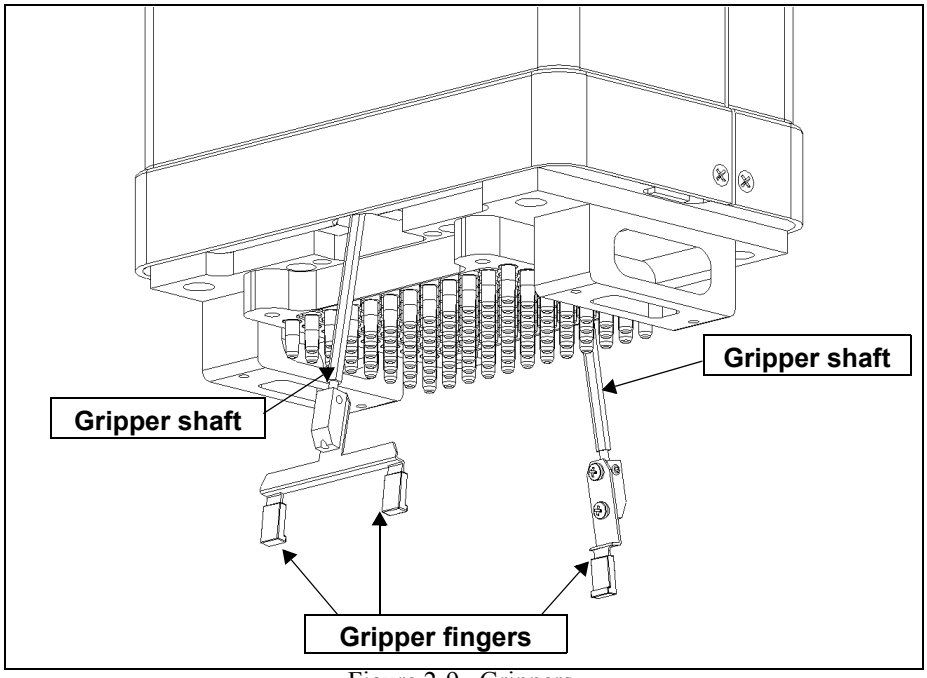

Figure 2-9. Grippers

The grippers contain two fingers:

- a double gripper located to the front of the instrument
- a single gripper located to the back of the instrument

2.4.1 Framing Grippers

WARNING: Grippers may bend if not taught (framed) properly with the AccuFrame.

Grippers are framed during installation by a Beckman Coulter Service Engineer. The framing process for the grippers must be repeated when:

- A head is changed.
- Extraordinary circumstances occur, such as accidentally bending a gripper.

Should grippers need to be framed, refer to Section 4.4, *Framing the Grippers*.

2.5 Preventive Maintenance

The Multichannel Pod requires little preventive maintenance; however, to ensure optimum operation, perform the following maintenance procedures as necessary.

WARNING: To prevent injury, use proper decontamination procedures.

- Wipe up all spills immediately.
- Return heads to their original packaging when they are not in use.
- Check connections periodically to make sure that all are secure (refer to Section 2.6, *Troubleshooting*).
- Check and tighten head mount screws and gripper mount screws.
- Make sure that gripper shafts are straight and gripper pads are in good condition. Replace as needed (refer to Section 2.6.1, *Replacing Grippers*).

2.6 Troubleshooting

WARNING: Do not connect or disconnect any cable while power is applied to the Biomek NX.

Perform the troubleshooting techniques provided in Table 2-3 when necessary.

Note: In the case of any other pod-related problems, contact a Beckman Coulter Service Engineer.

Table 2-3. Multichannel Pod Troubleshooting

If	Then
Power is lost to the pod.	Contact a Beckman Coulter Service Engineer.
Grippers are not deploying.	Check input air pressure. Contact a Beckman Coulter Service Engineer.
Power is lost to the Y-axis.	Contact a Beckman Coulter Service Engineer.
The head does not work properly.	Contact a Beckman Coulter Service Engineer.
Aspiration or dispense actions are not accurate.	Contact a Beckman Coulter Service Engineer.
A mandrel on the head is damaged.	Contact a Beckman Coulter Service Engineer—the head may need to be returned to the factory for repair or replacement.
Front gripper shaft is bent.	Replace the front gripper fingers using Front Removeable Rod Assembly, Beckman Coulter Part Number 394062. Refer to Section 2.6.1, *Replacing Grippers*, for instructions.
Front gripper pads look worn.	
Rear gripper shaft is bent.	Replace the rear gripper fingers using Rear Removeable Rod Assembly, Beckman Coulter Part Number 394063. Refer to Section 2.6.1, *Replacing Grippers*, for instructions.
Rear gripper pads look worn.	

2.6.1 Replacing Grippers

Grippers are easily replaced by pulling the damaged grippers out of the head and pushing the replacement grippers into the head.

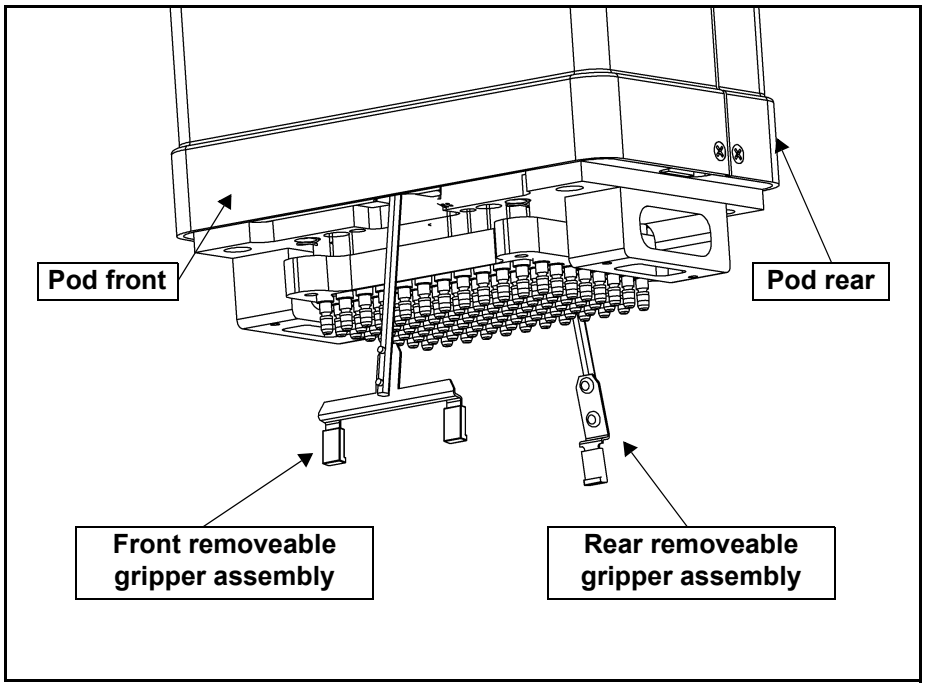

Figure 2-1. Installed replaceable grippers

2.6.1.1 Removing Gripper Fingers

WARNING: Avoid all labware on the Biomek NX deck when removing or installing grippers. It is recommended that all labware in the vicinity of the pod be moved or removed to avoid spills and contact with labware.

CAUTION: Use caution when removing grippers. Since grippers mount tightly into the Multichannel Pod, they pull free of the Multichannel Pod suddenly.

To remove grippers:

1. Move the Multichannel Pod to the maximum Y- and Z-axis limits (refer to Section 5.4, *Using Advanced Manual Control*).
2. Grasp both sides of the gripper (Figure 2-10).
3. Apply force in a downward direction to pull the gripper from the head.

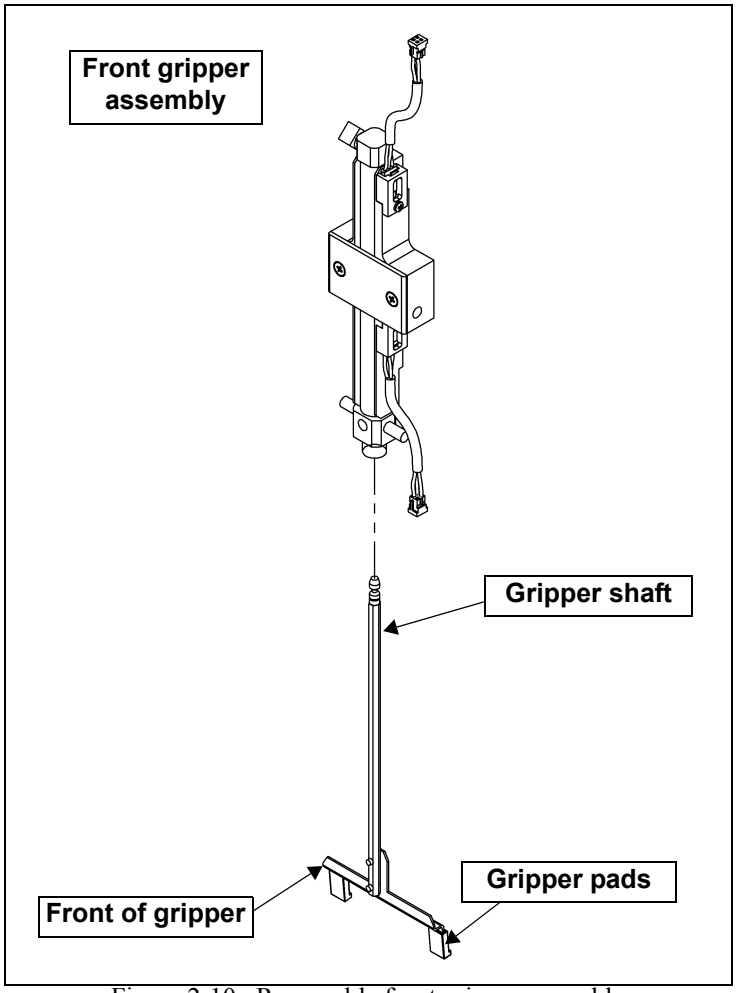

Figure 2-10. Removable front gripper assembly

2.6.1.2 Installing Gripper Fingers

WARNING: Avoid all labware on the Biomek NX deck when removing or installing grippers. It is recommended that all labware in the vicinity of the pod be moved or removed to avoid spills and contact with labware.

To install gripper fingers:

1. Move the Multichannel Pod to the maximum Y- and Z-axis limits (refer to Section 5.4, *Using Advanced Manual Control*).
2. Orient the gripper so that the front of the gripper faces the outside and gripper pads face the inside of the Multichannel Pod (Figure 2-10).
3. Grasping both sides of the gripper, push the gripper straight up into the Multichannel Pod.

   Note: A click can be heard and felt when the grippers are seated in the Multichannel Pod.

4. Pull down on the gripper to ensure that it is fully seated in the pod.
5. Reframe the Multichannel Pod (refer to Section 4.4, *Framing the Grippers*).

3 Configuring the Biomek® NX-MC in Biomek Software

3.1 Overview

The Biomek NX Multichannel liquid handler must be configured in Biomek Software to ensure proper operation. Hardware Setup tells Biomek Software what devices, pods, and heads to expect on the instrument by providing a connection between the instrument and the software. This connection is established by installing, configuring, and removing devices in Hardware Setup.

Any active ALPs that require a CAN communication or other devices integrated on the deck of the Biomek NX Multichannel must also be configured in Hardware Setup. Refer to the ALPs User's Manual or the specific device integration manual for instructions on configuring the ALP or device in Hardware Setup.

CAUTION: Do not make any changes to the pod axes limits in Hardware Setup without contacting a Beckman Coulter Service Engineer or Beckman Coulter Technical Support.

Hardware Setup is used for:

- *Configuring the Biomek NX Multichannel Instrument* (Section 3.2).
- *Configuring a Multichannel Pod* (Section 3.3).
- *Saving, Restoring, and Deleting Settings* (Section 3.4).

3.1.1 Accessing Hardware Setup

Hardware Setup (Figure 3-1) is accessed from within Biomek Software.

To access Hardware Setup:

1. Choose **Start>Programs>SAGIAN Software>Biomek**. Biomek Software appears.
2. From the Instrument menu, choose **Hardware Setup**. Hardware Setup appears (Figure 3-1).

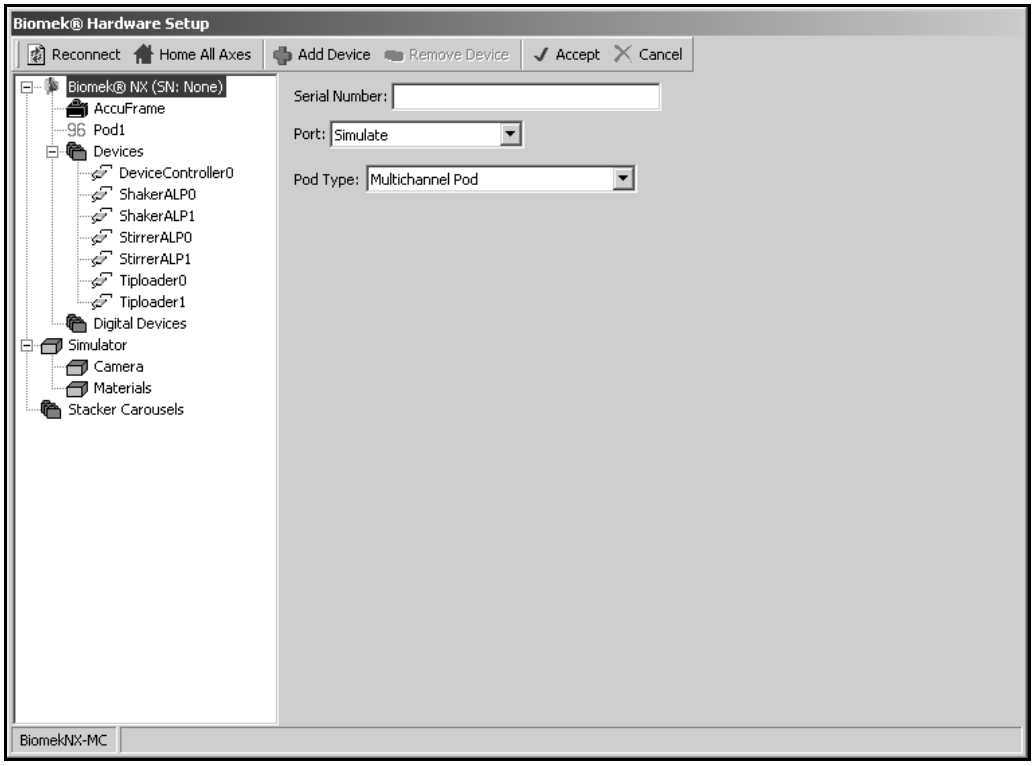

Figure 3-1. Hardware Setup for a Biomek NX Multichannel instrument.

3.1.2 Understanding the Options in Hardware Setup

An understanding of the options on the toolbar in Hardware Setup (Figure 23-1) is necessary to properly install, configure, and remove devices.

Table 23-1 lists and describes the toolbar options in Hardware Setup:

Table 3-1. Hardware Setup Options

Option	Description
Reconnect	Allows Hardware Setup to reexamine the devices present. Choose this option to determine what devices are present rather than closing and reopening Hardware Setup.
Home All Axes	Provides the Biomek NX Multichannel instrument with a point of reference from which to make subsequent moves. Home position is left, back. **Note:** The pod must be homed each time the Biomek NX instrument is powered on.
Add Device	Installs a device.
Remove Device	Removes a device.
Accept	Saves all changes to the instrument and closes Hardware Setup. Choose this option after the device has been installed and configured.
Cancel	Closes Hardware Setup without saving the modifications to the instrument.

3.2 Configuring the Biomek NX Multichannel Instrument

The Biomek NX Multichannel instrument is configured in Hardware Setup to relate information about the configuration of the multichannel pod on the system to the software and to specify the communications port to which it is connected.

To configure the Biomek NX instrument:

1. From Hardware Setup, select **Biomek® NX** from the left pane. The configuration view appears in the right pane (Figure 3-1).
2. Make sure the serial number listed in Hardware Setup corresponds to the serial number on the Biomek NX instrument.
3. Choose the appropriate **Port**.
4. Choose **Accept.** Hardware Setup closes.

Note: Accept must be chosen after the instrument has been configured to allow Hardware Setup to accept the configurations. However, other devices may be configured simultaneously as the Biomek NX instrument is configured, and Accept may be chosen after all devices have been configured.

Note: An asterisk next to the device indicates the device has been modified since the instrument was loaded.

3.3 Configuring a Multichannel Pod

The Multichannel Pod is a full-microplate replication tool incorporating a gripper and interchangeable heads to accommodate a variety of functions (refer to Chapter 2, Multichannel Pod).

Configuring a Multichannel Pod in Hardware Setup includes:

- *Configuring a New Head* (Section 3.3.1).
- *Setting Multichannel Pod Properties* (Section 3.3.2), as instructed by a Beckman Coulter Service Engineer.

Note: The settings for a Multichannel Pod can be saved, restored, and deleted (refer to Section 3.4, Saving, Restoring, and Deleting Settings).

3.3.1 Configuring a New Head

When a head on a Multichannel Pod is changed, the Hardware Setup must be changed appropriately.

CAUTION: If the hardware configuration is not updated using Hardware Setup, hardware crashes or inaccurate liquid transfer may occur.

CAUTION: To avoid hardware crashes, a new D-axis limit must be established and the grippers framed in the Biomek Software after the head has been configured in Hardware Setup.

To change the head on a Multichannel Pod (refer to Section 2.3.1, Changing Heads) and then configure Hardware Setup according to the following instructions.

1. In Hardware Setup, select the **Pod**.
2. Change the **Serial Number** to correspond to the serial number on the new head.

3. Choose the appropriate head in **Head Type** (Figure 3-2).

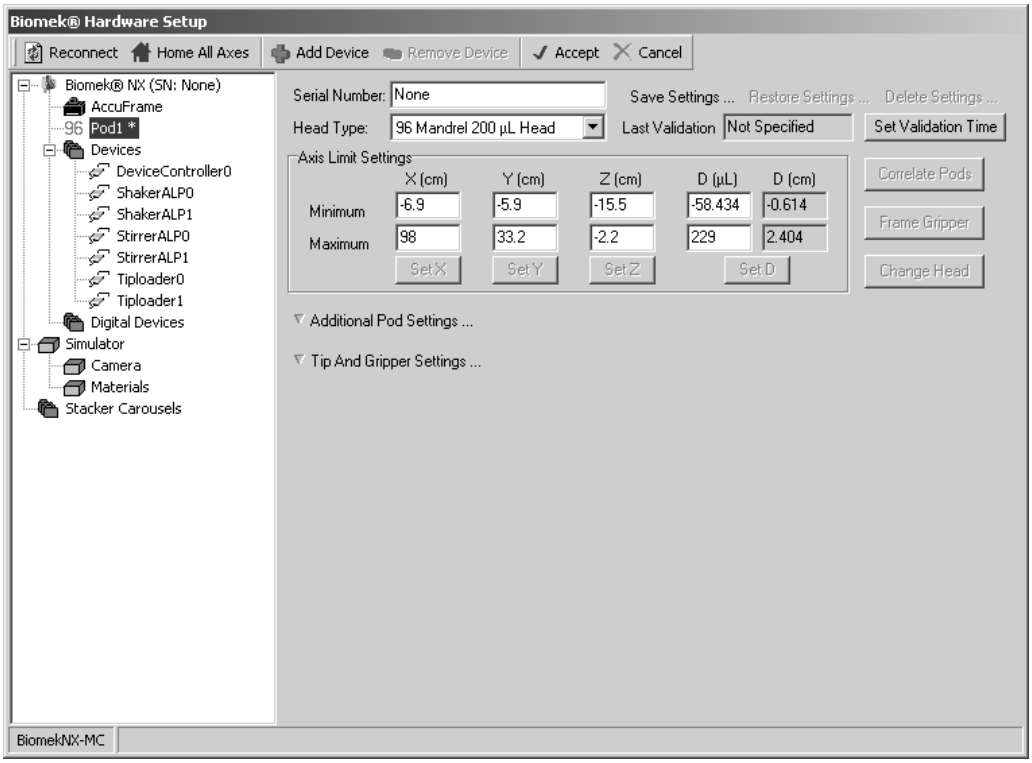

Figure 3-2. Hardware Setup showing the configuration of a Multichannel Pod

CAUTION: Always ensure that the grippers are retracted before homing.

4. Choose **Home All Axes**. Choosing Home All Axes homes all pod axes. The following Warning appears (Figure 3-3):

Figure 3-3. Warnings must be addressed before homing process begins

5. Choose **OK** after confirming that the Warning has been addressed appropriately.

Note: Additional Warnings may appear depending on deck configuration and the type of head installed on the Biomek NX Multichannel instrument. Address all warnings appropriately and choose **OK** to continue.

6. In Hardware Setup, choose **Set D** to establish a new D-axis limit.

7. Choose **Set Z** to establish a new Z-axis limit.
8. Frame the grippers according to the procedures outlined in Section 4.4, *Framing the Grippers*.

Note: An asterisk next to the pod indicates that the head has been modified since the workspace was loaded.

Note: Change Head is used only when physically removing or installing a head. Choosing Change Head moves the D-axis to –0.6 cm and extends the grippers to remove and install a head.

3.3.2 Setting Multichannel Pod Properties

Most of the properties, including pod settings and axes limits, of a Multichannel Pod are initially configured by a Beckman Coulter Service Engineer in Hardware Setup and should not be modified without specific instructions from a Beckman Coulter Service Engineer or Beckman Coulter Technical Support.

CAUTION: Do not make any changes to the pod axes limits without contacting a Beckman Coulter Service Engineer or Beckman Coulter Technical Support.

Table 23-2 describes the pod properties and axes limits listed in Hardware Setup for a Multichannel Pod.

Table 3-2. Multichannel Pod Properties

Property	Description
Additional Roving Height	Margin above the default height for the pod as it moves over everything on the deck.
Additional Timeout	Specifies a number of seconds to wait in addition to the normal time it takes to carry out a step before a timeout error occurs. Use when experiencing timeout problems without actual hardware problems.
Always move to max Z when roving	Check this field to move the pod to its maximum height during any move in the X- or Y-axis.
Enable Plate Sensor	Enables the plate sensor on the grippers to sense labware. Default setting is checked (enabled). Refer to Section 3.3.2.1, Using the Plate Sensor.
Final D Position (under Tip Load Settings)	Position the pod returns to along the D-axis after loading tips.
Final D Position (under Tip Unload Settings)	Position the pod returns to along the D-axis after unloading tips.
Gripper Extend Time	Specifies the time the pod takes to extend grippers.
Gripper Retract Time	Specifies the time the pod takes to retract grippers.

Table 3-2. Multichannel Pod Properties (Continued)

Property	Description
Gripper X, Y, Z, D Offsets	Controls gripping operation along X-, Y-, Z-, and D-axes from center of back edge of deck position. These offsets are automatically updated when the grippers are framed. **Note:** Gripper X offset is read-only.
Last Validation	Set by a Beckman Coulter Service Engineer, using the Set Validation button.
Maximum X, Y, Z, D	The furthest position the pod may move to along the X-, Y-, Z-, and D-axes (relative to the Home position). Set by using the appropriate buttons under the X (cm), Y (cm), Z (cm), and D (µL) columns. The D-axis must be established when a head is changed, but do not change the other axes limits without contacting a Beckman Coulter Service Engineer.
Minimum X ,Y, Z, D	The closest position the pod may move to along the X-, Y-, Z-, and D-axes (relative to the Home position). Set by using the appropriate buttons under the X (cm), Y (cm), Z (cm), and D (µL) columns. The D-axis must be established when a head is changed, but do not change the other axes limits without contacting a Beckman Coulter Service Engineer
Speed Limit	Controls the speed for pod movement based on a percent of its maximum speed.
Tip Settle Time	Specifies the time required for tips to settle on the mandrels after loading.
Tip Unload Time	Specifies the amount of time the pod takes to unload tips.
Unload Speed	Controls the pod speed when unloading tips, based on a percentage of the maximum pod speed. Recommended that this be modified only by a Beckman Coulter Service Engineer.

3.3.2.1 Using the Plate Sensor

A plate sensor is available on the grippers.

When the grippers have a plate sensor and Enable Plate Sensor (Figure 3-4) is checked in Hardware Setup or for the specific labware in the Labware Type Editor, labware can be sensed when the grippers are squeezed.

An error message (Figure 3-5) appears if labware is not sensed when the grippers are squeezed. Refer to the *Biomek® Software User's Manual,* Chapter 26, *Handling and Preventing Errors*, for information on recovering from errors.

Note: By default, Enable Plate Sensor is enabled.

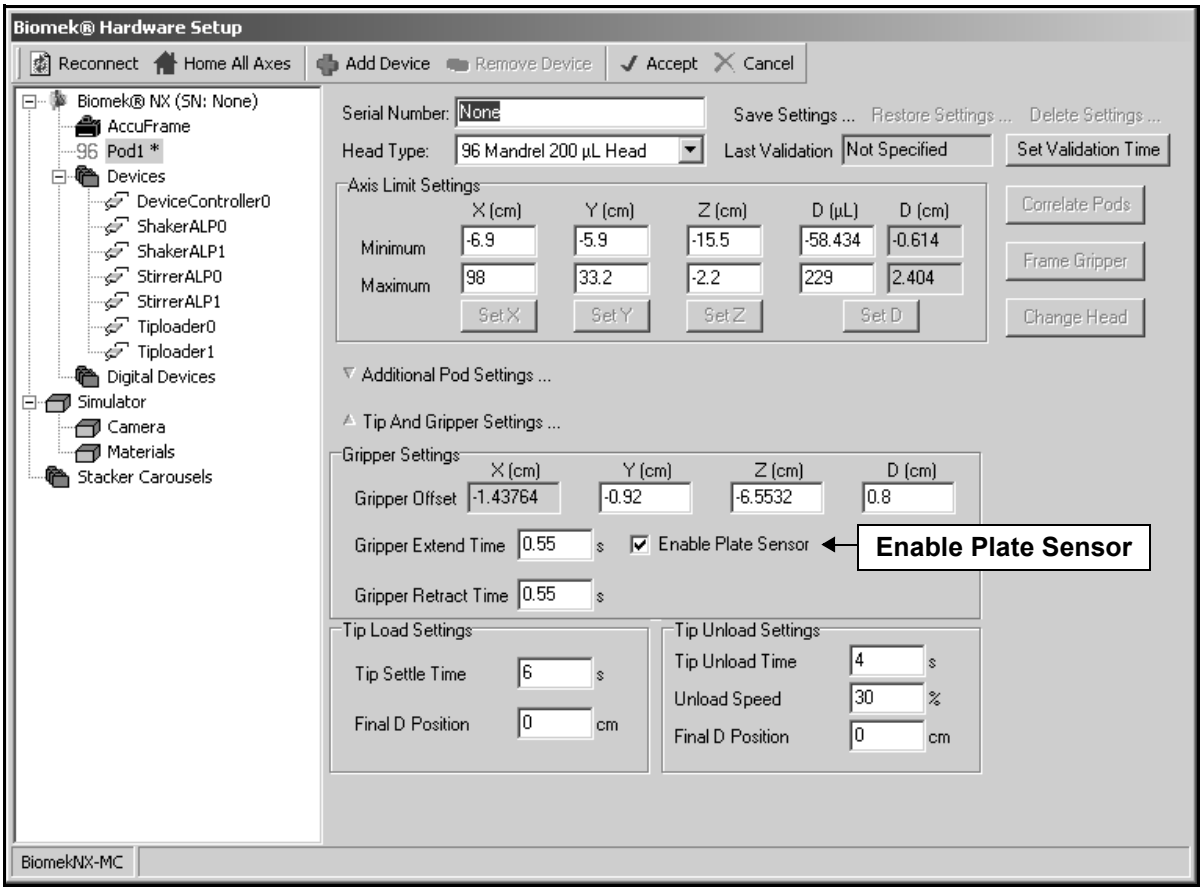

Figure 3-4. Hardware Setup displaying Enable Plate Sensor

Figure 3-5. Error for no plate sensed

3.4 Saving, Restoring, and Deleting Settings

The axes limits and pod settings may be saved, restored, and deleted using the Save Settings, Restore Settings, and Delete Settings options in Hardware Setup.

These options are particularly useful when changing heads on a Multichannel Pod. Because a new D-axis limit must be established when a head is changed, these options allow the D-axis limit to be saved and restored for specific head types. When settings are no longer needed, they may be deleted.

3.4.1 Saving Pod Settings

To save settings:

1. In Hardware Setup, select the appropriate **Pod** from the left pane to access the configuration area in the right pane.
2. Choose **Save Settings**. Save Configuration appears (Figure 3-6).

Figure 3-6. Save Configuration

3. Create a name for the current configuration
4. If desired, enter a description of the configuration.
5. Choose **OK**. The settings are saved.

3.4.2 Loading Pod Settings

To load the saved settings:

1. In Hardware Setup, select the appropriate **Pod** from the left pane to access the configuration area in the right pane.
2. Choose **Restore Settings**. Load Settings appears (Figure 3-7).

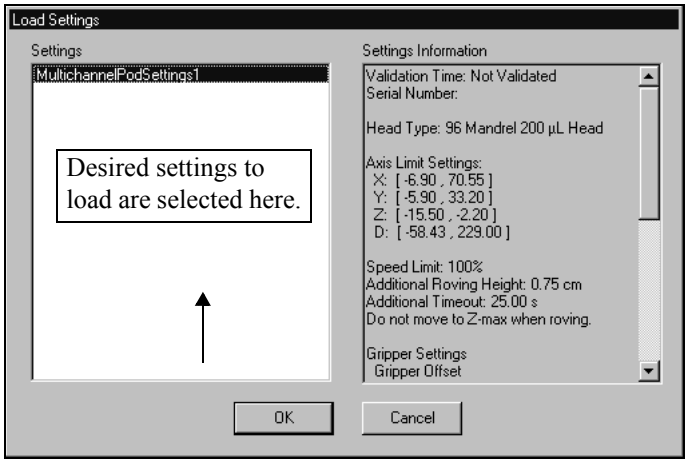

Figure 3-7. Load Settings

3. Select the desired settings.
4. Choose **OK**. The following Confirm appears (Figure 3-8).

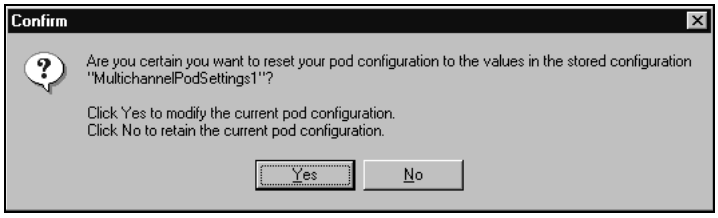

Figure 3-8. Confirmation to reset stored configuration

5. Choose **Yes**. The stored configuration is reset.

3.4.3 Deleting Pod Settings

To delete settings:

1. In Hardware Setup, select the appropriate **Pod** from the left pane to access the configuration area in the right pane.
2. Choose **Delete Settings**. Delete Settings appear (Figure 3-9).

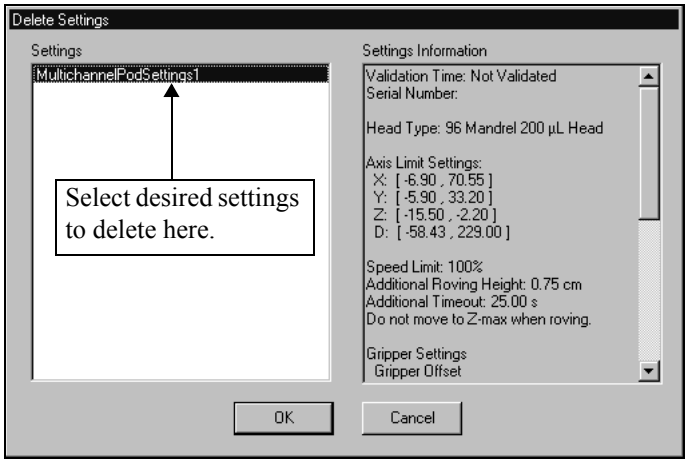

Figure 3-9. Delete Settings

3. Select the desired settings to delete.
4. Choose **OK**. The following Confirm appears (Figure 3-10).

Figure 3-10. Confirmation to delete stored configuration

5. Choose **Yes**. The stored configuration is deleted.

4 Framing Instructions

4.1 Overview

Framing is the procedure of teaching Biomek Software the location of the ALPs and devices positioned on the deck. Biomek Software uses this framing information to move the pod or grippers to the appropriate position to perform liquid-handling operations and manipulate labware.

A Beckman Coulter Service Engineer frames the Biomek NX instrument during system installation. It may be necessary to repeat the framing if:

- ALPs or devices are added, moved, or removed from the deck.
- the head on the Multichannel Pod is changed.

Framing deck positions can be performed automatically using the AccuFrame framing tool, or manually using a piece of labware to visually align the pod to the wells. The grippers may also be framed using the AccuFrame framing tool.

Framing the Biomek NX instrument includes:

- *Framing Deck Positions on the Biomek NX Instrument Using AccuFrame* (Section 4.2).
- *Manually Framing Deck Positions on the Biomek NX Instrument* (Section 4.3).
- *Framing the Grippers* (Section 4.4).

4.2 Framing Deck Positions on the Biomek NX Instrument Using AccuFrame

The AccuFrame is a tool used for framing ALP and labware positions on the Biomek NX deck (Figure 4-1). Framing using the AccuFrame tool requires no human judgment of alignment and is reproducible.

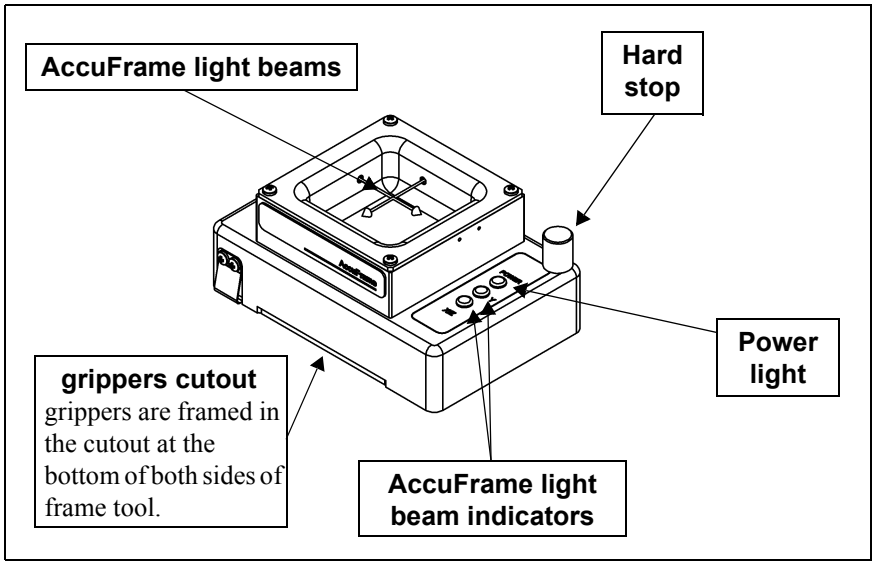

Figure 4-1. AccuFrame framing tool

The AccuFrame fits snugly on an ALP, and a teaching process is performed through Biomek Software to obtain the coordinates for each deck position. The framing is completed by breaking two light sensors on the AccuFrame at their intersection point.

The coordinates for each ALP are generated automatically through the software based upon teaching one position; however, when precision is critical, as when using 384-well plates, frame each position before using the Biomek NX instrument. This ensures that the pod and grippers locate each position reliably.

There are three indicator lights on the AccuFrame:

- First light indicates that the AccuFrame is powered on.
- Middle light indicates the framing status of the Y-axis.
- Third light indicates the framing status of the X- and Z-axes.

Note: The AccuFrame is calibrated by a Beckman Coulter Service Engineer to one instrument only, and each AccuFrame is assigned a unique identification number. This number is stored in Biomek Software and the AccuFrame. Each Biomek NX must be framed with the AccuFrame assigned to that instrument. Contact a Beckman Coulter Service Engineer to calibrate AccuFrame to multiple instruments.

To frame deck positions of the Biomek NX using AccuFrame, a framing fixture is attached to the head of the Multichannel Pod. When framing multiple position ALPs such as the 1 X 3 Passive ALP, all positions on the ALP should be framed to increase precision.

To frame the deck positions of the Biomek NX, the following operations must be completed:

- *Homing All Axes of the Pods* (Section 4.2.1).
- *Attaching the Framing Fixture to the Pod* (Section 4.2.2).
- *Installing AccuFrame* (Section 4.2.3).
- *Framing the Position* (Section 4.2.4).

Note: Some ALPs require additional or slightly modified procedures to frame properly. Consult the *ALPs User's Manual* for the specific ALP to frame for any special instructions.

Note: Deck positions on the Biomek NX can also be framed by choosing Manual Teach on Position Properties. Manual Teach involves loading tips and visually aligning them with the wells on a piece of labware(refer to Section 4.3, *Manually Framing Deck Positions on the Biomek NX Instrument*). Manual Teach is useful if specialized or very high density labware is used, or when Auto Teach yields unsatisfactory results. Some ALPs, such as the Positive Position ALP, must be framed manually.

4.2.1 Homing All Axes of the Pods

CAUTION: Before selecting OK to home all axes, the following conditions must be met:

- **Make sure there is no liquid present in the tips**
- **Make sure there are no disposable tips loaded**
- **Make sure the Framing Probe is NOT installed on the Multichannel Pod.**
- **Make sure the grippers on the Multichannel Pod are retracted.**

Prior to framing the Biomek NX deck, all axes must be homed. Homing the pod gives Biomek NX a point of reference from which to make subsequent moves. Home position is left and back. While it is necessary to home the pod after the Biomek NX instrument is powered on, it is not necessary to home the pod each time the host computer is turned on or the software is accessed.

Note: Home the pod each time the Biomek NX instrument is powered on. When attempting to use the pod, error messages result until the pod is homed.

To home the pod:

1. Choose **Start>Programs>SAGIAN Software>Biomek Software** to open Biomek Software.
2. Choose **Instrument**>**Home All Axes**. Warning appears (Figure 4-2).

Note: Additional Warnings and Information may appear, depending on the instrument configuration .

Note: Choosing Home All Axes homes all of the axes for all pods.

Figure 4-2. Warning to address before homing process begins

3. Choose **OK** on each Warning and Information after confirming that the actions have been addressed appropriately.

4.2.2 Attaching the Framing Fixture to the Pod

After homing the pod, the framing fixture must be installed on the pod used for framing.

When positioning the framing fixture, the framing probe must be pointed down and away from the mandrels of the head. From the front perspective, the framing guides on the framing fixture must be to the back and left.

To install the framing fixture on the multichannel head:

1. Hold the framing fixture (Figure 4-3) against the head with the framing guides pressed to the outside of the back row and left column of mandrels.

   Note: Make sure the front of the framing fixture is to the front of the instrument, and the framing guides are to the back and left of the instrument (Figure 4-3).

2. Gently pull the framing fixture to the front and right. Verify the framing guides are touching the mandrels.
3. Tighten each thumb screw by turning to the right until the framing fixture is firmly attached to the head. The pod is now ready for framing.

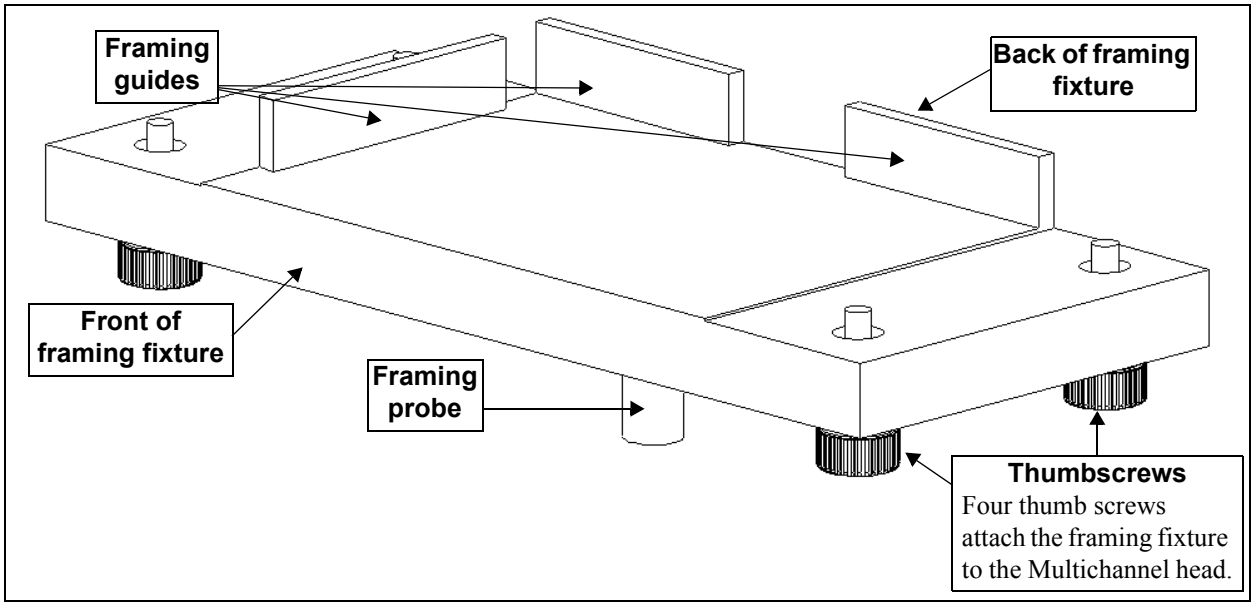

Figure 4-3. Framing Fixture

4. Install AccuFrame in the position to frame (refer to Section 4.2.3, *Installing AccuFrame*) and frame the Multichannel Pod according to the procedure in Section 4.2.4, *Framing the Position*.

4.2.3 Installing AccuFrame

AccuFrame is used during the framing process to frame deck positions. After the framing shaft is attached to the pod and AccuFrame is positioned on the ALP, the framing process is completed through the software.

WARNING: Turn off power to the Biomek NX instrument before attaching or removing AccuFrame from the instrument deck.

1. Turn off power to the Biomek NX instrument before connecting the AccuFrame.
2. Plug AccuFrame into an available CAN port on the Biomek NX tower.

WARNING: Make sure the light curtain is not violated by the AccuFrame cable. If the light curtain is violated, the framing process halts immediately.

WARNING: Make sure the AccuFrame cable does not interfere with pod movement.

3. Turn on power to the Biomek NX instrument.
4. Manually place the AccuFrame onto the ALP position that requires framing by placing the back right corner first and pushing the AccuFrame gently down onto the ALP position.

   Note: The deck is usually framed from from left to right, starting at the back left position. However, ALPs may be framed in any order.

5. Make sure that the AccuFrame is fully seated along the posts along the top and right sides of the position.

   Note: Some ALPs require a framing adaptor to accommodate using AccuFrame to frame the position. Make sure the correct adaptor is used for each type of ALP. Framing proceeds as normal once the AccuFrame is placed on the appropriate adaptor.

4.2.4 Framing the Position

To frame the Biomek NX deck position:

Note: Some ALPs require additional or slightly modified procedures to frame properly. Consult the *ALPs User's Manual* for the specific ALP to frame for any special framing instructions.

1. In Biomek Software, choose **Instrument**>**Deck Editor**. Deck Editor appears (Figure 4-4).

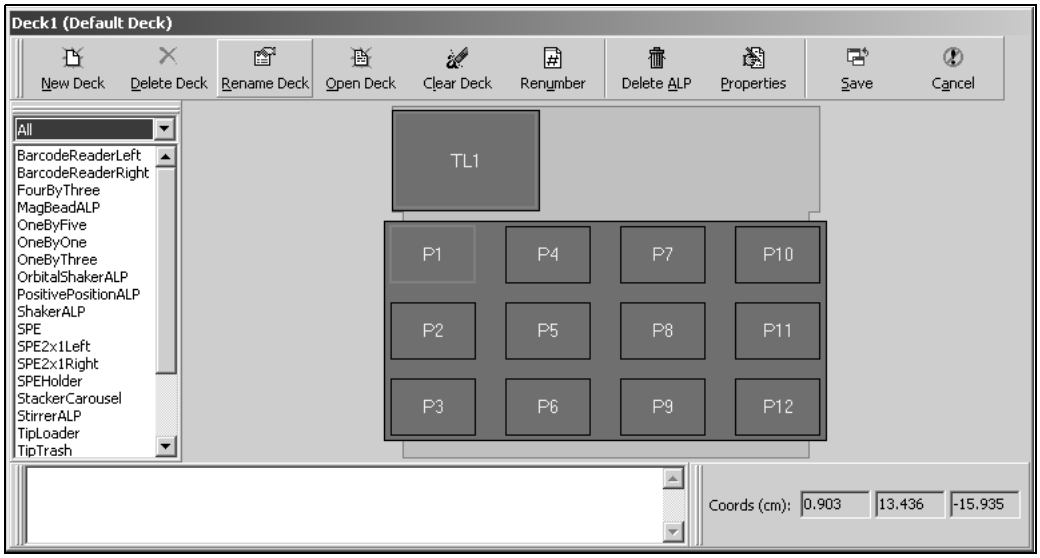

Figure 4-4. Deck Editor

2. In Biomek Software, open the deck that requires framing in the Deck Editor. Verify that it reflects the current configuration of ALPs on the physical deck. If it does not reflect the current physical deck configuration, place devices on the appropriate deck locations in the Deck Editor by dragging and dropping from the list onto the deck. When the Deck Editor reflects the configuration of the current physical deck, proceed to step 3.

3. Double-click on the deck position containing the AccuFrame. Position Properties appears (Figure 4-5).

Note: The coordinates displayed are default values; the software must be taught precisely where the position is on the physical deck.

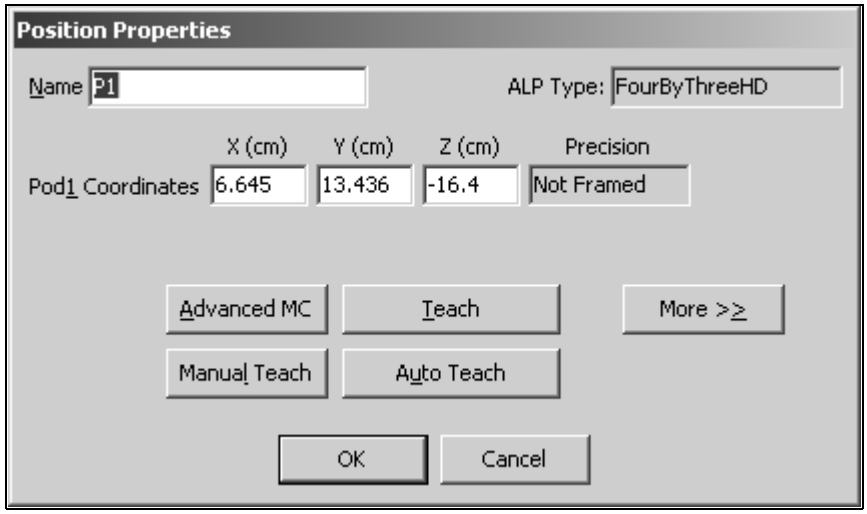

Figure 4-5. Position Properties

4. Choose **Auto Teach**. A Confirm similar to Figure 4-6 appears.

Note: This moves the pod to the position being taught. The framing probe should be above the AccuFrame in that position.

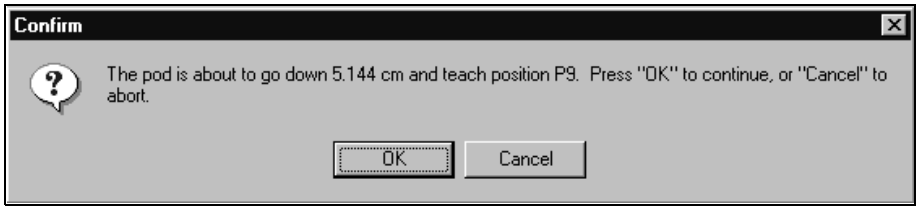

Figure 4-6. Confirm

5. Visually verify that the framing probe is positioned to avoid hitting the wall of the AccuFrame and that it is positioned to lower within the AccuFrame tool.
6. Choose **OK**.

Note: The pod lowers and moves around inside the AccuFrame automatically until it breaks both light beams simultaneously (Figure 2-1). The pod stops after teaching (framing) is completed, and the two light beam indicators are illuminated.

Note: An error message appears if both light beams are not broken when the pod is lowered into the AccuFrame. If this occurs, using Advanced Manual Control (refer to Chapter 5, *Manually Controlling the Biomek NX in Biomek Software*), move the pod until the probe breaks both light beams and all the indicator lights are on. Choose **Teach**, and the pod continues the teaching process. The pod may also be moved by hand until the probe breaks both light beams and all the indicator lights are on.

7. Wait until the pod stops moving and **Teaching Instructions** appears (Figure 4-7).

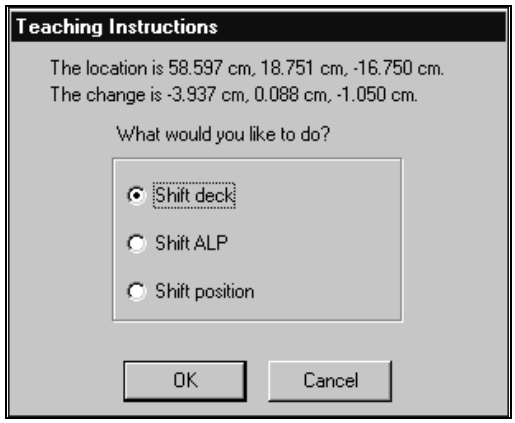

Figure 4-7. Teaching Instructions

8. Choose from **Shift deck**, **Shift ALP**, or **Shift position** for appropriate teaching instructions (refer to Section 4.2.4.1, *Selecting Appropriate Teaching Instructions*).
9. If the coordinates displayed appear reasonable, choose **OK**. Position Properties appears again, and the position is framed for the selected pod.
10. Choose **OK** to close Position Properties.
11. For framing additional positions, move the AccuFrame to the next position to frame (refer to Section 4.2.3, *Installing AccuFrame*) and repeat steps 3 through 11.
12. Choose **Save** to save framing information for all positions and close the Deck Editor (Figure 4-4).

Note: Choosing **Cancel** loses all changes to the deck, including framing information, since the Deck Editor was opened.

13. Remove the framing fixture from the head of the Multichannel Pod.

4.2.4.1 Selecting Appropriate Teaching Instructions

In Teaching Instructions (Figure 4-7), the entire deck, a deck position, or an ALP can be shifted by the teaching process. Determine what should be shifted using the following information:

CAUTION: Use Shift deck only before other ALPs or positions are taught. Shift deck shifts all ALPs and positions, resulting in incorrect coordinates if applied to previously framed ALPs and positions.

- Shift deck — shifts all ALPs and positions associated with the deck by the change amounts shown. Choose Shift deck when framing the first location of a new deck. The shift amount required typically is not large, but everything on the deck may need to move 1 cm, for example.
- Shift ALP — shifts the entire ALP and all deck positions associated with the ALP by the change amounts shown. Shift ALP typically is precise enough for using 96-well plates.
- Shift position — shifts only the deck position containing the AccuFrame by the amounts shown. Shift position is the most precise teaching procedure, and it is useful when 384-well microplates are used (especially on larger ALPs, such as the 4x4); otherwise, Shift ALP is usually sufficient.

Note: When framing a multiple-position ALP (1x3, 1x5, 4x3, or 4x4), Shift ALP on the first position, then Shift position on the rest.

4.3 Manually Framing Deck Positions on the Biomek NX Instrument

Biomek® NX Manual Framing Wizard is a wizard-type interface that is used to manually frame deck positions, primarily for using high density labware. Since the wells of high density labware are relatively small, using the Manual Framing Wizard helps to ensure that the tips can access the wells without causing any damage to the tips, probes, pod, or ALP.

Note: Some ALPs, such as the Positive Position ALP, must be framed using Manual Teach to improve pipetting accuracy to high density labware.

Note: When not using high density labware, the standard framing procedure using the AccuFrame is acceptable. To frame using the AccuFrame, refer to Section 4.2, *Framing Deck Positions on the Biomek NX Instrument Using AccuFrame*.

To frame using Manual Teach:

1. Choose **Start>Programs>SAGIAN Software>Biomek Software** to open Biomek Software.
2. From the Instrument menu, choose **Deck Editor**. Deck Editor appears (Figure 4-8).

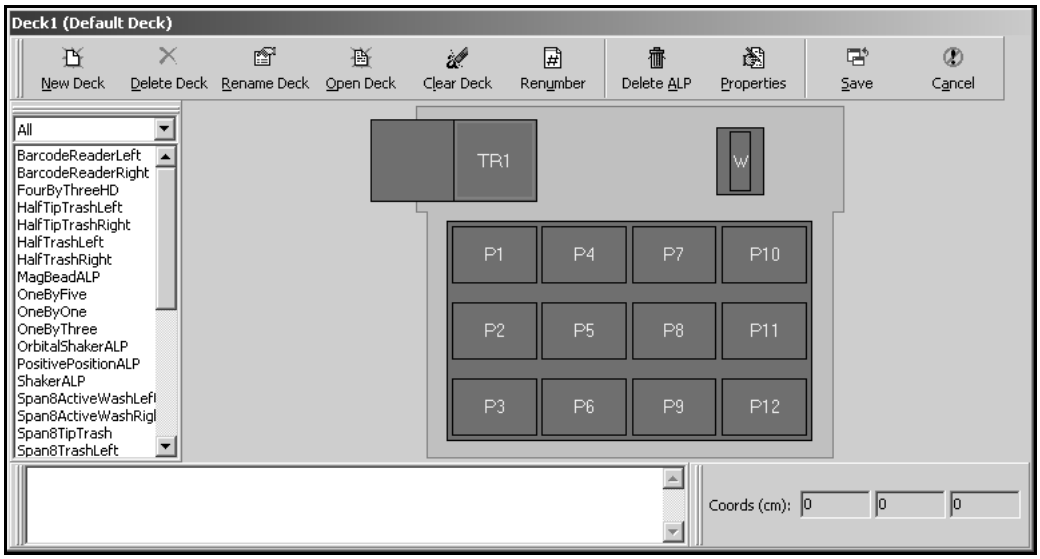

Figure 4-8. Deck Editor

3. Open **Position Properties** for the desired deck position by double-clicking on the deck position. Position Properties appears (Figure 4-9).

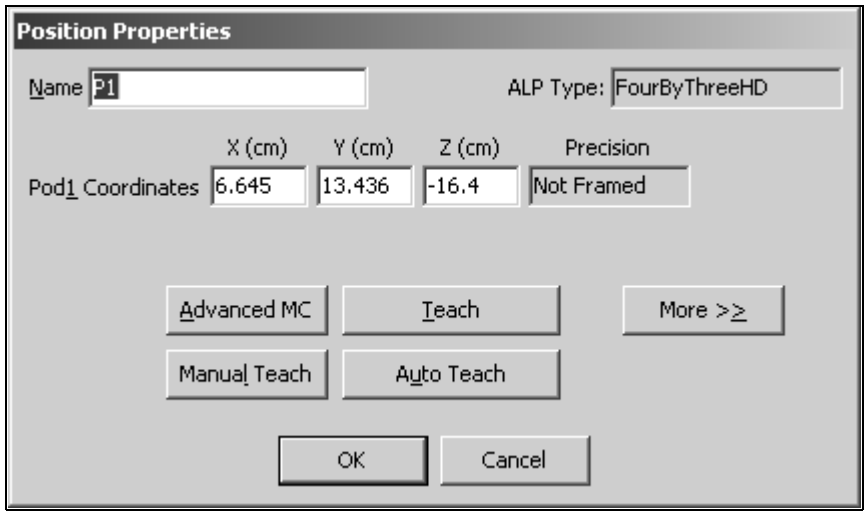

Figure 4-9. Position Properties for a Positive Position ALP

4. In Name, verify that the ALP is assigned a unique name.
5. Choose **Manual Teach**. Biomek® NX Manual Framing Wizard opens with a Warning (Figure 4-10).

Note: On the left side of Manual Framing Wizard, a list of steps required to complete the teaching process is displayed. As the steps of Manual Framing Wizard are accessed, the steps are highlighted on the left.

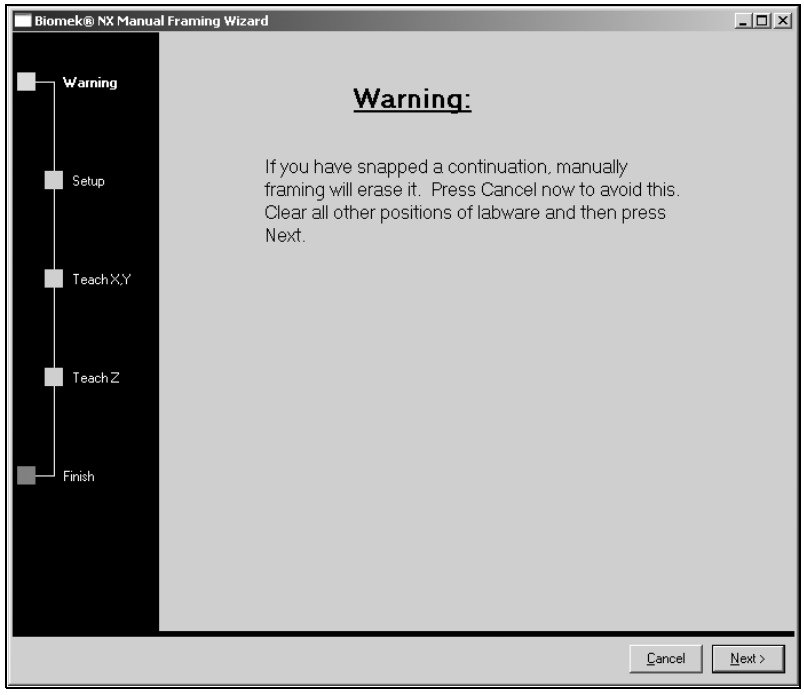

Figure 4-10. Manual Framing Wizard — Warning

6. Choose **Next** and Manual Framing Wizard — Setup appears. Figure 4-11 or Figure 4-12 appears, depending on whether or not tips are loaded onto the pod.

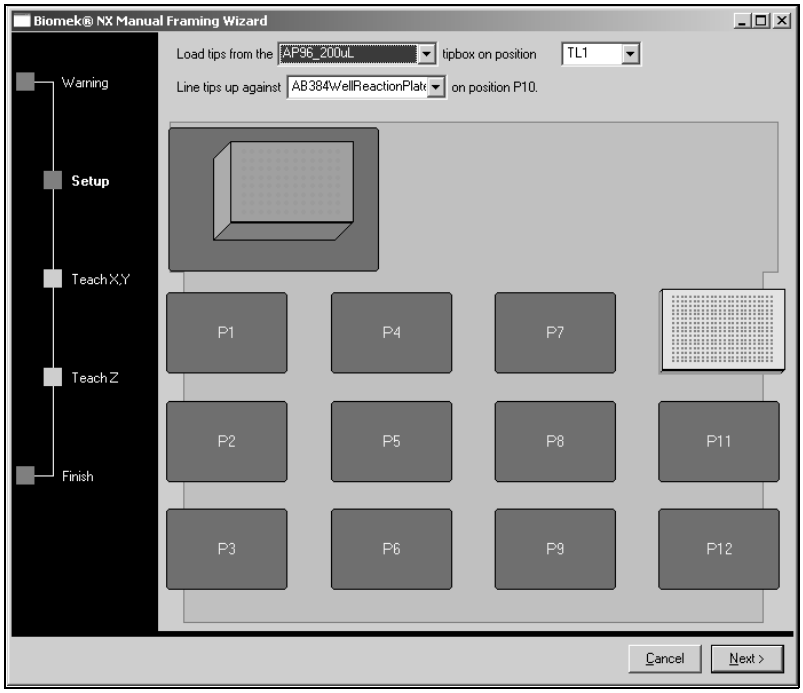

Figure 4-11. Manual Framing Wizard if tips are not already loaded.

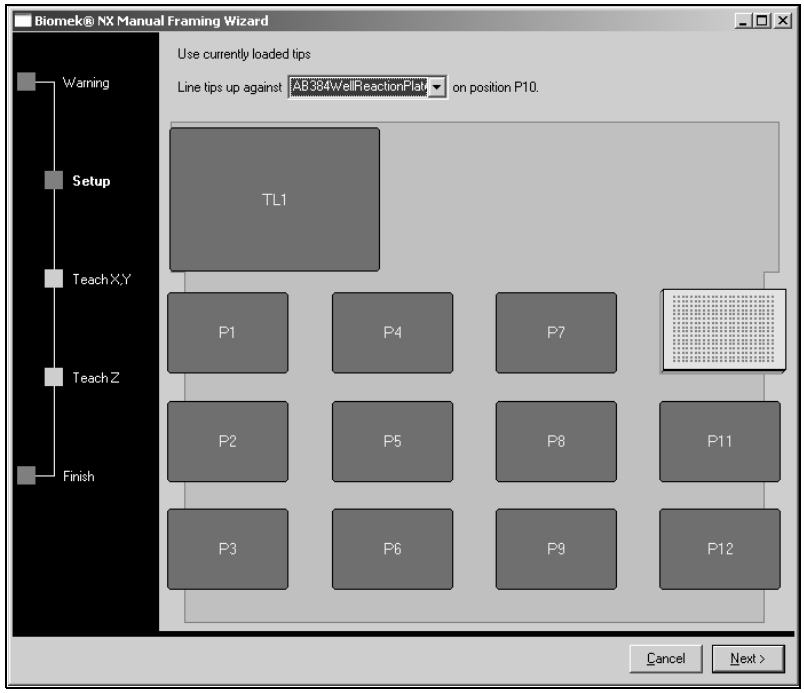

Figure 4-12. Manual Framing Wizard if tips are loaded

7. If no tips are loaded, in Load tips from the, select the type of tips to load and the position on which the tip box is located (Figure 4-11).

8. In **Line tips up against**, select the appropriate labware type of the labware placed in the position to frame.

9. Choose **Next** to continue to the next screen. Biomek NX Manual Framing Wizard — Teach X,Y appears.

10. Select **Well Corner** to align the tips to the corners, or junction, of four wells.

Note: Well Corner is available only when framing to a deck position occupied by a piece of labware with square wells.

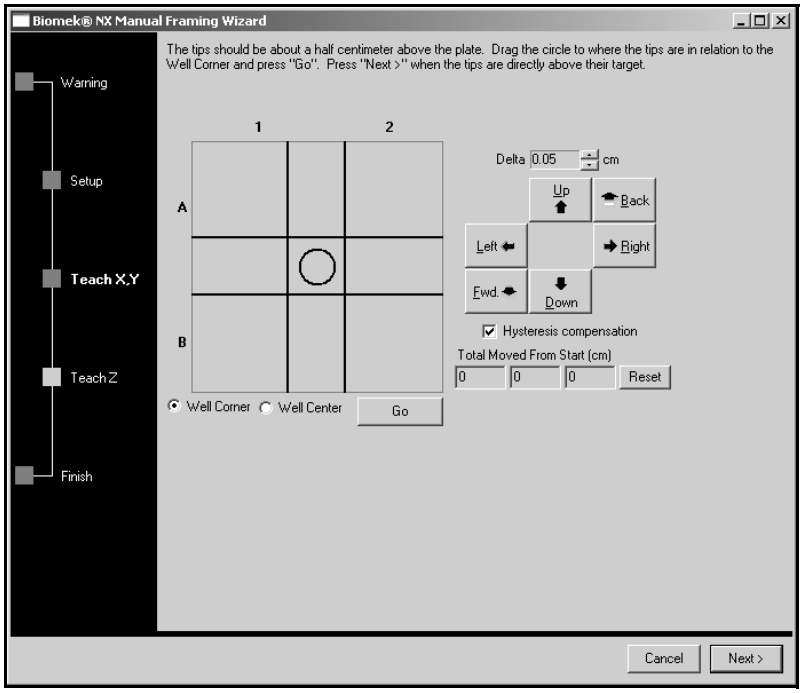

Figure 4-13. Framing to the corner of four wells

OR

Select **Well Center** to align the tips to the center of the wells.

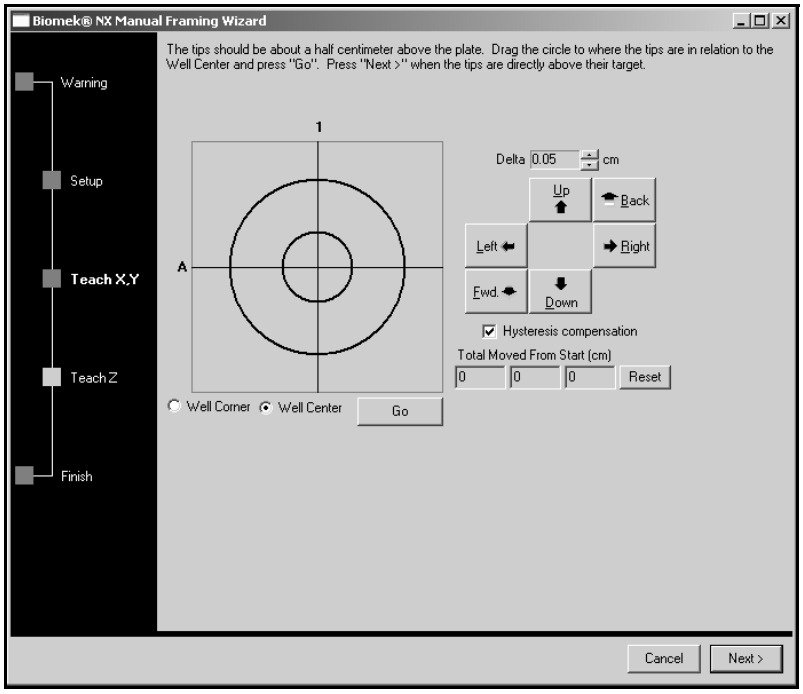

Figure 4-14. Framing to the center of a well

11. To align the tips in the X- and Y-axes with the wells of the microplate on top of the ALP, lower the tips in the Z-axis until they are approximately 1 mm above the top of the ALP.

    Note: Since tip height is set in the next step in the Manual Teaching process, it is safe to move the pod to any height to make aligning the tips with the microplate easier.

12. Visually verify the physical position of the tips in relation to the physical position of the wells of the microplate on top of the ALP.

13. Adjust the position of the tip to align it with the microplate well or corner by either:

    - *Using the Graphic Alignment Tool* (Section 4.3.1).
    - *Using the Delta Value and Directional Buttons* (Section 4.3.2).

4.3.1 Using the Graphic Alignment Tool

The graphic alignment tool (Figure 4-15) is used to instruct Biomek Software of the current position of the tips to the physical position of the wells of the microplate on top of the ALP. Biomek Software uses the information it is given to move the pod so the tips are directly above the target position.

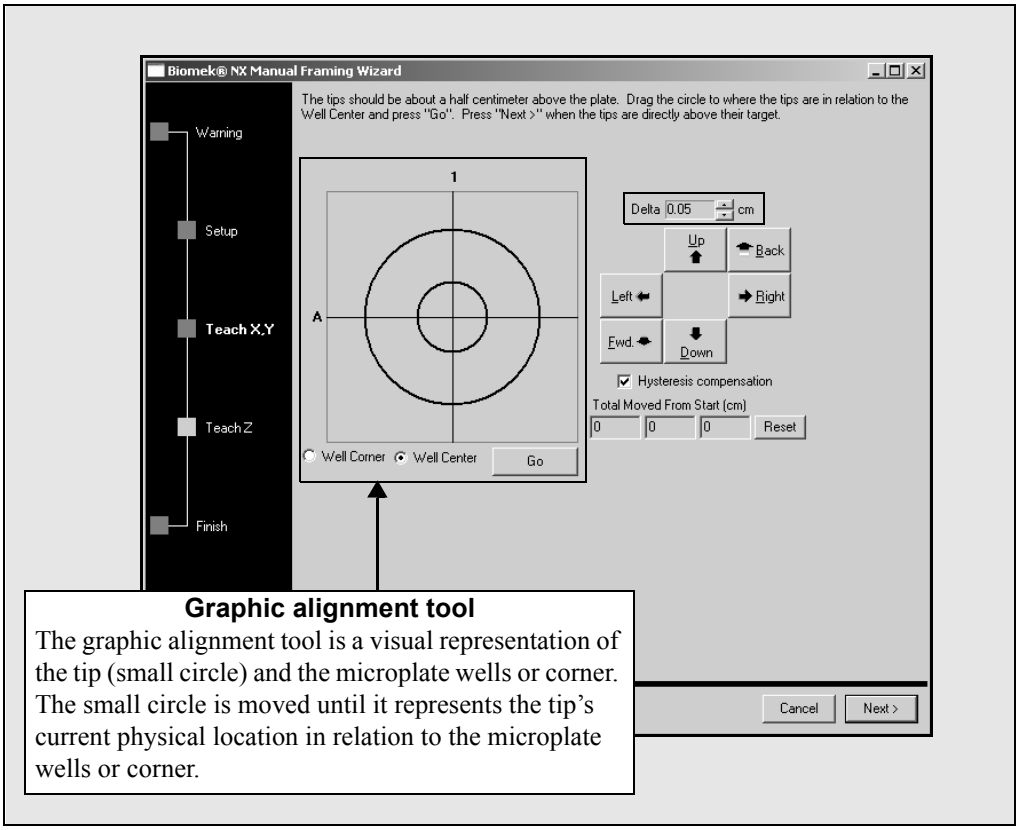

Figure 4-15. Manual Teaching the X- and Y-axes

To use the graphic alignment tool:

1. Drag the center (small) circle until it represents the tip's physical position in relation to the physical position of the wells of the microplate on top of the ALP.

   Note: The small circle represents the tip on the pod. The objective is to provide the software with a representation of the tip's position in relation to the physical position of the wells of the microplate on top of the ALP. The software uses this graphical representation to know approximately how far in any direction the pod must move to align the tips with the wells of the microplate on top of the ALP.

2. Select **Go**. The pod moves in accordance with the position of the small circle in relation to the large circle.

   Note: When the move is completed, the small circle resets itself to the center of the large circle. The values displayed in Total Moved from Start (cm) changes each time steps 1 and 2 are completed. If desired, the values in Total Moved from Start (cm) can be reset to zero by selecting **Reset**.

3. Visually verify the position of the tips on the pod in relation to the physical position of the wells of the microplate on top of the ALP. If the tips are still not accurately positioned above the target position on the microplate, repeat steps 1 and 2 until they are accurately positioned above the target position the microplate.

   Note: The tips may also be aligned with the microplate using the delta value and directional buttons (refer to Section 4.3.2, *Using the Delta Value and Directional Buttons*).

4. Once the tip is aligned with the wells of the microplate on top of the ALP, choose **Next** to continue. Biomek® NX Manual Framing Wizard displays Teach Z (refer to Section 4.3.3, *Framing the Z-Axis*).

4.3.2 Using the Delta Value and Directional Buttons

The tip can be positioned manually using the delta values and directional buttons to align it with the physical position of the wells of the microplate on top of the ALP. Pressing one of the directional buttons moves the pod in that direction by the distance specified in Delta. Position the tips above the wells of the microplate on top of the ALP.

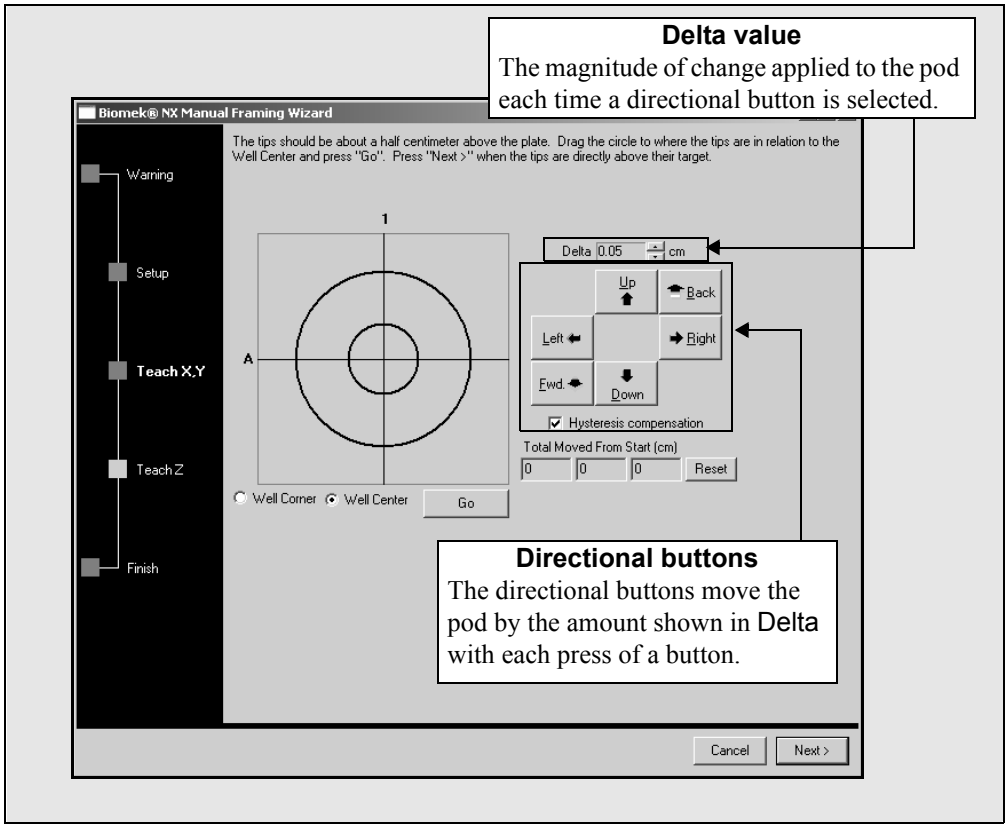

Figure 4-16. Manual Teaching the X- and Y-axes

To use the delta value and directional buttons to position the tip:

1. In **Delta**, select the magnitude of change applied to the tips each time a directional button is selected (Figure 4-16).

Note: The default Delta value is 0.05 cm. If the tips are a considerable distance from the desired location, increase the distance traveled by increasing the Delta value (maximum setting is 1.0 cm). If the tips are almost to the desired location, reduce the Delta value to fine tune the position (minimum setting is 0.005 cm).

2. Select the **directional button** representing the motion required to physically move the tips into position over the wells of the microplate on top of the ALP (Figure 4-16).

   Note: Each time a directional button is selected, the pod and tips move the distance specified in Delta in the indicated direction.

   Note: The tips can be physically positioned over the wells of a microplate using:

   - the directional buttons in Manual Teach.
   - the directional keys on the keyboard.
   - the directional keys on the numeric keypad.

   The directional buttons displayed in Manual Teach parallel the keys on the numeric keypad. More specifically, Fwd. correlates to the '1' on the numeric keypad, while Down is found on the '2', Left is found on the '4', Right on '6', Up on '8', and Back on '9'.

3. Visually verify the position of the tips on the pod in relation to the physical position of the wells of the microplate on top of the ALP. If the tips are still not accurately positioned above the wells of the microplate on top of the ALP, repeat steps 1 and 2 until they are accurately positioned above the target position.

   Note: The tips may also be aligned with the target position using the graphic alignment tool (refer to Section 4.3.1, *Using the Graphic Alignment Tool*).

4. Once the tips are aligned with the target position , choose **Next** to continue. Biomek® NX Manual Framing Wizard displays Teach Z (refer to Section 4.3.3, *Framing the Z-Axis*).

4.3.3 Framing the Z-Axis

After the X- and Y-axes are framed, the Z-axis must be framed to ensure aspirate and dispense operations are performed at the desired height. The final screen in Biomek® NX Manual Framing Wizard is for framing the Z-axis (Figure 4-17).

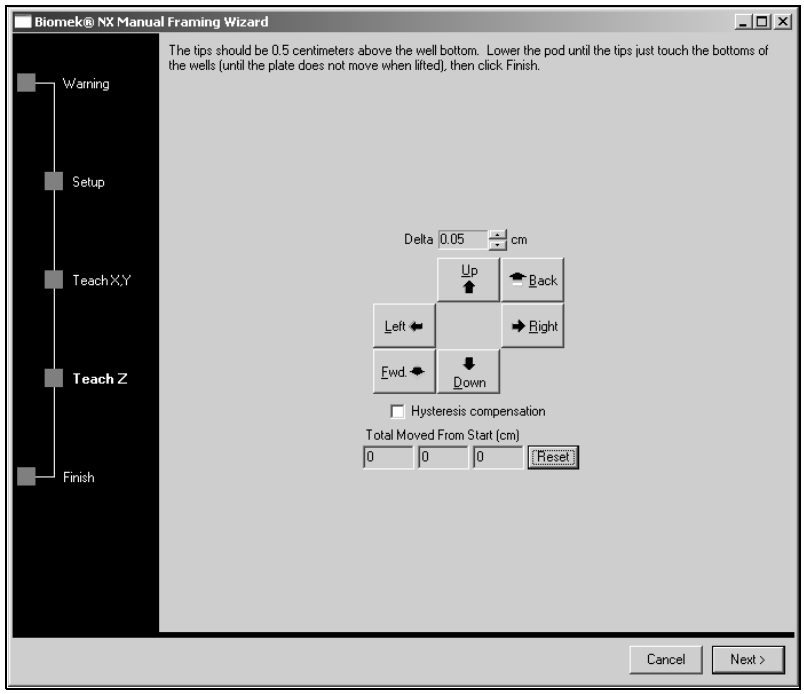

Figure 4-17. Manual Teaching (Teach Z)

1. In **Delta**, select the magnitude of change applied to the pod each time a directional button is selected (Figure 4-17).

Note: The default Delta value is 0.05 cm. If the tip is a considerable distance above the position, increase the distance traveled by increasing the Delta value (maximum setting is 1.0 cm). If the tip is almost to the desired location, reduce the Delta value (minimum setting is 0.005 cm).

Note: Since the X- and Y-axes were framed previously, it is safe to move the pod in the X- and Y-axes if it makes framing the pod in the Z- axis easier.

2. Select the **directional button** representing the motion required to physically move the pod down until the tip just touches the microplate at the well corner or the bottom of the well.

   Note: Each time a directional button is selected, the pod and tips move the distance specified in Delta in the indicated direction.

   Note: The tip can be can physically positioned over the labware positioner using:

   - the directional buttons in Manual Teach.
   - the directional keys on the keyboard.
   - the directional keys on the numeric keypad.

   The directional buttons displayed in Manual Teach parallel the keys on the numeric keypad. More specifically, Fwd. correlates to the '1' on the numeric keypad, while Down is found on the '2', Left is found on the '4', Right on '6', Up on '8', and Back on '9'.

3. Once the tip is just touching the target position, select **Finish**. The pod moves up to its maximum height in the Z-axis, Manual Teaching closes, and Position Properties appears (Figure 4-9).
4. Choose **OK** to save the framing information and close Position Properties.
5. Repeat the procedure to frame additional deck positions using manual teach.
6. Choose **Save** to save framing information for all positions and close the Deck Editor (Figure 4-8).

   Note: Choosing **Cancel** loses all changes to the deck, including framing information, since the Deck Editor was opened.

4.4 Framing the Grippers

A Beckman Coulter Service Engineer frames the grippers during system installation; however, it may be necessary to repeat the framing procedure if:

- the head is changed.
- grippers are replaced.
- extraordinary circumstances occur, such as accidentally bending a gripper.

Before framing the grippers, make sure:

- instrument is homed (refer to Section 4.2.1, *Homing All Axes of the Pods*).
- deck position is framed prior to framing the grippers to that location (refer to Section 4.2, *Framing Deck Positions on the Biomek NX Instrument Using AccuFrame*).
- AccuFrame is installed on the appropriate position (refer to Section 4.2.3, *Installing AccuFrame*).
- framing fixture is not attached to the Multichannel Pod.

To frame the grippers:

1. Choose **Start>Programs>SAGIAN Software>Biomek Software** to start the Biomek Software.
2. From the Instrument menu, choose **Hardware Setup**. Hardware Setup appears.
3. Choose the Multichannel Pod. The configuration to frame the grippers appears on the right (Figure 4-18).

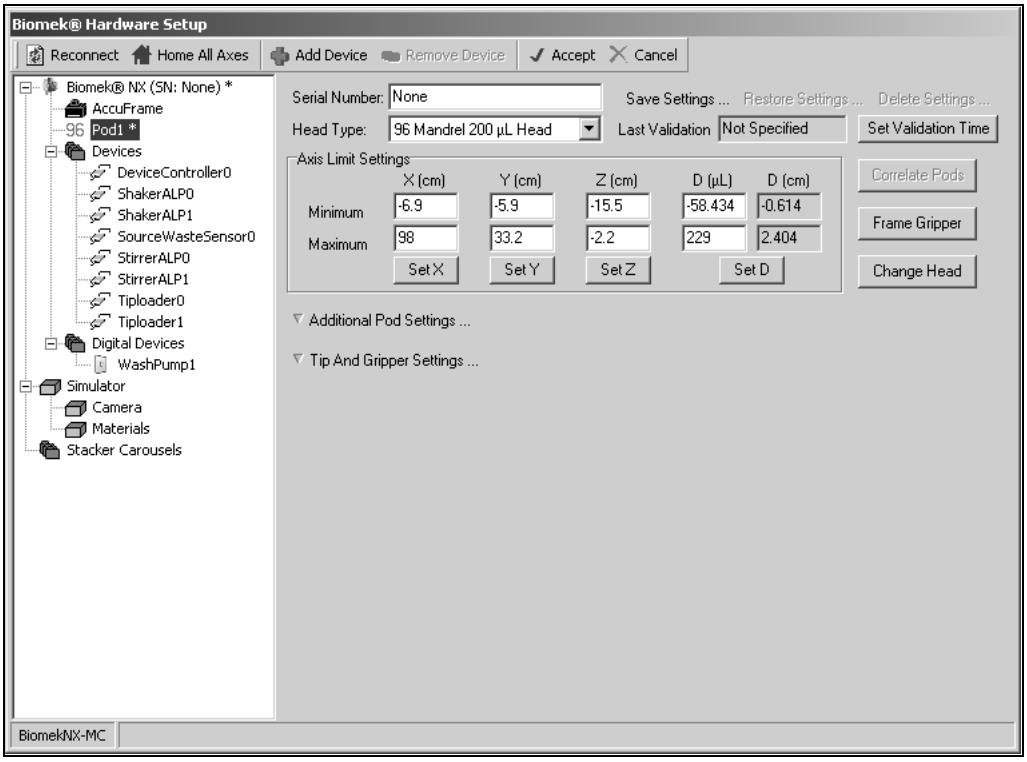

Figure 4-18. Hardware Setup

4. Choose **Frame Gripper**.
5. When a Warning appears, make sure the topics that appear in the Warning are addressed and choose **OK** (Figure 2-14).

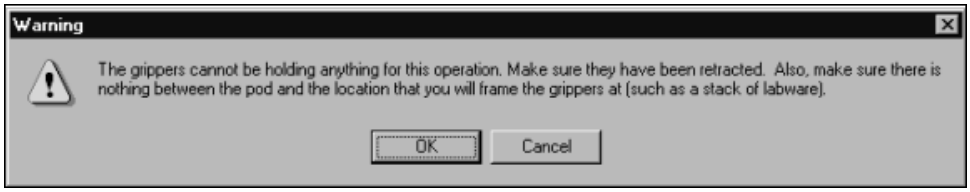

Figure 4-19. Warning to make sure grippers are ready for framing

6. In **Pick Position** (Figure 4-20), select a previously framed deck position and frame the grippers to that location. The deck position must be framed first and should be a small passive ALP, if possible.

Note: Make sure that the AccuFrame is correctly placed on the selected position (refer to Section 4.2.3, *Installing AccuFrame*).

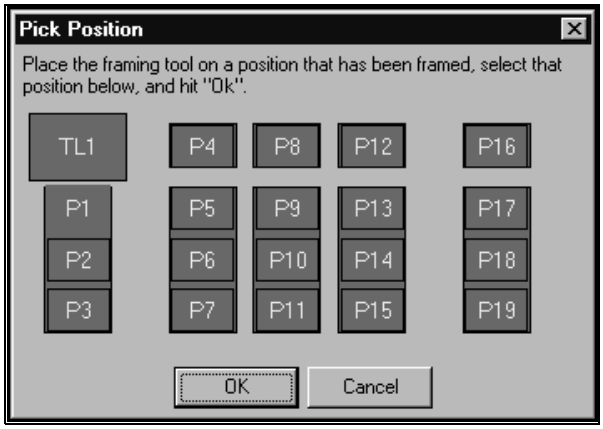

Figure 4-20. Pick previously framed deck position to frame the grippers

7. Choose **OK**. This moves the pod to that position and extends the grippers. Advanced Manual Control (Figure 4-21) and Frame Gripper (Figure 4-22) appear side by side.

Note: The grippers are extended a little high and opened a little wide at the end of the move initiated by step 6.

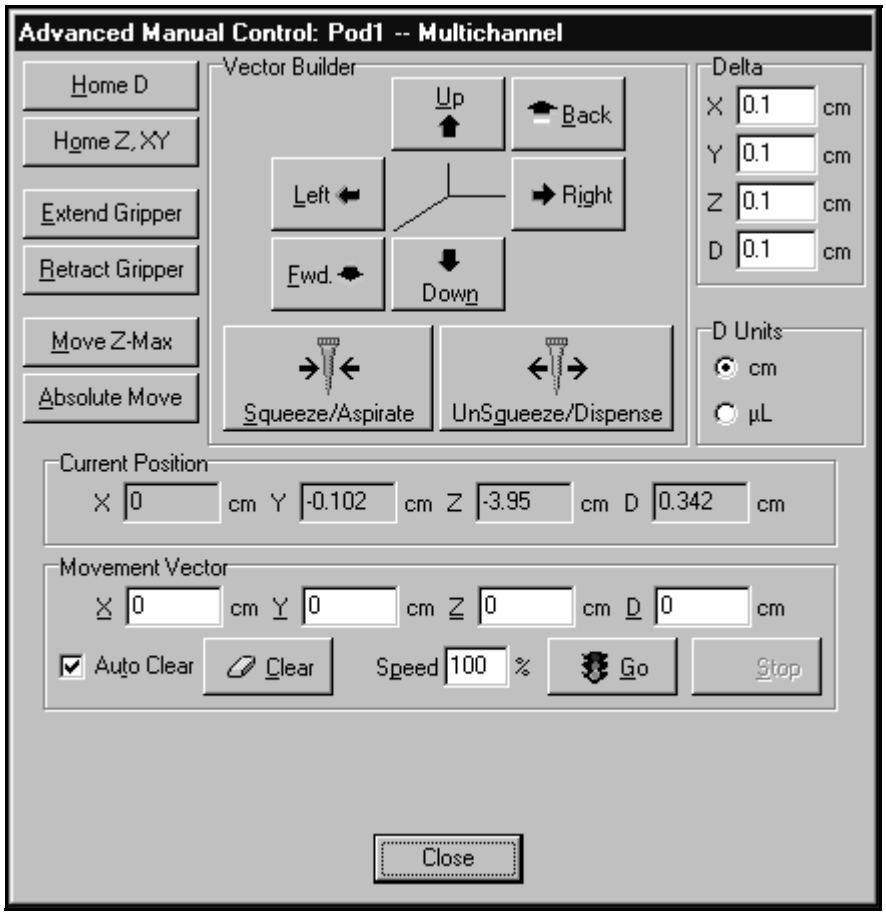

Figure 4-21. Advanced Manual Control for moving grippers during framing

Note: Do not select Close; if Advanced Manual Control closes, the framing process must be completed again, beginning with step 1.

Figure 4-22. Moving pod into gripping position

8. Use **Advanced Manual Control** to move the grippers until they are aligned with the bottom of the AccuFrame (Figure 4-23), and squeeze the grippers until they firmly touch the AccuFrame inside the notches at the bottom of the AccuFrame (Figure 4-24). If necessary, refer to Chapter 5, *Manually Controlling the Biomek NX in Biomek Software*, for instructions on moving the grippers.

Note: Both front and rear grippers must touch at the same time when squeezing, which usually necessitates a move along the Y-axis.

Note: Assessing the position of the grippers in step 8 is a visual task.

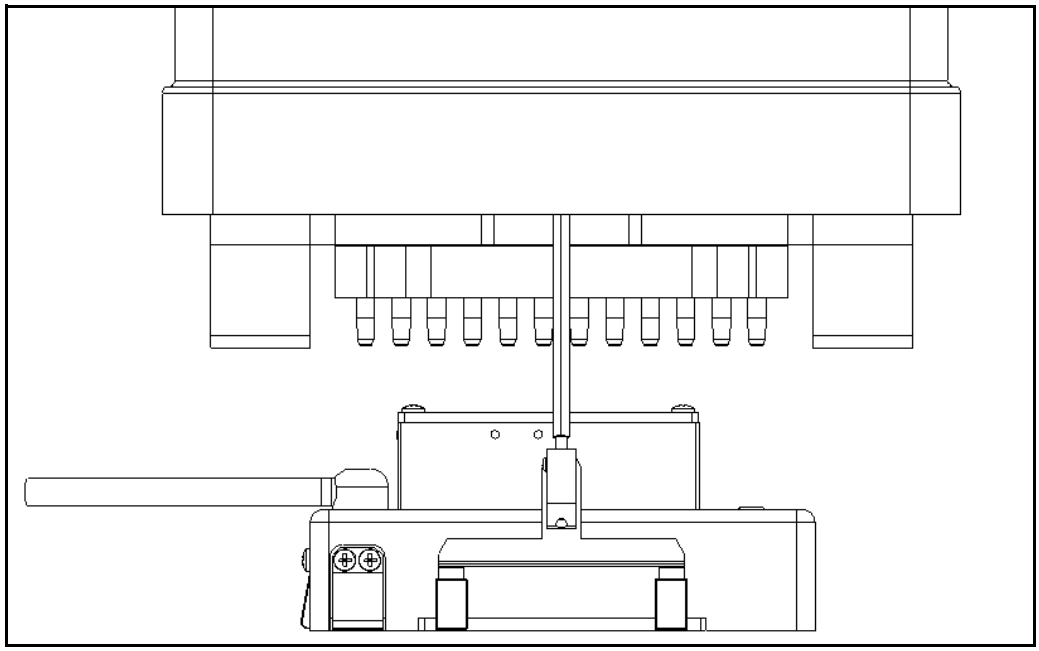

Figure 4-23. Gripper framing position on the AccuFrame

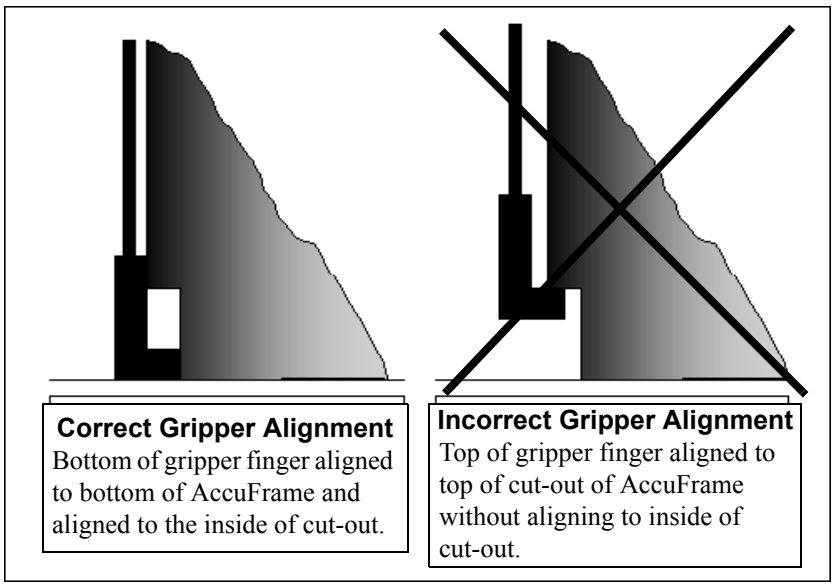

Figure 4-24. Correct and incorrect gripper framing alignment

9. In Frame Gripper, choose **OK** (Figure 4-22). The grippers are now framed.

10. From Hardware Setup, choose **Accept** to save changes and close Hardware Setup.
11. From Biomek Software, choose **Instrument>Manual Control**. Manual Control appears.
12. Choose **Advanced Controls** and select **Pod1**. Advanced Manual Control appears (Figure 4-21).
13. Choose **Move Z-Max**.

    Note: Choosing Move Z-Max raises the pod to allow access to the AccuFrame.

14. Choose **Close** to close Advanced Manual Control.
15. Choose **Exit** to close Manual Control.
16. Remove the AccuFrame from the ALP position.

4.4.1 Testing Gripper Framing Accuracy

To make sure the grippers work properly, create and run a method at reduced speed (around 10%) to move a piece of labware from one framed deck position to another (refer to Section 3.3.2, Setting Multichannel Pod Properties). If problems occur, repeat the gripper framing process until the grippers are working correctly.

4.5 Troubleshooting

Perform the troubleshooting techniques provided in Table 4-1 when necessary.

Note: In the case of any other framing-related problems, contact a Beckman Coulter Service Engineer.

Table 4-1. Troubleshooting Framing

If	Then
AccuFrame power light not on	Check the CAN connection to make sure the AccuFrame is connected to Biomek NX instrument.
The Y-axis and the X/Z-axes Light Beams cannot be broken when moving a finger around the interior of AccuFrame	Make sure the AccuFrame is receiving power.
One or both beam indicator lights on AccuFrame stay on when no objects are breaking the light beams	There is most likely an internal obstruction to sensors. Call a Beckman Coulter Service Engineer.

5 Manually Controlling the Biomek NX in Biomek Software

5.1 Overview

Manual Control and Advanced Manual Control are used to control:

- Movement of the pod
- Grippers independently of a method.
- Pod when teaching the deck, framing the grippers, and recovering from errors.
- Tip Loader and other ALPs independently of a method

Note: Refer to the *ALPs User's Manual* for information on manually controlling specific ALPs.

The sections in this chapter include:

5.2 Accessing Manual Control

To open Manual Control, choose **Instrument>Manual Control**. An Information dialog (Figure 5-1) appears briefly as the connection is made with the Biomek NX instrument, immediately followed by Manual Control (Figure 5-2).

Note: Manual Control is available only when a method is not being executed. If a need for manual control is realized during a method run, stop the method using the Stop button or Snap Continuation button (refer to the *Biomek® Software User's Manual,* Chapter 26.11.2, *Snapping a Continuation*).

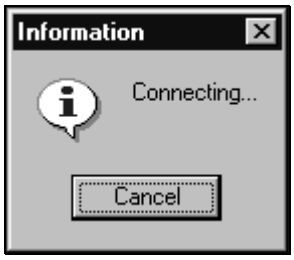

Figure 5-1. Confirms Manual Control is connecting

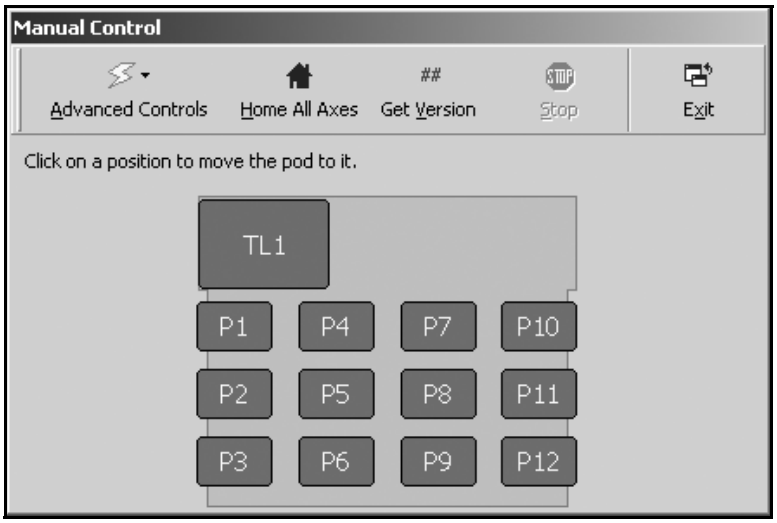

Figure 5-2. Manual Control

5.3 Using Manual Control

Use Manual Control for:

- *Homing all Axes of the Pod* (Section 5.3.1).
- *Moving the Pod to a Specific Deck Position* (Section 5.3.2).
- *Stopping the Pod* (Section 5.3.3)
- *Viewing the Firmware Version* (Section 5.3.4)
- *Accessing Advanced Manual Control* (Section 5.3.5)

5.3.1 Homing all Axes of the Pod

CAUTION:Before selecting OK to home all axes, the following conditions must be met:

- **Make sure there is no liquid present in the tips.**
- **Make sure there are no disposable tips loaded**
- **Make sure the Framing Tool is NOT installed on the Multichannel Pod**
- **Make sure the grippers are retracted**

Home the pod each time the Biomek NX instrument is powered on. Homing the pod gives Biomek NX a point of reference from which to make subsequent moves. Home position is left, back.

Note: When attempting to use the pod, error messages result until the pod is homed.

Note: While it is necessary to home the pod after the Biomek NX instrument is powered on, it is not necessary to home the pod each time the host computer is turned on or the software is accessed.

To home the pod:

1. Choose **Instrument>Manual Control**. Manual Control appears (Figure 5-2).
2. Choose **Home All Axes**. The following Warning appears (Figure 5-3):

Figure 5-3. Warnings must be addressed before homing process begins

3. Choose **OK** after confirming that the actions have been addressed appropriately.

5.3.2 Moving the Pod to a Specific Deck Position

Use Manual Control to easily move the pod to a specific deck position. Manual Control moves the pod to the top of the Z axis, then centers it over the selected position.

To move a pod to a specific deck position:

1. Choose **Instrument>Manual Control**. Manual Control appears (Figure 5-2).
2. Click on the desired deck position on the Manual Control Deck Display (Figure 5-2).

5.3.3 Stopping the Pod

To stop a pod once a movement has started:

1. Choose **Instrument>Manual Control**. Manual Control appears (Figure 5-2).
2. Choose **Stop**.

5.3.4 Viewing the Firmware Version

Get Version shows the current firmware version for installed devices, pods, and main firmware.

To view the firmware version:

1. Choose **Instrument>Manual Control**. Manual Control appears (Figure 5-2).
2. Choose **Get Version**. The firmware version displays in an Information dialog similar to (Figure 5-4).

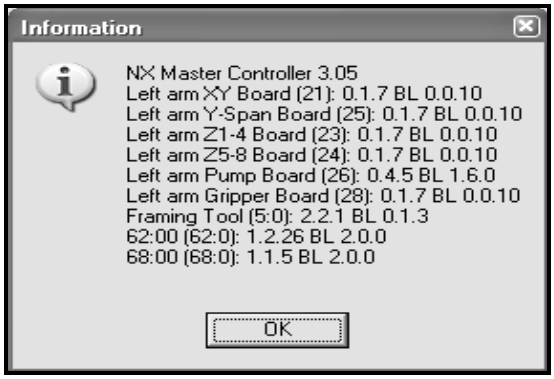

Figure 5-4. Firmware version information

3. To close Information, choose **OK**.

5.3.5 Accessing Advanced Manual Control

To access Advanced Manual Control:

1. Choose **Instrument>Manual Control**. Manual Control appears (Figure 5-2).
2. Choose **Advanced Controls**.
3. Select a device from the menu. Advanced Manual Control for the selected device appears.

5.4 Using Advanced Manual Control

Use Advanced Manual Control to:

- View the current position of the pod.
- Move the pod to a safe roving height.
- Build and apply movement vectors to the pod.
- Allow small movements that are useful when teaching the deck or framing the grippers.
- Extend and retract the grippers.

5.4.1 Viewing the Current Position the Pod

The current position of the pod is displayed as four coordinates. Each axis coordinate is the distance from the home position.

X, Y, and Z are displayed in centimeters. The D-axis is displayed in either centimeters (cm) or microliters (µL). (Refer to the description for D Units in Table 5-1.)

To view the current position of a pod:

1. Choose **Instrument>Manual Control**. Manual Control appears (Figure 5-2).
2. Choose **Advanced Controls**.
3. Select **Pod1**. Advanced Manual Control for the pod appears (Figure 5-5). The current position is shown in Current Position.
4. Choose **Close** to close Advanced Manual Control.
5. Choose **Exit** to close Manual Control.

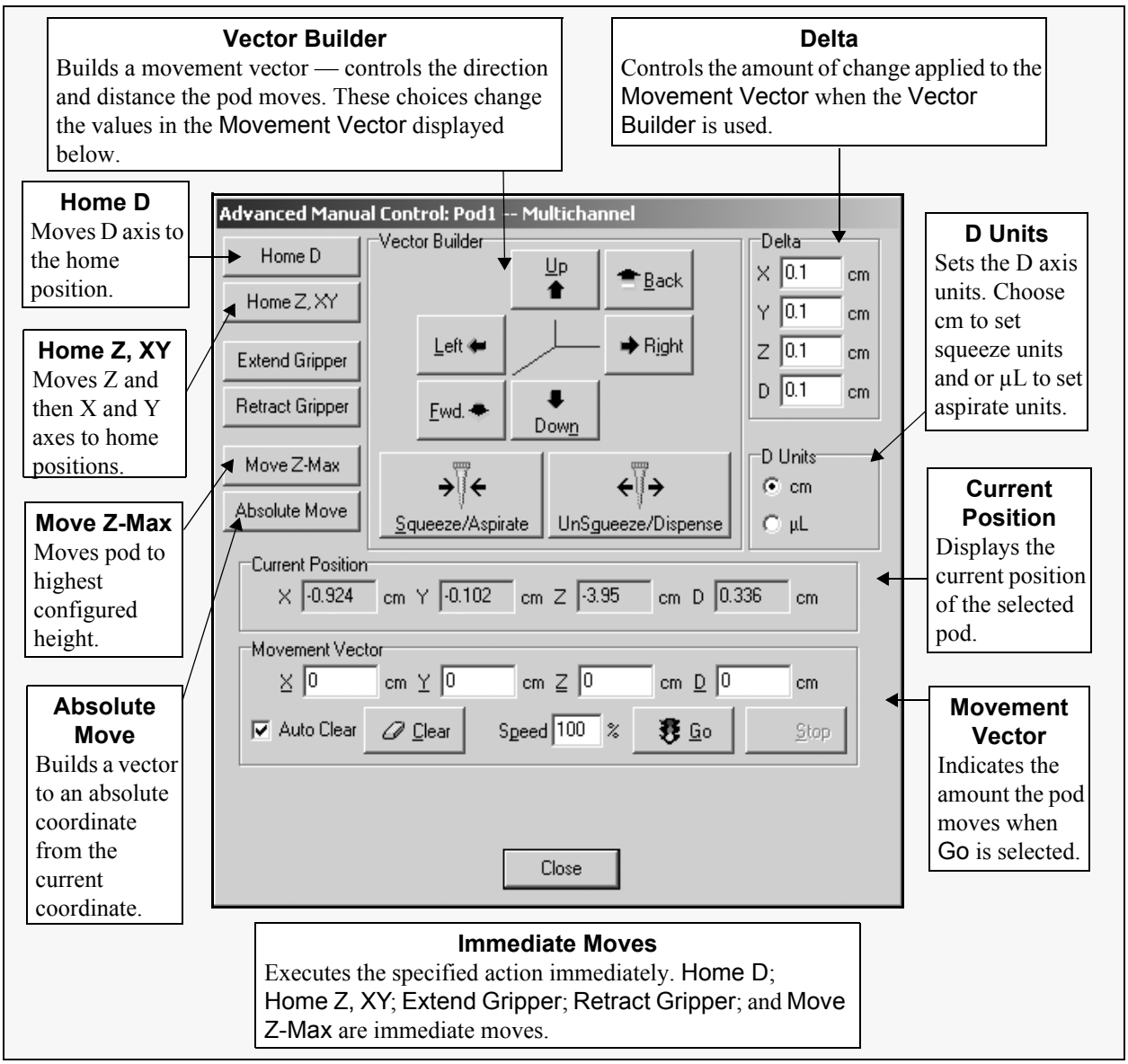

Figure 5-5. Overview Advanced Manual Control for a Multichannel Pod
(See Table 5-1 for further descriptions of fields.)

Table 5-1. Advanced Manual Control selection areas for the Multichannel Pod (Refer to specific subsections for instructional use.)

Area	Description
Absolute Move	Builds a vector to an absolute coordinate from the current coordinate.
Auto Clear	When checked, each time Go is selected the Movement Vector resets to the 0 vector (no movement). **Note:** Auto Clear is on by default.
Clear	Sets movement vector entries to 0.
Current Position	Current location of the pod (after the pod has been homed).
D Units	Sets the D axis units. **Note:** Choose cm to set squeeze units or µL to set aspirate units.
Delta	Sets the magnitude of change the Vector Builder applies to the Movement Vector for each axis.
Extend Gripper	Extends the grippers.
Home D	Moves D axis to home position.
Home Z, XY	Moves Z and then X and Y axes to home position.
Move Z-Max	Moves the pod to highest configured height.
Movement Vector	The amount of movement that occurs when Go is selected. Movement vectors are relative to the current position.
Retract Gripper	Retracts the grippers.
Speed	Sets the speed of the pod, with 0 percent meaning use current speed.
Vector Builder	Relative moves, which allow the pod to move from its current location to anywhere on the deck, are created using the Vector Builder. Each time a Vector Builder button is pressed, the Movement Vector is changed in the corresponding axis by the amount indicated in Delta. Up and Down move the pod in the Z axis, Left and Right move the pod in the X axis, and Back and Fwd move the pod in the Y axis. Squeeze/Aspirate and UnSqueeze/ Dispense move the head in the D axis based upon the selection made in D Units.

5.4.2 Moving the Pod to a Safe Roving Height

Use Move Z-Max in Advanced Manual Control to move the pod to its highest configured height. This helps to avoid collisions when moving the pod around the deck manually.

Note: The possibility of collisions is not completely eliminated by this command; for example, if the gripper is extended and holding a microplate, and the pod is moved over a tip box on a tiploader, a collision could occur.

1. Choose **Instrument>Manual Control**. Manual Control appears (Figure 5-2).
2. Choose **Advanced Controls**.
3. Select **Pod1**. Advanced Manual Control for the pod appears (Figure 5-5).
4. Choose **Move Z-Max**.
5. Choose **Close** to close Advanced Manual Control.
6. Choose **Exit** to close Manual Control.

5.4.3 Understanding Movement Vectors for the Pod

The use of Advanced Manual Control for the pod centers around the building and applying of movement vectors. A movement vector simply indicates the magnitude and direction of motion applied to the pod.

When the point of reference is at the front and center of the unit, positive and negative pod values are as follows:

- Positive value X = right motion
- Positive value Y = forward motion
- Positive value Z = up motion
- Positive value D = squeezing/aspirating motion
- Negative value X = left motion
- Negative value Y = back motion
- Negative value Z = down motion
- Negative value D = unsqueezing/dispensing motion

5.4.4 Setting Delta Values for the Pod

A Delta value is the amount of change in an axis that is applied to the Movement Vector when a button in the Vector Builder is pressed. For example, if the Delta value for X is 3, each time Right is clicked in the Vector Builder, 3 cm is added to the X axis of the Movement Vector.

Note: The move does not occur until Go is selected in the Movement Vector area of Advanced Manual Control.

To set Delta values:

1. Choose **Instrument>Manual Control**. Manual Control appears (Figure 5-2).
2. Choose **Advanced Controls**.
3. Select **Pod1**. Advanced Manual Control for the pod appears (Figure 5-5).
4. Enter a value in X, Y, Z, and D to set the Delta value for each axis.
5. In D Units, select **cm** or **µL**.
6. Choose **Close** to close Advanced Manual Control.
7. Choose **Exit** to close Manual Control.

5.4.5 Performing Relative Moves for the Pod

Relative moves allow the pod to move from its current location to anywhere on the deck. Relative moves are created in the Vector Builder using the Delta values, or the vector can be manually edited.

Note: Use Auto Clear when the values in the Movement Vector fields must be reset to zero after the move is performed. Turn off Auto Clear to retain the values after the move has occurred. Choose Clear to set the values back to zero at any time.

To move a pod relative to its current position:

1. Choose **Instrument>Manual Control**. Manual Control appears (Figure 5-2).
2. Choose **Advanced Controls**.
3. Select **Pod1**. Advanced Manual Control for the pod appears (Figure 5-5).
4. Choose **Clear** to change the Movement Vector values to 0.
5. Enter the desired **X**, **Y**, **Z**, and **D** values in Movement Vector.

   OR

   Click the appropriate buttons (see Table 5-2) in Vector Builder (Figure 5-6), until the desired values appear in Movement Vector (Figure 5-5).

Note: Hold the button down to quickly add Delta value to the Movement Vector.

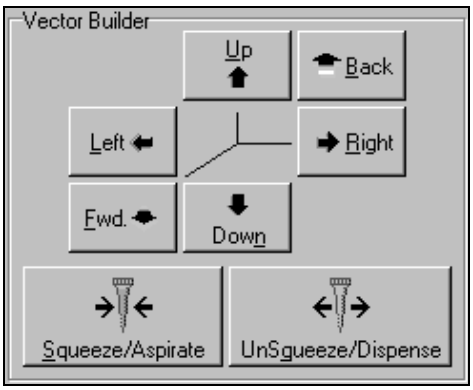

Figure 5-6. Vector Builder

r

Table 5-2. Vector Builder Buttons for the Multichannel Pod

Button	Description
Right (+ Delta X)	Sets the distance the pod moves in the X axis. Adds Delta X to movement value.
Left (– Delta X)	Sets the distance the pod moves in the X axis. Subtracts Delta X from movement value.
Fwd (+ Delta Y)	Sets the distance the pod moves in the Y axis. Adds Delta Y to movement value.
Back (– Delta Y)	Sets the distance the pod moves in the Y axis. Subtracts Delta Y from movement value.
Up (+ Delta Z)	Sets the distance a pod moves in the Z axis. Adds Delta Z to movement value.
Down (– Delta Z)	Sets the distance the pod moves in the Z axis. Subtracts Delta Z from movement value.
Squeeze/Aspirate (+ Delta D)	Sets the distance the head or grippers move in the D axis. Adds Delta D to movement value.
UnSqueeze/Dispense (– Delta D)	Sets the distance the head or grippers move in the D axis. Subtracts Delta D from movement value.

Note: Positive values move the pod to the right (X), toward the front of the deck (Y), up (Z) and squeeze/aspirate (D). Negative values move the pod to the left (X), towards the back of the deck (Y), down (Z) and unsqueeze/dispense (D).

Note: Minimum and Maximum X, Y, Z, and D values displayed in Hardware Setup indicate how far the pod is able to move. These values are also displayed as a tool tip when hovering over the fields in Movement Vectors.

6. Enter a value in **Speed** to specify the percent of the pod's maximum speed.
7. Choose **Go**. The pod moves from its current position to a new position by the values displayed in the Movement Vector. The new position is displayed in Current Position.
8. Choose **Close** to close Advanced Manual Control.
9. Choose **Exit** to close Manual Control.

5.4.6 Performing Absolute Moves for the Pod

Absolute Move allows the pod to move to a specific coordinate position in the workspace of the instrument. Use Absolute Move when the coordinates of the desired position are known.

Note: When an Absolute Move is entered, the values displayed in Movement Vector reflect the relative move required to physically move the pod to the desired position. Make sure the physical location of the pod is not changed between the time the vector is built and the time the Go button is pressed.

1. Choose **Instrument>Manual Control**. Manual Control appears (Figure 5-2).
2. Choose **Advanced Controls**.
3. Select **Pod1**. Advanced Manual Control for the pod appears (Figure 5-5).
4. Choose **Absolute Move**. Absolute Move appears (Figure 5-7)).

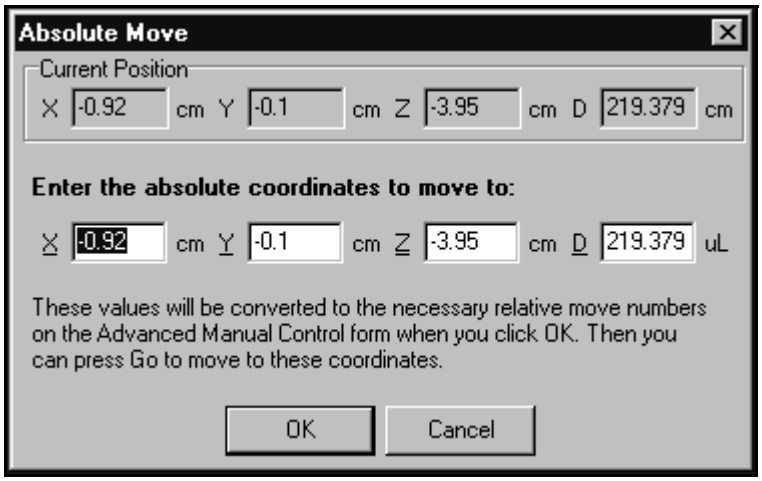

Figure 5-7. Enter Absolute Move Coordinates

5. Enter the **X**, **Y**, **Z**, and **D** values for the desired position.

   Note: Minimum and Maximum X, Y, Z, and D values displayed in Hardware Setup indicate how far the pod is able to move. These values are also displayed as a tool tip when hovering over the fields in Movement Vectors.

6. Choose **OK**. The Movement Vector changes to reflect the necessary relative move.
7. Enter a value in **Speed** to specify the percent of the pod's maximum speed to use for the move.
8. Choose **Go**. The pod moves from its current position to a specified absolute position. The new position is displayed in Current Position.
9. Choose **Close** to close Advanced Manual Control.
10. Choose **Exit** to close Manual Control

5.4.7 Extending and Retracting the Grippers

Use Advanced Manual Control to extend or retract the grippers when changing the head on the pod.

CAUTION: Select Move Z-Max to move the pod to its highest point before extending the grippers. To avoid breaking labware or bending the grippers, make sure the grippers will not hit any labware when extended.

CAUTION: Do not retract grippers when they are holding labware.

From Advanced Manual Control for the pod:

- Choose **Extend Gripper** to extend the grippers.
- Choose **Retract Gripper** to retract the grippers.

Appendix A: Specifications

Table A-1. System Specifications

Item	Description
Environment	Indoor use only
Power Requirements	US: 100-120VAC, 60Hz Europe: 200-240VAC, 50Hz
Pneumatic Requirements	40 - 100 psi of clean dry air 275 - 690 kPa of clean dry air
Compressed Air Requirements	Air Pressure: 40 - 100 psi of clean dry air — 414- 690 kPa of clean dry air Air Flow: 2.25 cfm @ 40 psi — 0.064 m^3/min @ 414 kPa
Dimensions of base unit:	36 in. (L) x 31 in. (W) x 44 in. (H) 91.44 cm. (L) x 78.74 cm. (W) x 86.36 cm. (H)
Weight	180 lbs. includes instrument and tip loader
Ambient Operating Temperature	5-30°C (59-86°F)
Humidity Restrictions	<85% (non-condensing) @ 30°C (86°F)
Altitude Restrictions	up to 2000m (6562ft)
Installation Category	Category II
Pollution Degree	2
Fuses	US: 250VAC, 3.15 amp, 5x20 mm, SLO-BLO, UL recognized, CSA certified Europe: 250VAC, 3.15 amp, 5x20 mm, SLO-BLO, CENELEC approved
Communications to Host	RS-232 port

Table A-1. System Specifications (Continued)

Item	Description
Communications to Tip Loader	CAN
Communications to Active ALPs	CAN
Biomek controller host PC	The following specifications are the minimum requirements needed for the IBM PC. CPU: Pentium IV, 2 GHz RAM: 512 MB Hard Drive: 13.5 GB CD ROM Drive: 24X Monitor: 17", Super VGA, 1024 x 768, small fonts, w/ 16-bit color Operating System: Windows NT 4.0 with Service Pack 6a, Windows 2000 with Service Pack 4, or Windows XP with Service Pack 1a Other Software: SQL Server Personal Edition

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