Precision™

Microplate Pipetting System

Operator's Manual

BIO-TEK®

Precision™ Microplate Pipetting System MANUAL UPDATE

P/N 7111000, Revision D1
January 2005

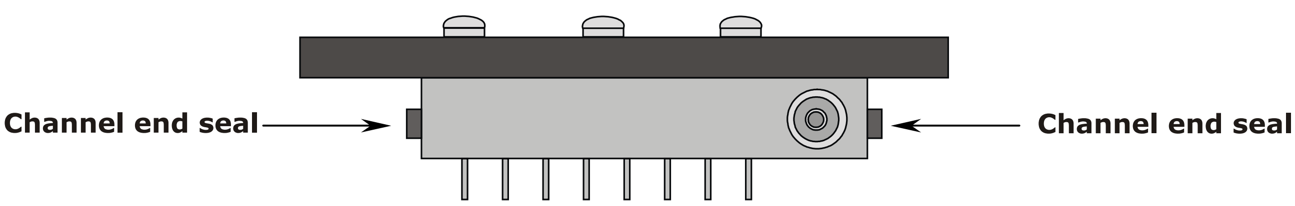
This Manual Update contains changes to the Precision Microplate Pipetting System Operator's Manual for Precision models with the **dispensing manifold** (8-Channel Plus, 12-Channel Plus, and Universal).

These changes will be incorporated in the next full revision (Rev E) of the Operator's Manual, in **Chapter 8**, **Maintenance,** (To clean the manifold tubes and channels, page 211).

- **Lubrication of channel-end seals:** Do not apply lubricant to the two channel-end seals when reinserting the seals after cleaning the manifold. Use **alcohol** to assist with reinsertion of the channel-end seals.

- **Color of channel-end seals:** The two channel-end seals may be black **or** gray (the manual currently states that the seals are black).

DISPENSING MANIFOLD



Precision™
Microplate Pipetting System
Operator's Manual

August 2004

7111000
Revision D
Bio-Tek® Instruments, Inc.

Notices

Bio-Tek® Instruments, Inc.

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Trademarks

Restrictions and Liabilities

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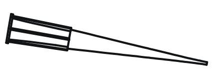
Document Conventions

This manual uses the following typographic conventions:

Example	Description
	This icon calls attention to important **safety** notes.
Warning!	A **Warning** indicates the potential for bodily harm and tells you how to avoid the problem.
Caution:	A **Caution** indicates potential damage to the instrument and tells you how to avoid the problem.
`DEFINE`	Text in `COURIER` font represents menu options as they appear on the display of the instrument's external keypad.
Note:	**Bold** text is primarily used for emphasis.
	This icon calls attention to important information.
	The pipette tip icon calls attention to usage tips.

Revision History

Revision	Date	Changes
A	5/00	• First issue.
B	6/02	• Added text throughout concerning 12-Channel and Universal models, and Precision Power software. Added Performance section to Chapter 1. • Updated model titles to “8-Channel” and/or “Plus,” where appropriate. • Added new chemical compatibility caution, page vi. • Updated Notices, Document Conventions, Package Contents, etc. • Updated Appendices B and D; added new Appendix E.
C	10/03	• Incorporated grease-kit instructions for linear way maintenance. • Made minor improvements to the Intended Use Statement, and to acceptance test and specifications descriptions.
D	8/04	• Revised product name to conform to latest product naming structure. • Added new text throughout manual concerning compatibility/operation of Precision with the Bio-Stack. • Updated warnings/cautions/safety info in Preface. In Chapter 1, revised specs and Technical Support sections, added Optional Accessories list and new section on Applications Support. • Revised unpacking/repackaging artwork and instructions in Chapter 3. • Updated Performance Verification section, Chapter 7 with information from latest Precision IQ-OQ-PQ Procedures (PN 7111017) and revised Decontamination instructions in Chapter 8. • Revised error codes, Chapter 9 and added new Appendix E, Chemical Compatibility. • Reformatted for cosmetic effect.

Intended Use Statement

- The Precision Microplate Pipetting System supports most liquid handling protocols for 96- and 384-well plates, including reagent addition, serial dilutions, and sample transfers.
- This system has its own on-board software for instrument control. Alternatively, it is designed for use with PC-based software: Bio-Tek's Precision Power™ for Windows® software provides the user with PC control of the instrument for enhanced functionality.
- The Precision can be used as a stand-alone instrument, or can operate with standard robotic systems, such as Bio-Tek's Bio-Stack Microplate Stacker.
- **In the European Union:** This product may **only** be used for Research and Development and other non-clinical uses.
- **In all other jurisdictions:** This product may be used for Research and Development and *in vitro* Diagnostic Use.

Quality Control

It is considered good laboratory practice to run laboratory samples according to instructions and specific recommendations included in the assay package insert for the test to be conducted. Failure to conduct Quality Control checks could result in erroneous test data.

Repackaging and Shipping

ⓘ If you need to ship the instrument to Bio-Tek for service or repair, contact Bio-Tek for a Return Materials Authorization (RMA) number, and be sure to use the original packing. Other forms of commercially available packing are not recommended and can void the warranty. If the original packing materials have been damaged or lost, contact Bio-Tek for replacement packing.

Warnings

Operate the instrument on a flat surface and away from excessive humidity.

When operated in a safe environment according to the instructions in this manual there are no known hazards associated with the Precision™. However, the operator should be aware of certain situations that could result in serious injury; these may vary depending on the instrument model.

Hazards and Precautions

Hazards

Warning! Power Rating. The symbol near the power connector indicates a potential shock hazard. Ensure that the instrument is connected to an external power supply that provides voltage and current within the specified rating for the system. Use of an incompatible power supply may produce electrical shock and fire hazards. See ***Technical Specifications*** in ***Chapter 1***.

Warning! Electrical Grounding. Never use a two-prong plug adapter to connect primary power to the external power supply. Use of a two-prong adapter disconnects the utility ground, creating a severe shock hazard. Always connect the power cord directly to a three-prong receptacle with a functional ground. See ***Technical Specifications*** in ***Chapter 1***.

Warning! Internal Voltage. Always turn off the power switch and unplug the power supply before cleaning the outer surface of the instrument.

Warning! Moving Parts. The symbol on the pipette shuttle indicates a potential for personal injury. At any given time during instrument operation, the pipette shuttle may be moving. There are potential pinch points on the mechanism, and opportunities for skin puncture with the pipette tips. Keep hands completely out of the way of the pipette shuttle when the instrument is in operation.

Warning! Liquids. Avoid spilling liquids on the instrument; fluid seepage into internal components creates a potential for shock or instrument damage. If a spill occurs while a program is running, abort the program and turn the instrument off. Wipe up all spills immediately. Do not operate the instrument if internal components have been exposed to fluid. Do not attempt to remove or replace supplies outside the expected supply replenishment windows. Interruptions to instrument movement can result in spilled fluids.

Hazards, Cont'd

Warning! Potential Biohazards. Some assays or specimens may pose a biohazard. Adequate safety precautions should be taken as outlined in the assay's package insert. Always wear safety glasses and appropriate protective equipment, such as chemically resistant rubber gloves/apron. Do not attempt to remove or replace supplies outside the expected supply replenishment windows. Interruptions to instrument movement can result in spilled fluids and potential biohazards.

Warning! Unspecified Use. Failure to operate this equipment according to the guidelines and safeguards specified in this manual could result in a hazardous condition.

Precautions

The following precautions are provided to help avoid damage to the instrument:

Caution: Service. The instrument should be serviced by Bio-Tek authorized service personnel. Only qualified technical personnel should perform troubleshooting and service procedures on internal components.

Caution: Environmental Conditions. Do not expose the instrument to temperature extremes. For proper operation, ambient temperatures should remain between 15°-35°C. Performance may be adversely affected if temperatures fluctuate above or below this range. Storage temperature limits are broader (see ***Chapter 8***, ***Maintenance***).

Caution: Chemical Compatibility. Some chemicals may cause irreparable damage to this instrument. The following chemicals have been deemed safe for use in this instrument: buffer solutions (such as PBS), saline, surfactants, deionized water, 70% ethyl, isopropyl, or methyl alcohol, 40% formaldehyde, and 20% sodium hydroxide. Other chemicals may cause severe damage to the instrument. Contact Bio-Tek prior to using any other chemicals. (Refer also to ***Appendix E***, ***Chemical Compatibility***.)

Caution: Sodium hypochlorite. Do not expose any part of the instrument to the recommended diluted sodium hypochlorite solution (bleach) for more than 20 minutes. Prolonged contact may damage the instrument surfaces. Be certain to rinse and thoroughly wipe all surfaces. See ***Decontamination*** in ***Chapter 8*** for the recommended diluted bleach solution.

Precautions, Cont'd

Caution: Power Supply. Use only the specified external power supply to ensure proper operation of the unit. Refer to ***Chapter 1*** for power supply specifications.

Caution: Shipping Plate and Bracket. The plywood shipping plate that is attached to the bottom of the instrument and the metal shipping bracket attached to the pipette shuttle must be removed prior to operating the Precision, and reinstalled before repacking the instrument for shipment. See ***Chapter 3***, ***Installation and Setup***, for instructions.

Caution: Warranty. Failure to follow preventive maintenance protocols may void the warranty. See ***Chapter 8***, ***Maintenance***.

Caution: Disposal. This instrument contains printed circuit boards and wiring with lead solder. Dispose of the instrument according to Directive 2002/96/EC, "on waste electrical and electronic equipment (WEEE)."

Certifications

CE **Based on the testing described below and information contained herein, this instrument bears the CE mark.**

EC Directive 89/336/EEC Electromagnetic Compatibility

Emissions - CLASS A

The system has been type tested by an independent, accredited testing laboratory and found to meet the requirements of EN 61326-1:1998 for Radiated Emissions and Line Conducted Emissions. Verification of compliance was conducted to the limits and methods of the following:

CISPR 16-1:1993 and CISPR 16-2:1999

Immunity

The system has been type tested by an independent, accredited testing laboratory and found to meet the requirements of EN 61326-1:1998 for Immunity. Verification of compliance was conducted to the limits and methods of the following:

EN 61000-4-2 (1998) Electrostatic Discharge

EN 61000-4-3 (1998) Radiated EM Fields

EN 61000-4-4 (1995) Electrical Fast Transient/Burst

EN 61000-4-5 (1995) Surge Immunity

EN 61000-4-6 (1996) Conducted Disturbances

EN 61000-4-11 (1994) Voltage Dips, Short Interruptions and Variations

EC Directive 73/23/EEC Low Voltage (Safety)

EN 61010-1 (1993)

"Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements" (including Amendment No. 2: 1995).

Directive 2002/96/EC: Waste Electrical and Electronic Equipment

Disposal Notice

This instrument contains printed circuit boards and wiring with lead solder. Dispose of the instrument according to Directive 2002/96/EC, "on waste electrical and electronic equipment (WEEE)."

Electromagnetic Interference and Susceptibility

USA FCC CLASS A

Warning: Changes or modifications to this unit not expressly approved by the manufacturer could **void the user's authority** to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. Like all similar equipment, this equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause interference, in which case the user will be required to correct the interference at his own expense.

Canadian Department of Communications Class A

This digital apparatus does not exceed Class A limits for radio emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas du bruits radioelectriques depassant les limites applicables aux appareils numerique de la Class A prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

User Safety

This device has been type tested by an independent laboratory and found to meet the requirements of the following:

North America

Underwriters Laboratories UL 3101-1

1st Edition, "Electrical Equipment for Laboratory Use, Part 1: General Requirements."

Canadian Standards Association CAN/CSA C22.2 No.1010.1-1992

"Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use; Part 1: General Requirements."

International

EN 61010-1

"Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements."

Safety Symbols

Some of these symbols may appear on the instrument:

Alternating current
Courant alternatif
Wechselstrom
Corriente alterna
Corrente alternata

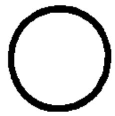
Direct current
Courant continu
Gleichstrom
Corriente continua
Corrente continua

Both direct and alternating current
Courant continu et courant alternatif
Gleich - und Wechselstrom
Corriente continua y corriente alterna
Corrente continua e corrente alternata

Earth ground terminal
Borne de terre
Erde (Betriebserde)
Borne de tierra
Terra (di funzionamento)

Protective conductor terminal
Borne de terre de protection
Schutzleiteranschluss
Borne de tierra de protección
Terra di protezione

On (Supply)
Marche (alimentation)
Ein (Verbindung mit dem Netz)
Conectado
Chiuso



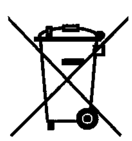
Off (Supply)
Arrêt (alimentation)
Aus (Trennung vom Netz)
Desconectado
Aperto (sconnessione dalla rete di alimentazione)

Caution (refer to accompanying documents)
Attention (voir documents d'accompanement)
Achtung siehe Begleitpapiere
Atención (vease los documentos incluidos)
Attenzione, consultare la doc annessa

Warning, risk of electric shock
Attention, risque de choc electrique
Gefährliche elektrische Schlag
Precaución, riesgo de sacudida eléctrica
Attenzione, rischio di scossa elettrica

Warning, risk of crushing or pinching
Attention, risque d'écrasement et pincement
Warnen, Gefahr des Zerquetschens und Klemmen
Precaución, riesgo del machacamiento y sejeción
Attenzione, rischio di schiacciare ed intrappolarsi

Warning, hot surface
Attention, surface chaude
Warnen, heiße Oberfläche
Precaución, superficie caliente
Attenzione, superficie calda



Separate collection for electrical and electronic equipment
Les équipements électriques et électroniques font l'objet d'une collecte sélective
Getrennte Sammlung von Elektro- und Elektronikgeräten
Recogida selectiva de aparatos eléctricos y electrónicos
Raccolta separata delle apparecchiature elettriche ed elettroniche

Warranty

This Warranty is limited and applies only to new products, except for computer-based software, which is covered under a separate Warranty Policy, manufactured by Bio-Tek Instruments, Inc. (“Bio-Tek”). Bio-Tek makes no warranty whatsoever regarding the condition of used products.

Bio-Tek warrants the instrument (hereinafter collectively referred to as “Products” or “Product”) for a period of one (1) year from the original purchase date against defective materials or workmanship. This Warranty is limited to the original purchaser (the “Purchaser”) and cannot be assigned or transferred. All claims under this Limited Warranty must be made in writing to Bio-Tek, Attention: Service Department. Purchaser must ship the Product to Bio-Tek, postage pre-paid. Bio-Tek shall either repair or replace with new or like-new, at its option and without cost to the Purchaser, any Product that in Bio-Tek’s sole judgment is defective by reason of defects in the materials or workmanship.

This Warranty is VOID if the Product has been damaged by accident or misuse, or has been damaged by abuse or negligence in the operation or maintenance of the Product, including without limitation unsafe operation, operation by untrained personnel, and failure to perform routine maintenance. This Warranty is VOID if the Product has been repaired or altered by persons not authorized by Bio-Tek, or if the Product has had the serial number altered, effaced, or removed. This Warranty is VOID if the Product has not been connected, installed or adjusted strictly in accordance with written directions furnished by Bio-Tek. Batteries, fuses, light bulbs, and other “consumable” items used in any of the Products are not covered by this Warranty. Software utilized in conjunction with any of the Products is not covered by the terms of this Warranty but may be covered under a separate Bio-Tek software warranty.

We will continue to stock parts for a minimum period of five (5) years after the manufacture of any equipment has been discontinued. Parts shall include all materials, charts, instructions, diagrams, and accessories that were furnished with the standard models.

THIS WARRANTY CONTAINS THE ENTIRE OBLIGATION OF BIO-TEK INSTRUMENTS, INC., AND NO OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY ARE GIVEN. PURCHASER AGREES TO ASSUME ALL LIABILITY FOR ANY DAMAGES AND/OR BODILY INJURY OR DEATH THAT MAY RESULT FROM THE USE OR MISUSE OF ANY EQUIPMENT OR INSTRUMENT BY THE PURCHASER, HIS EMPLOYEES, AGENTS, OR CUSTOMERS, OTHER THAN THE EXPRESS WARRANTY CONTAINED HEREIN. WE SHALL NOT BE RESPONSIBLE FOR ANY DIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND. THIS WARRANTY SHALL NOT BE CHANGED OR MODIFIED IN ANY WAY WITHOUT THE EXPRESS WRITTEN PERMISSION OF AN OFFICER OF BIO-TEK INSTRUMENTS, INC.

Registration

Once the instrument has been set up, and is running successfully, please take a moment to fill out and mail the postage-paid Warranty Registration card. By sending in the registration card, you'll be assured of receiving prompt information on product enhancements.

If you prefer, you may register your instrument online at Bio-Tek's Web site: www.biotek.com.

Chapter 1

Introduction

This chapter introduces Bio-Tek's Precision Microplate Pipetting System. Product information, including hardware and software features and technical specifications, is presented here. See ***Chapter 2, Instrument Description*** for more in-depth information including the principles of operation and component descriptions.

Product Overview

Bio-Tek's Precision™ Microplate Pipetting System is an affordable, innovative solution for automating liquid handling in your laboratory. A unique hardware design combined with powerful and versatile on-board software allow for a smooth transition from your manual methods to automation with the Precision. The instrument supports a wide variety of fluid transfer operations for both 96- and 384-well microplates, including:

- Sample transfer
- Plate replication
- Serial dilutions
- Reagent addition
- Mixing within a well
- Continuous reagent dispense (using the manifold)

You'll find the Precision does not limit you to using just a few types of reagent vessels or microplates. We've designed the hardware and the software to allow you to create custom "Specification Files" for some of the supplies already in use at your laboratory. To get you started, the instrument comes pre-installed with Specification Files for some common lab products, including Rainin FinePoint™ 250 µl tips, Labcon® 50 µl and 200 µl tips, Nunc flat 1 x 8 microstrips / 96-well microplates, Corning Costar® 384-well microplates, and Bio-Tek's 4-vessel reagent holder.

And just as we've given you Specification Files for some common lab products, we've also put together a few "Programs" for you (see the list in ***Appendix B)***. A **Program** simply contains a sequence of commands to perform a fluid transfer. Programs are created, modified, and run from the instrument's Main Menu. You can run the existing programs, modify them, or create new ones.

Variations

The Precision is available in four models. All models support 96- and 384-well microplates and are robot-compatible.

Bio-Tek PN	Model	Description
PRC384	8-Channel Precision	Instrument with 8-channel pipette.
PRC384M	8-Channel Precision	Instrument with 8-channel pipette and syringe pump with 8-channel dispensing manifold. The manifold allows for rapid plate filling.
PRC384/12	12-Channel Precision	Instrument with 12-channel pipette and syringe pump with 12-channel dispensing manifold for rapid plate filling.
PRC384U	Universal Precision	Instrument with 12-channel pipette and two platforms for dispensing into a column of 8 wells or a column of 12 wells. This instrument includes a syringe pump and both an 8- and 12-tube manifold for rapid plate filling.

Precision Power™ Software is also available for creating, editing, and running programs on the Precision. Precision Power is a Microsoft Windows-based software tool developed by Bio-Tek Instruments, Inc. for simplifying the programming of the Precision. The user has the advantage of a full computer keyboard, mouse, graphic display, and intuitive software to simplify the programming process. In addition, Precision Power offers increased functionality not available on the base instrument, including nested loops, more commands per program, and supply replenishing during program execution.

Compatibility With the Bio-Stack System

Many Precision instruments are compatible with Bio-Tek's **Bio-Stack™ Microplate Stacker**. (Please refer to the table below for a list of compatible models.)

In this configuration, Bio-Tek's **Precision Power™ Software** and **Bio-Stack™ PC Control Software** are installed on a host PC equipped with two serial ports. Precision Power uses one port to control the Bio-Stack via the **ActiveX component** of the Bio-Stack PC Control Software, and the other port to control all functionality of the Precision.

The Bio-Stack can rapidly and systematically transfer microplates one at a time to and from the Precision, and includes:

- Removable stacks (one input and one output) that can hold up to 30 microplates each.
- Optional restacking of plates to maintain correct sequencing.
- The ability to continue processing a stack of plates following the aborting/failure of one plate.
- The ability to pause processing to allow the user to add more plates to the input stack or to remove some from the output stack.

If you have purchased the Bio-Stack to operate with your Precision, an accessory kit (PN 7110004) is included with the Bio-Stack that contains the Bio-Stack PC Control Software and hardware for aligning the two instruments. Refer to the Bio-Stack Operator's Manual for instructions on mechanical alignment, and to the Precision Power User's Guide or Help System for instructions on configuration of the Precision for operation with the Bio-Stack

If you are interested in purchasing the Bio-Stack, refer to the table below to determine if your Precision is compatible with the Stacker. Please note that some of the instruments that are compatible may need to be upgraded with **new basecode software**. Contact your local dealer for more information.

The following models are compatible	
8-Channel, 8-Channel Plus, Universal in 8-channel mode	With serial numbers >187931
The following models are not compatible	
8-Channel, 8-Channel Plus, Universal in 8-channel mode	With serial numbers < 187931
Universal in 12-channel mode	All serial numbers
12-Channel Plus	All serial numbers

Hardware Features

- External membrane keypad with 25 alphanumeric keys and 2-line x 24-character LCD display
- 8-channel and/or 12-channel pipette
- Optional syringe pump and 8-channel and/or 12-channel manifold, with priming trough
- Six-station and/or 4-station supply platform, with components that are easily removed for cleaning
- External 24-volt power supply compatible with 100-240 V~ @ 50-60 Hz
- Bi-directional serial RS-232 COM port (25-pin male connector)
- Parallel port
- Controllable flow rates and volumes provided by 8- or 12-channel positive displacement pipette syringe pumps, and an optional positive displacement manifold syringe pump
- Accurate and repeatable pipette, manifold, and supply platform positioning provided by multiple stepper motors

Software Features

The on-board, menu-driven software supports:

- Ability to create programs to perform fluid transfers
- Ability to create detail and specification files for inclusion in programs
- User-definable file names, resulting in the rapid recall of files
- Ability to edit, copy or delete files
- Ability to send file contents to a printer
- Ability to “lock” files to avoid unintentional modification
- Validation utility checks programs for errors
- Easy-to-update basecode software
- Storage of up to 80 programs, 80 detail files, and 80 spec files
- Pre-defined QC programs
- Specification measurement utility to configure the software for use with a wider variety of tips and vessels

Package Contents

- Precision™ Microplate Pipetting System
- Power cord (PN 75089)
- External 24 VDC power supply (PN 61062)
- RS-232 cable (PN 75053)
- Printer cable (PN 71072)
- Waste collection bin for used tips and for residual fluid (PN 44284)
- 1 box of Labcon 200 pipette tips (PN 98195)
- 4 Bio-Tek reagent vessels, 50 ml capacity (PN 7112122) for Precision 8-Channel, 8-Channel Plus, and Universal models
- 3 Bio-Tek reagent vessels, 65 ml capacity (PN 7112113) for Precision 12-Channel Plus, and Universal models
- 4 holders for tips or reagent vessels (PN 7112117)
- 4 holders for microplates or microstrip holders (PN 7110509)
- 1 set spare pipette tip o-rings (PN 19458): 8 o-rings for 8-channel pipette, 12 o-rings for 12-channel pipette
- Set of shipping materials (PN 7113002)
- Unpacking (PN 7111005) and packing (PN 7111006) instructions
- Shipping document kit (PN 94075) including Warranty Card, Certificate of Compliance, and FDA Certification
- Declaration of Conformity (PN 7111002)
- Grease kit for periodic cleaning and lubrication of the linear ways and motor screws (PN 7110017)
- Operator's Manual (PN 7111000)

For manifold models only:

- One 2-liter supply bottle with cap, Luer fitting, and tubing (PN 4070515)
- Syringe inlet and outlet tubing (PN 7110516 and 7110517)
- Stylus for cleaning the dispense tubes (PN 2872304)
- Priming trough (PN 7112112)
- Manifold priming trough drain set (PN 7110015)
- Hanger tube (PN 7112050)

Optional Accessories

- Dispense manifold tubing for DMSO (PN 7110530)
- Spare dispense manifold tubing (PN 7110523)
- Spare dispense manifolds
  - 12-channel (PN 7110550S)
  - 8-channel (PN 7110549S)
- Spare reagent bottle (2 L) with cap and connector (PN 4070515)
- Protective aerosol cabinet (PN 7113003)
- Spare reagent reservoirs
  - 1 x 12 (PN 7112113)
  - 1 x 8 (PN 7112122)
- Spare pipette tip o-rings (PN 19458): 8 o-rings for 8-channel pipette, 12 o-rings for 12-channel pipette
- Bio-Tek blue test dye solution (PN 7773001) and wetting agent solution (PN 7773002) for liquid testing
- Precision Power Software (PN PRCPWR)
- Precision Power Software Version 2 Upgrade (PN PRCPWR UPGRADE V2)
- Precision ActiveX Programmer's Package (PN 7110008)
- Precision Service Manual (PN 7110001)
- Installation-Operational-Performance Qualification (IQ-OQ-PQ) Procedures (PN 7110524)
- Bio-Stack Microplate Stacker (PN BIOSTACK)

❖ **Note:** Precision Power Software Version 2 Upgrade is required for operation of the Precision with the Bio-Stack.

Many other accessories are available for the Precision. Contact Bio-Tek for more information.

Technical Specifications

Supplies

	The Precision is initially configured for use with the tips and vessels listed here; however, the instrument can be configured to support a wider variety of tips and vessels, as described later in this manual.
Tips	Bio-Tek 250 µl pipette tips (manufactured by Rainin®) Bio-Tek 50 µl pipette tips (manufactured by Labcon®) Bio-Tek 200 µl pipette tips (manufactured by Labcon®)
Vessels	Nunc™ flat 1 x 8 microstrips / 96-well microplate Nunc™ round 1 x 8 microstrips / 96-well microplate Corning Costar® 384-well microplate Bio-Tek's reagent reservoirs

Electrical

Primary Main Power to External Power Supply:	100-240 V~ @50-60 Hz
Secondary DC Output from the External Power Supply:	24 VDC 48 Watts

Physical

Dimensions:	Instrument only: 15" D x 21" W x 16" H (38.1 cm x 53.3 cm x 40.6 cm) Instrument with optional aerosol cabinet: 17.5" D x 23" W x 17.5" H (44.5 cm x 58.4 cm x 44.5 cm)
Weight:	Instrument only: 28 lbs. (12.7 kg) Instrument with optional aerosol cabinet: 38 lbs. (17.2 kg)

Environmental

Operating conditions	15°-35°C (59°-95°F)
Relative humidity	10-80% (non-condensing)

Hardware

Pipette	8-channel and 12-channel, 120 µl maximum displacement per channel
Manifold	8-channel and 12-channel, for dispensing fluid only
Supply bottle volume	2 liters
User interface	External membrane keypad with 25 alphanumeric keys and 2-line x 24-character LCD display

Performance

Precision	Pipette precision is ≤ 2.0% CV, when dispensing 100 µl per well of deionized water with 0.1% Tween® 20 with either FD&C #1 blue or #5 yellow dye. Touch off dispensing technique shall be used with an excess aspirated volume of not less than 10 µl. The temperature of the instrument under test and the reagent shall be the same during testing. Manifold precision is ≤ 3.0% CV typical, when dispensing 100 µl per well of deionized water with 0.1% Tween® 20 with either FD&C #1 blue or #5 yellow dye.
Accuracy	Pipette accuracy is ≤ 2.0%, when dispensing 100 µl per well of deionized water with 0.1% Tween® 20. Touch off dispensing technique shall be used with an excess aspirated volume of not less than 10 µl. The temperature of the instrument under test and of the water solution shall be the same during testing. Manifold accuracy is ≤ 2.0% typically, when dispensing 100 µl per well of deionized water with 0.1% Tween® 20.

Technical Support

Bio-Tek's Precision Microplate Pipetting System is backed by a superior support staff. The TAC engineers provide assistance with use and maintenance, troubleshooting support, and frequently asked questions.

The Bio-Tek Service Center provides periodic certification of laboratory instruments and calibration plates, performing both calibration and verification to ensure that your instrumentation meets the manufacturer's specifications.

Our Service Center also provides repair and refurbishment services, thoroughly testing each repaired instrument to ensure it meets current factory performance specifications.

If the Precision ever fails to work perfectly and you need troubleshooting assistance, or if you require certification, refurbishment, or repair of the instrument, please contact Bio-Tek's Technical Assistance Center.

Whichever method of contact you choose, please be prepared to provide the following information:

- Product name and serial number.
- The instrument's on-board software configuration information. To see this, start at the Main Menu and press **`UTIL`** ➔ **`TESTS`** ➔ **`CHKSUM.`**
- For troubleshooting assistance or instruments needing repair:
  - the specific steps that produce your problem
  - any error codes displayed on the screen (descriptions of error codes are available in ***Chapter 9***, ***Error Codes***).
- A daytime phone number.
- Your name and company information.
- A fax number and/or an e-mail address, if available.

> ❖ **Note:** Bio-Tek offers a **Depot Service Contract** for instruments after the initial warranty has expired. Please refer to the Bio-Tek website for more information: www.biotek.com.

If you need to return the Precision to Bio-Tek for service, contact Bio-Tek for a Return Materials Authorization (RMA) number. When obtaining the RMA, explain whether the instrument requires calibration, cleaning, periodic maintenance, warranty work, and/or repair.

Repackage the Precision properly (see ***Repackaging the Instrument for Shipping*** in ***Chapter 3***), and ship the instrument to Bio-Tek at the shipping address listed on the following page.

Phone Support

You can telephone the **Technical Assistance Center** between 8:30 AM and 5:30 PM Eastern Standard Time (EST), Monday through Friday, excluding holidays.

Bio-Tek Instruments Main Number:	802-655-4040
Technical Assistance Center:	800-242-4685

Electronic Communication

Electronic communication is available via the following:

E-Mail:	tac@biotek.com
Internet Site:	www.biotek.com

Fax Support

If you prefer, you may send a fax with your questions or requests for help 24 hours a day to the following numbers:

Technical Assistance Center:	802-655-3399

Written Communication

You may write a letter with your comments and send it to:

Bio-Tek Instruments, Inc.

Technical Assistance Center

PO Box 998, Highland Park

Winooski, Vermont 05404-0998 USA

Shipping Address

Ship instruments that need repair or service to Bio-Tek at the following address:

Bio-Tek Instruments, Inc.

Technical Assistance Center

100 Tigan Street

Highland Park

Winooski, Vermont 05404 USA

Applications Support

Bio-Tek's fully equipped Application Laboratory provides our on-staff scientists with the means to assist you with your most difficult applications. The primary focus of our scientists is to help you with the integration of our instrumentation and software with your unique scientific applications.

If you are having difficulty with integrating a unique data reduction transformation, finding the right curve fit, or just looking for a recommendation on an appropriate fluorophore, contact Bio-Tek at the phone numbers or e-mail address listed below.

Phone Support

You can telephone the **Applications Support** staff between 8:30 AM and 5:30 PM Eastern Standard Time (EST), Monday through Friday, excluding holidays.

In the U.S. call:	(888) 451-5171
Outside the U.S. call:	(802) 655-4740

Electronic Communication

Electronic communication is available via the following:

E-Mail:	applications@biotek.com
Internet Site:	www.biotek.com

Chapter 2

Instrument Description

Chapter 1 provided an introduction to the Precision Microplate Pipetting System. This chapter goes into greater detail by discussing the principles of operation and introducing important components. The information provided here is important for the operation, customization, and maintenance of the instrument.

Principles of Operation

The Precision Microplate Pipetting System is a microprocessor-driven device with adequate memory for performing all functions described in this manual, and for the storage of up to

- 80 program files,
- 80 specification files, and
- 80 detail files.

All three file types are created, stored, and run using the on-board software via the 2-line x 24 character display and external keypad. In addition, these files may be created and run using **Precision Power** software loaded on a host PC. If you have purchased Precision Power to control your Precision instrument, please refer to the **Precision Power User's Guide** for more information on creating and running program, specification, and detail files. If you would like to purchase Precision Power, please contact your local dealer for more information.

Supply Types

Each program defines the required **supply types** (tips, reagent vessels, microplates, etc.), and their locations, tip and vessel specifications, and many aspirate and dispense parameters. Before a program can be run, the operator is responsible for loading the necessary supplies. Depending on the program and instrument model, the pipette or manifold handles fluid delivery.

Pipette Design

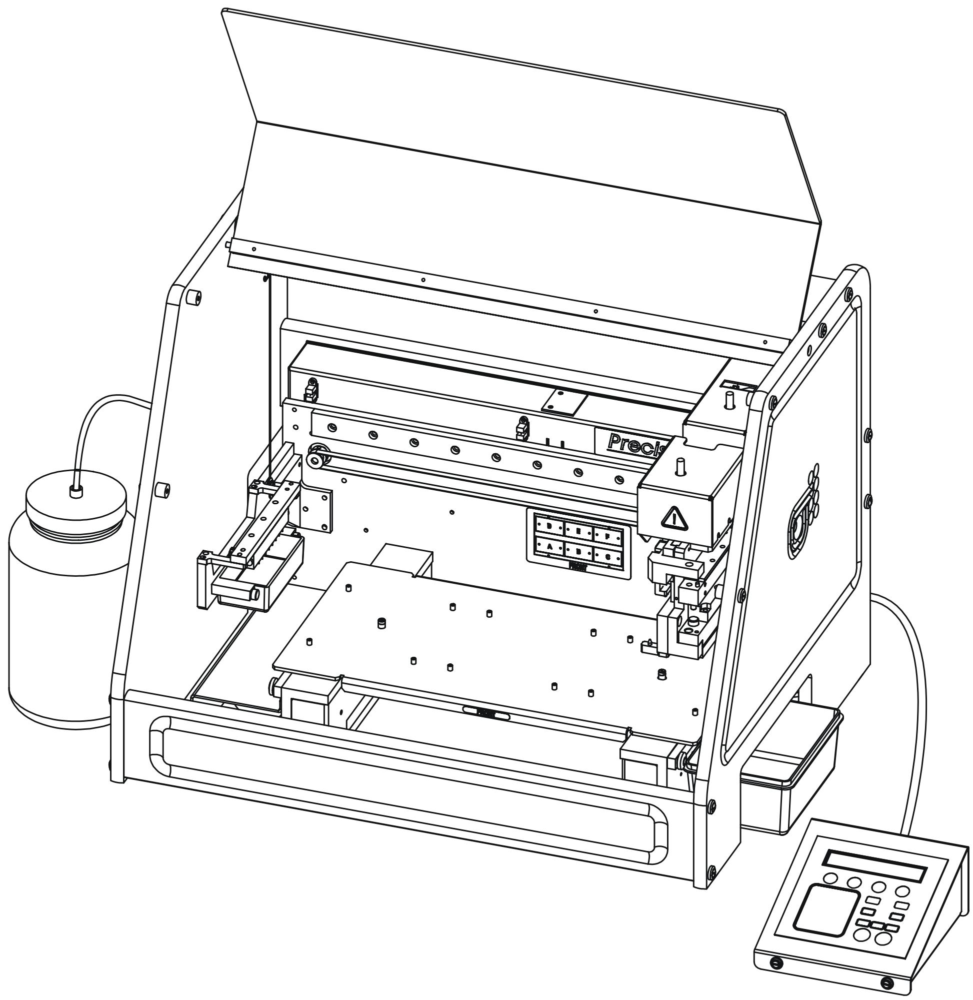
The unique **pipette design** provides a reliable way to pick up and seal the tips, and also ensures the long life of the seals. The pipette has eight or twelve channels terminating in tapered stainless steel tips that mate with disposable pipette tips. The pipette moves in the z- (up/down) axis to pick up tips and to aspirate and dispense fluid, and in the x- (left/right) axis to access the different stations on the supply platform.

Supply Platform

The **supply platform** has six or four stations (depending upon the model) that can accommodate tip containers, reagent vessel holders, and microplates. The platform is arranged in two rows of three stations, or (one row of four stations). It moves in the y (back/ forward) axis to orient the appropriate row under the path of the pipette and manifold. The ability of the platform to move in the y-axis allows the pipette and manifold to access both 96- and 384-well microplates, and makes the instrument compatible with robotic plate handlers.

Dispensing Manifold

The Precision 8-Channel Plus, 12-Channel Plus and Universal models have a **dispensing manifold**, in addition to the pipette. The manifold with its positive displacement pump allows for the direct dispensing of reagent to 96-and 384-well microplates. The manifold moves in the x- and z-axes.



Components

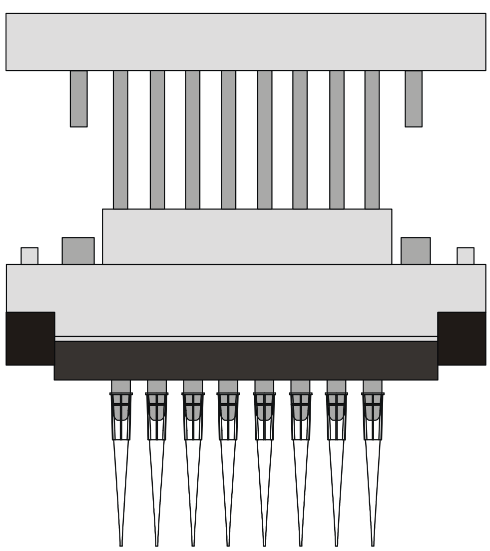
This section introduces several important components of the Precision.

❖ All figures shown in this chapter and throughout the manual are eight-channel models.

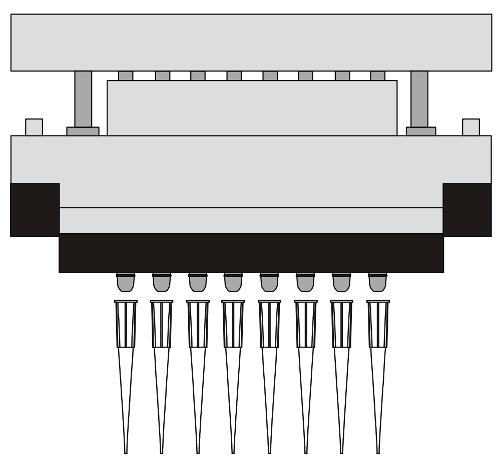
Pipette

The pipette uses individual syringes and disposable pipette tips to perform fluid transfers. The pipette "shuttle" (the entire pipette mechanism) travels in the z- (vertical) axis when picking up tips, aspirating fluid, dispensing fluid, and disposing of tips. It travels in the x- (horizontal) axis when moving from station to station. Each individual stainless steel pipette tip has an o-ring seal where it mates with the disposable tip to hold it securely in place. The maximum volume of each pipette channel is 120 µl.

The drawing below is of an eight-channel pipette head. The image on the left shows the positioning of the pipette mechanism after tips have been engaged. The drawing on the right shows the positioning of the mechanism when disposing of the used tips. The stripper plate is pushed down until the tips disengage. They can be dropped into the waste collection bin or into the tip rack.



Pipette with 8 disposable tips engaged



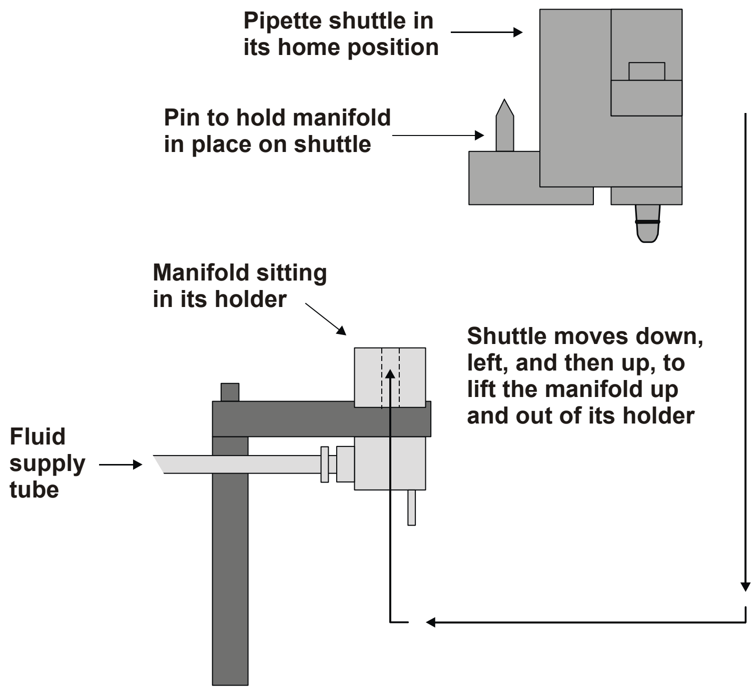
Pipette stripping off used tips

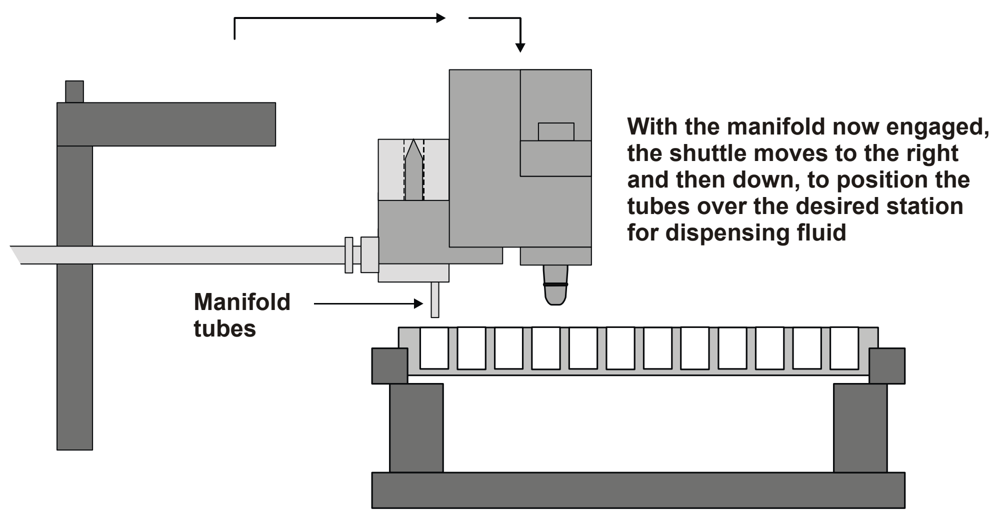
Manifold

When fitted with the appropriate accessory hardware, the pipette "shuttle" has the ability to retrieve an 8- or 12-channel dispensing manifold. The manifold does not aspirate. An external 2-liter supply bottle containing reagent or other solution is the source of fluid for the manifold. The manifold is particularly beneficial because it can perform rapid loading of a single solution to multiple microplates.

The manifold must be primed prior to use. This can be done automatically at the start of the program or manually through a utility section of the software. When the manifold is in its home position, it sits above the priming trough.

The pipette shuttle transports the manifold in the x- and z-axes, and the supply platform moves in the y-axis, allowing the manifold to dispense to both 96-well and 384-well plates, at any supply station. The drawings on the following page show how the pipette shuttle retrieves the manifold by lifting it up and out of its holder, and then positions it over a plate for dispensing. The view is from the front of the instrument.


Pipette shuttle in its home position
Pin to hold manifold in place on shuttle
Manifold sitting in its holder
Shuttle moves down, left, and then up, to lift the manifold up and out of its holder
Fluid supply tube


With the manifold now engaged, the shuttle moves to the right and then down, to position the tubes over the desired station for dispensing fluid
Manifold tubes

Supply Platform

The supply platform used with a Precision™ in the eight-channel configuration has six “stations” labeled A–F. The stations are arranged in a 2 x 3 matrix, as shown in the drawings on the following page.

Precision models such as the Universal in 12-channel configuration and the 12-Channel Precision, have a supply platform with four stations labeled A-D. The stations are arranged in a 1 x 4 matrix.

Any station in the six-station or four-station platforms can be used for *any* supply, such as a tip tray, a reagent vessel holder, a microplate, or a microstrip holder.

The entire supply platform moves in the Y, or front-to-back, axis to provide the pipette and manifold with access to both rows of stations, and to accommodate 384-vessel plates. When pipette tips are used, they can either be returned to the tip tray or discarded into the detached waste container on the right side of the instrument.

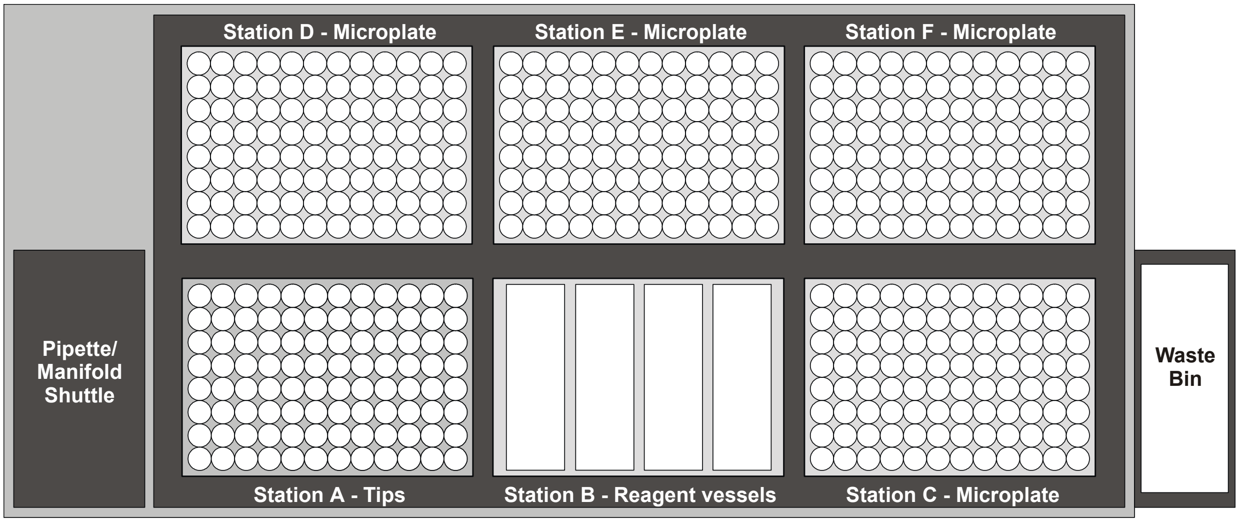
❖ The Universal model also has the six station (A-F) supply platform for operation in the 8-channel configuration.

Alignment of the Supply Platform With the Bio-Stack

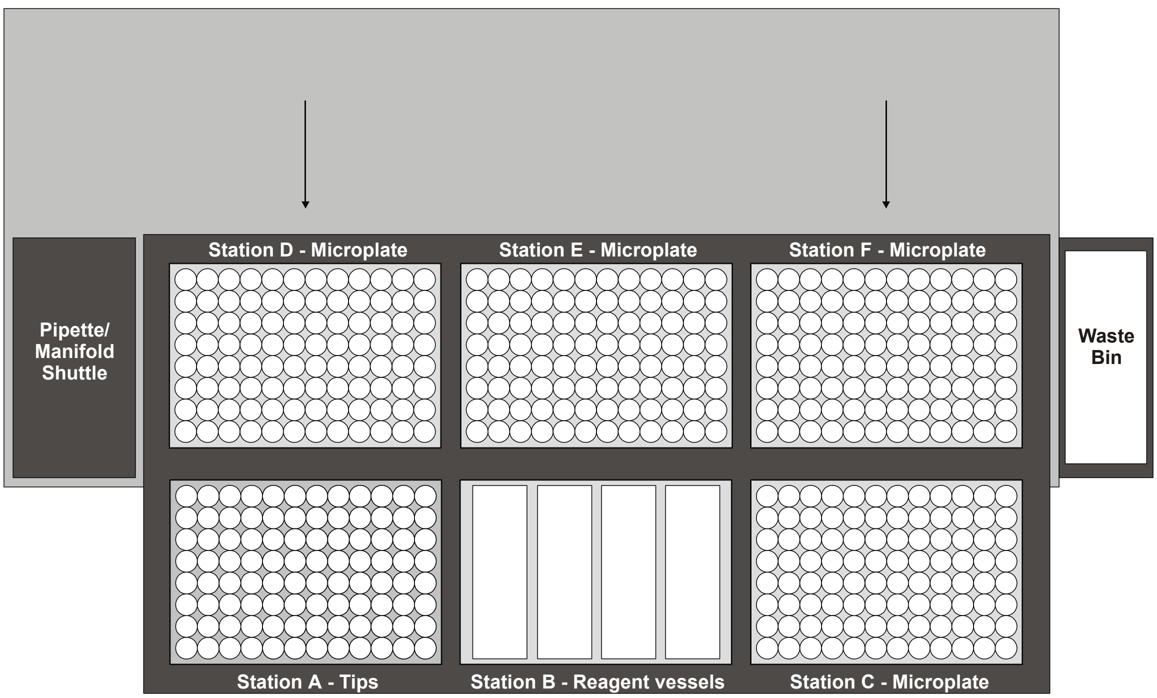
If you have purchased Bio-Tek’s **Bio-Stack™ Microplate Stacker** for operation with the Precision, the supply platform must be aligned with the Stacker, using the alignment hardware and **Instrument|Precision Series|Configuration** feature in **Precision Power™ Software**. (Special aligning plates and posts also must be attached to the two instruments.)

Please refer to the Bio-Stack Operator’s Manual for instructions on mechanical alignment, and to the Precision Power User’s Guide or Help System for instructions on configuration of the Precision for operation with the Bio-Stack.

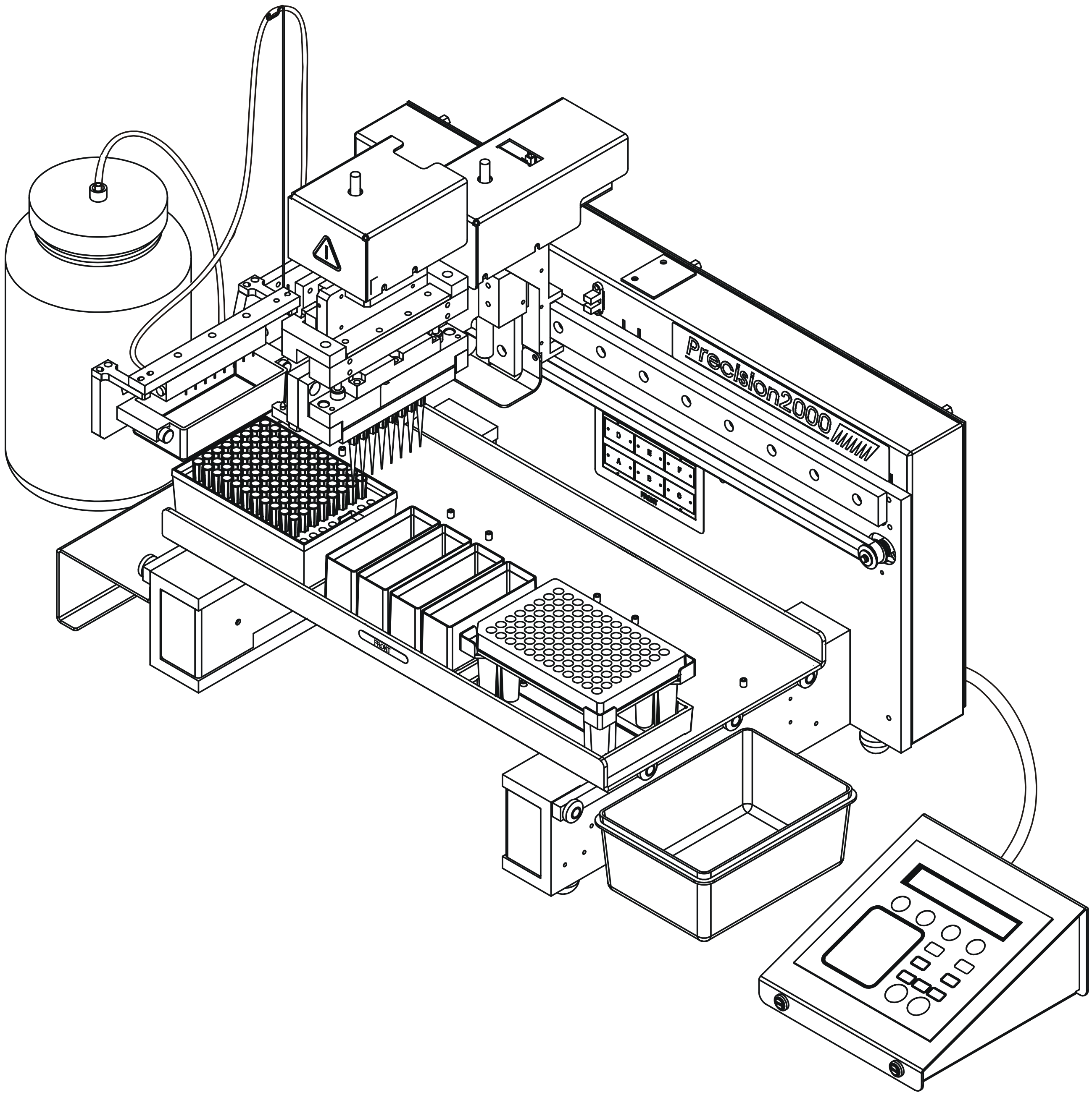
❖ The Bio-Stack can be aligned with supply stations A, B, or C, however, if two Bio-Stacks are used with the Precision, the Stackers must be positioned at stations A and C in order to allow adequate spacing between the two instruments.



Supply platform is positioned so that the pipette/manifold can access stations A, B, and C.



Supply platform is positioned so that the pipette/manifold can access stations D, E, and F.



This drawing shows the 6-station supply platform with tips at Station A, Bio-Tek's reagent vessels at Station B, and a 96-well microplate at Station C.

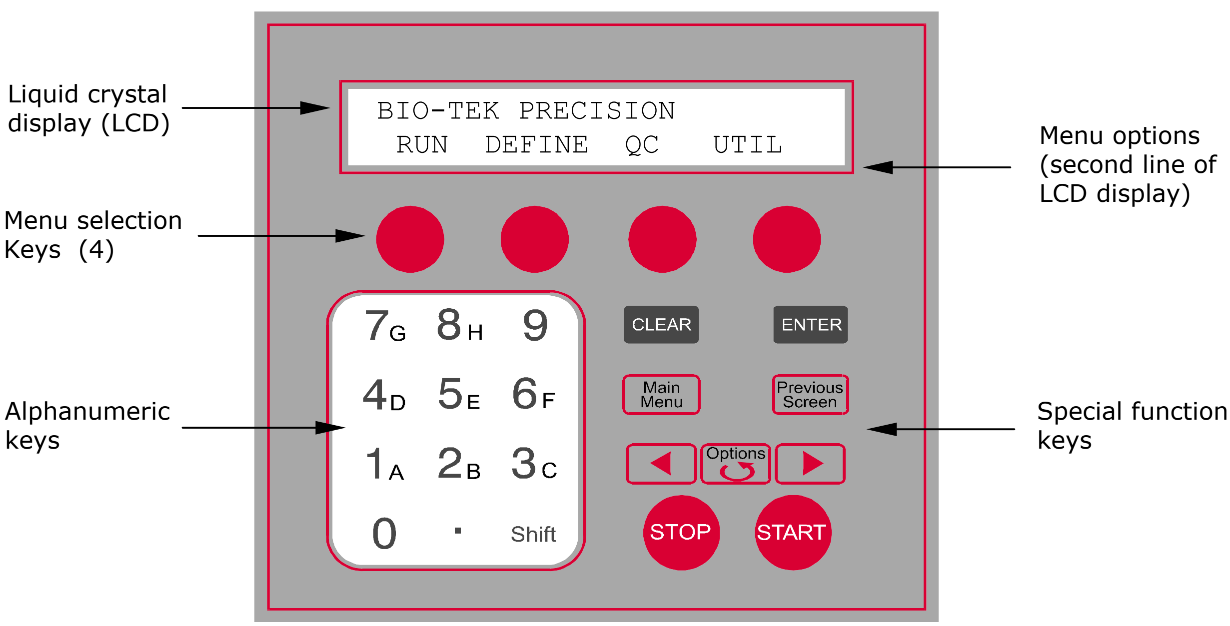
On-Board Software

All Precision models are installed with the same basecode and configuration software. The hardware configuration is set via a dip switch and is detected by the software.

- The **basecode software** controls the instrument operations and provides an interface for accessing, creating, and manipulating protocols (pickup, aspirate, and dispense sequences), and for running various utilities. The basecode also stores tip and vessel specifications.
- The **configuration software** contains various configuration items for the instrument, including printer and report format files, and sample programs.
- The software part numbers and version information can be viewed from the instrument front panel, by selecting **UTIL → TESTS → CHKSUM.**

External Keypad

The external keypad with its 2-line x 24 character display provides access to the on-board software:



Keypad Description

	The keypad has four **menu selection keys**, one below each selectable menu option. Press a key to select the menu item displayed above it. For example, from the **Main Menu**, press the leftmost key to select `RUN`, the rightmost to select `UTIL`.
Main Menu	Exit the current screen and return to the **Main Menu.**
Options	To scroll through the different options within a program, press the **Options** key or the **Shift** + **Options** key combination.
ENTER	Pressing **ENTER** generally saves the current screen settings and advances to the next screen in a series.
Previous Screen	Pressing **Previous Screen** generally saves the current screen settings (if they are valid) and returns control to the screen most previously viewed.
CLEAR	Press **CLEAR** to clear all characters when editing a file name or other text.
◀	Press the ◀ (reverse) arrow to move the cursor to the left in the LCD display.
▶	Press the ▶ (forward) arrow to move the cursor to the right in the LCD display.
START	To start running a program, press the **START** key.
STOP	To stop running (abort) a program, press the **STOP** key.

Chapter 3

Installation and Setup

This chapter describes the sequential steps for correctly unpacking the Precision, installing its components, and repackaging the instrument for shipment.

STEP 1: Unpack and Inspect the Instrument

Important! Save <u>all</u> packaging materials. If the Precision™ is shipped to Bio-Tek for repair or replacement, it must be carefully repackaged, according to the instructions in this chapter, using the original packing materials. Using other forms of commercially available packing materials is not recommended and can **void the warranty**. If the original packing materials have been damaged, replacements are available from Bio-Tek under PN 7113002. The table below lists all materials included in the shipping set 7113002.

See ***STEP 6: Repackaging the Instrument*** for Shipping at the end of this chapter for complete repackaging and shipping instructions.

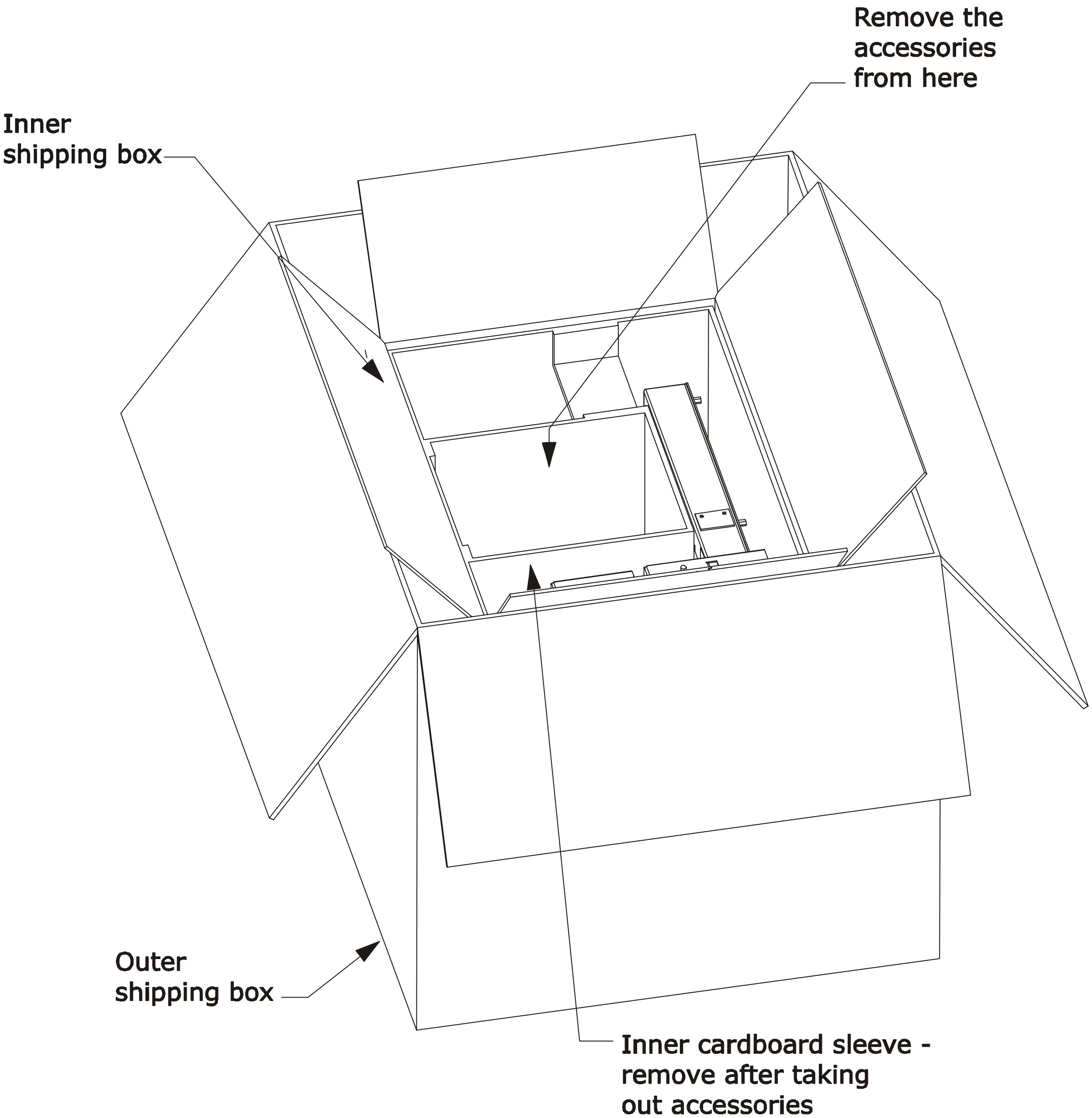
Important! The Precision is shipped with a protective plywood shipping plate and pipette shipping bracket. The plate and bracket must be *removed* before the instrument is used, and *reinstalled* prior to shipping to avoid irreparable damage to the instrument (see page 31 for removal instructions). Failure to properly remove and reinstall the shipping plate and bracket may **void your warranty**.

The Precision and its accessories are securely packaged inside custom-designed shipping materials. This packaging should protect the instrument from damage during shipping. If the outer box is dented or crushed, carefully inspect the instrument and accessories for signs of damage.

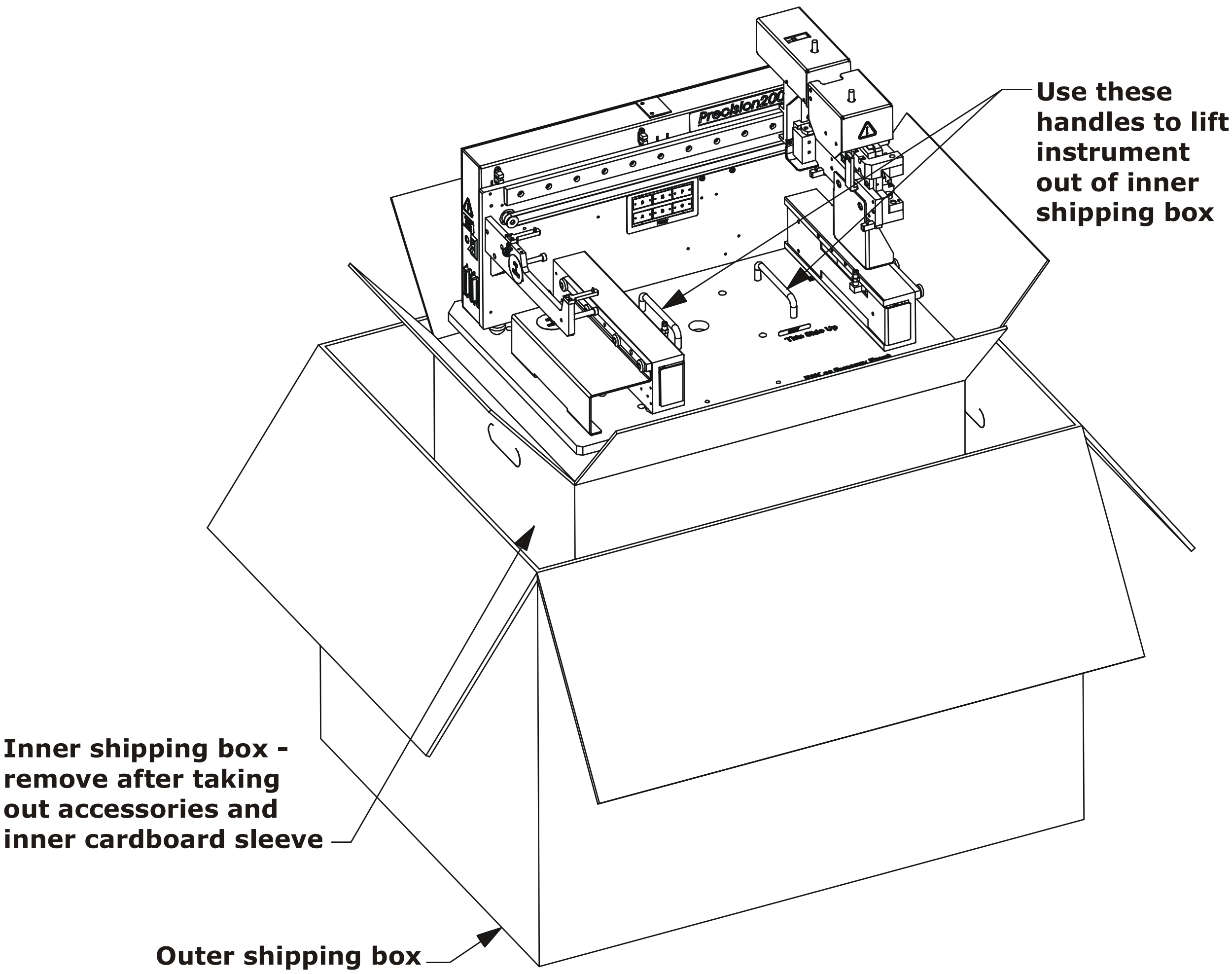
If the instrument *is* damaged, notify the carrier and your manufacturer's representative immediately. Keep the shipping cartons and packing material for the carrier's inspection. The manufacturer will arrange for repair or replacement of your instrument immediately, before the shipping-related claim is settled.

To unpack the instrument and its accessories:

1. Carefully open the top of the **outer shipping box** and remove the **top foam shipping blocks** (four).
2. A **supply platform** is taped to the top of the inner shipping box. Remove the supply platform and set it aside for now.
3. Carefully open the top of the **inner shipping box**.
4. Remove the instrument's **accessories** from the inner cardboard sleeve.
5. Remove the **inner cardboard sleeve**.


Remove the
accessories
from here
Inner
shipping box
Outer
shipping box
Inner cardboard sleeve -
remove after taking
out accessories

6. Lift the inner shipping box (the box has two hand holes) out of the outer shipping box, place it on a stable surface, and remove the **bottom foam corner blocks** (four).
7. Reach into the bottom of the inner box, grasp the **two handles** on the plywood shipping plate, and carefully **lift the instrument** up and out of the box.
8. Set the instrument on a stable surface.



STEP 2: Remove the Shipping Plate and Bracket

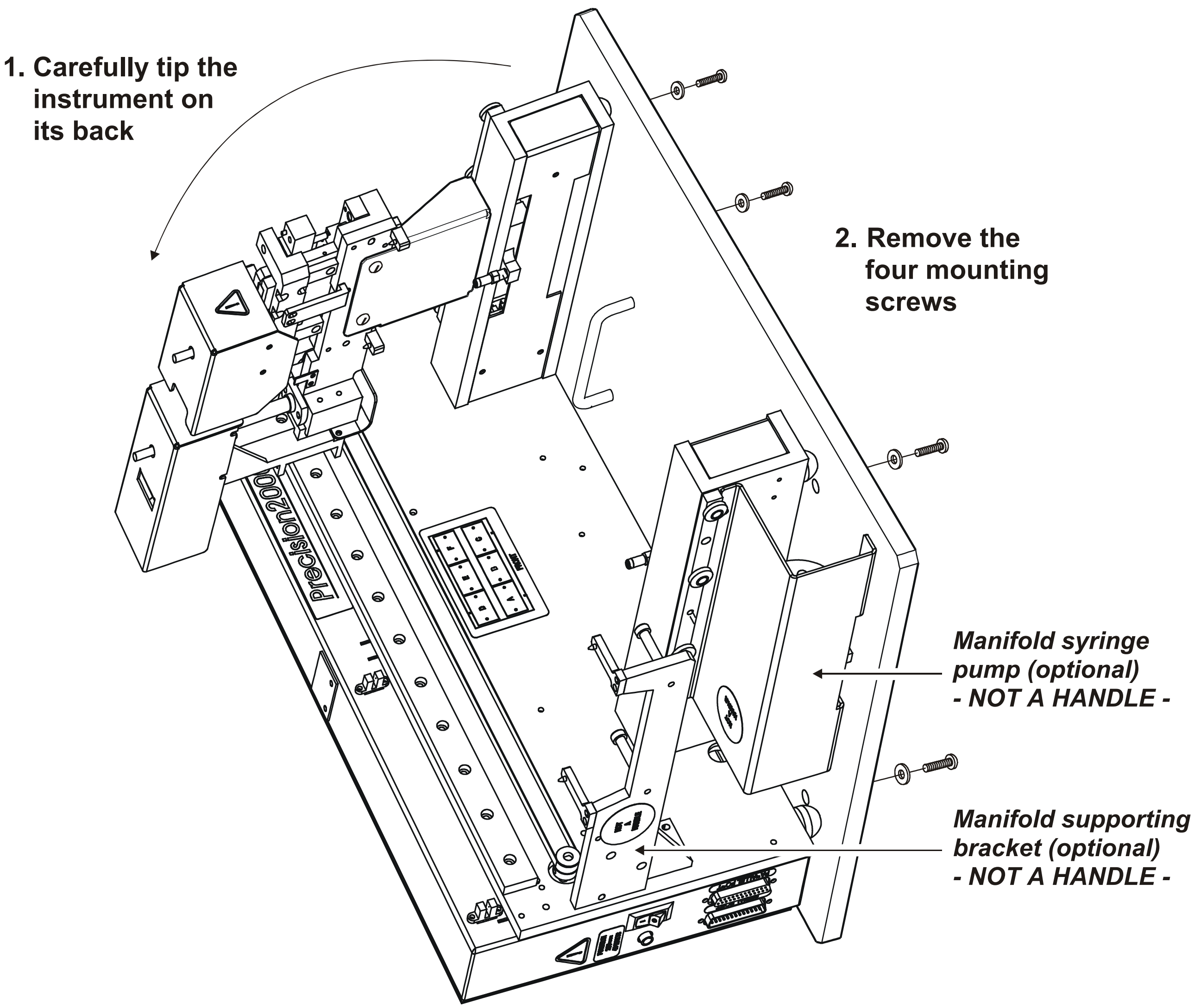
To ensure the safety of the Precision during shipping, a plywood plate is affixed to the bottom of the instrument and a metal bracket is affixed to the pipette shuttle. These two shipping accessories *must be removed* before the instrument is turned on for the first time. You will need a long-handled, flat-head screwdriver to remove these items.

Plywood Shipping Plate

Refer to the figure on the following page. To remove the plywood shipping plate:

1. Carefully tip the instrument onto its back. For easier removal of the plate, position the instrument at the edge of the bench or table so the instrument lies flat and the plywood hangs below the edge.
2. Remove the four mounting screws and washers that hold the plate onto the bottom of the instrument. Retain these screws and washers for future re-shipment.
3. Carefully return the instrument to its upright position.

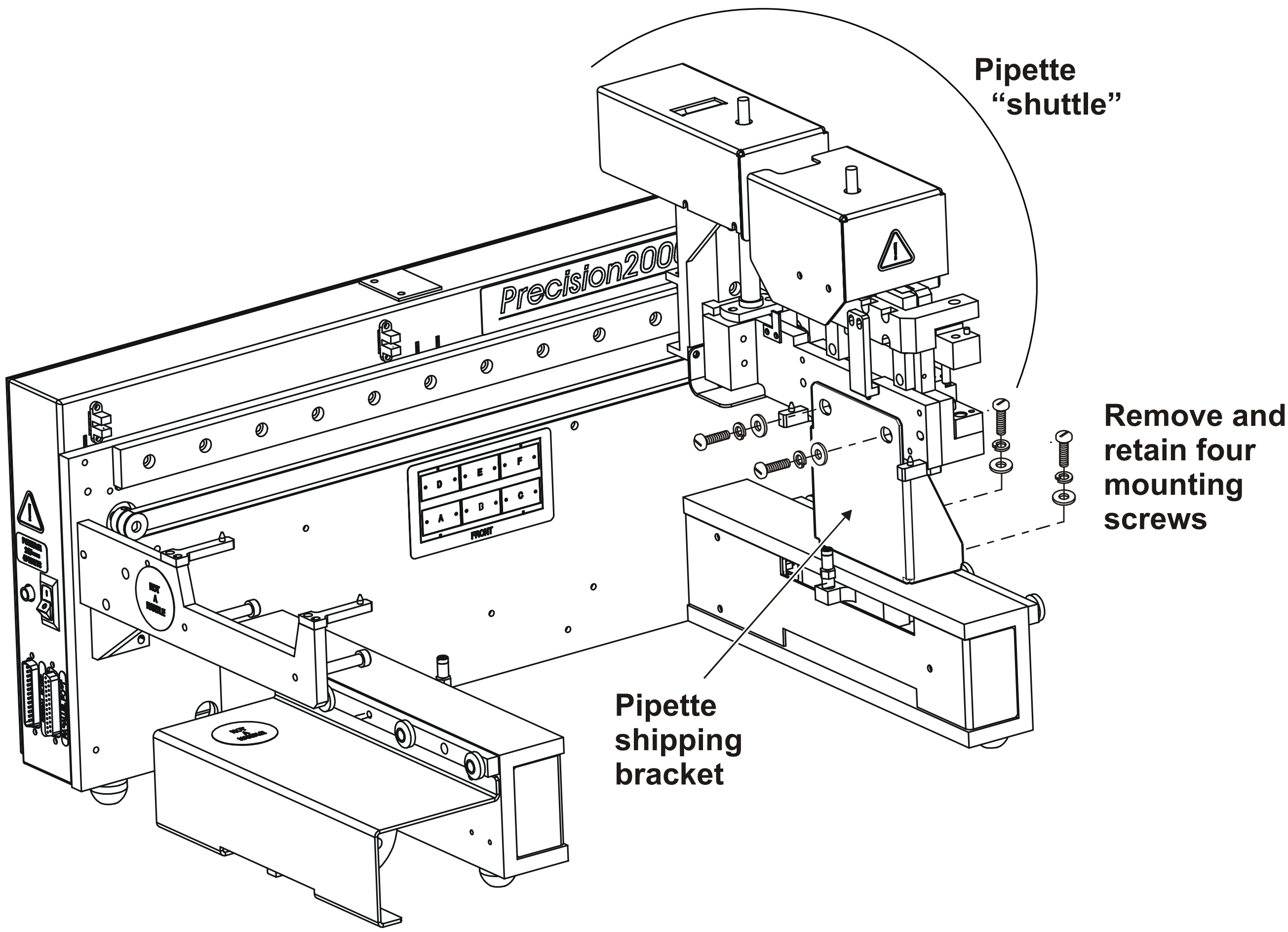
Important! If the instrument contains the optional manifold support and syringe pump (as seen in the illustration on the following page), do not use these items as handles! They are both labeled “NOT A HANDLE.”


1. Carefully tip the instrument on its back
2. Remove the four mounting screws
Precision2000
Manifold syringe pump (optional) - NOT A HANDLE -
Manifold supporting bracket (optional) - NOT A HANDLE -

Pipette Shipping Bracket

To remove the pipette shipping bracket:

1. Remove the four mounting screws and washers holding the bracket onto the pipette shuttle.
2. Retain these screws and washers for future re-shipment.



STEP 3: Set up the Instrument and Its Components

Evaluate the Operating Environment

For optimal operation, install the Precision on a level, stable surface in an area where ambient temperatures between 15°C (59°F) and 35°C (95°F) can be maintained.

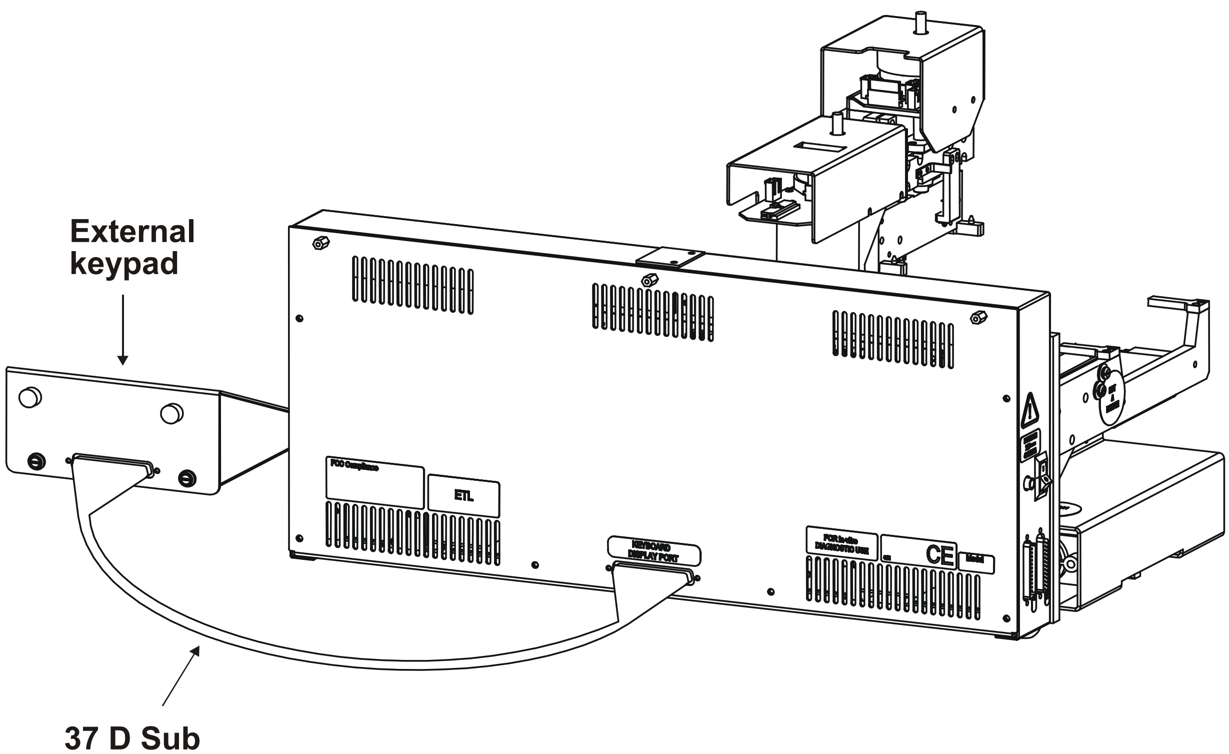
The instrument is sensitive to **excessive humidity.** Condensation directly on the sensitive electronic circuits can cause the instrument to fail internal self-checks. The specified humidity range for this instrument is from 10-80%, non-condensing.

Install the Components

For all instruments, the external keypad, supply platform, waste collection bin, and external power supply must be installed. For instruments with the optional manifold, the manifold, tubing support wire, and tubing must also be installed.

External Keypad

1. Connect the external keypad to the rear of the instrument using the supplied 37 D Sub cable, as shown below:



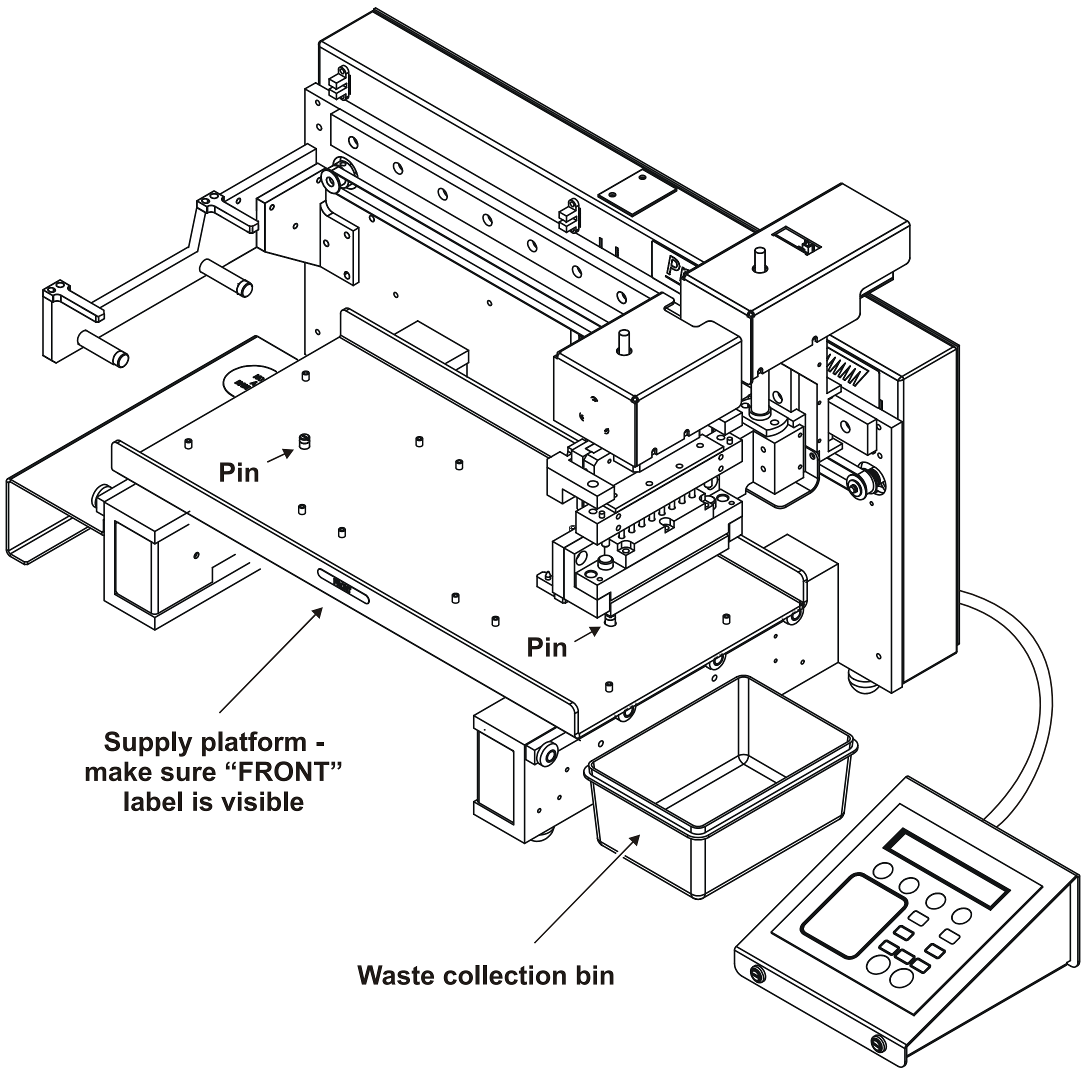
Supply Platform and Waste Collection Bin

To install the supply platform:

1. Locate the **two resting pins** affixed to the two arms on which the supply platform will sit.
2. Orient the supply platform so the label **FRONT** is visible when standing in front of the instrument.
3. Set the platform on the two resting pins; right pin first, then left. Make sure the platform is **securely fastened and level.**

To install the waste collection bin:

1. Place the bin on the **same surface** that the instrument sits on.
2. Orient the bin so it sits to the **right of the supply platform**, below the pipette shuttle.



Supplies

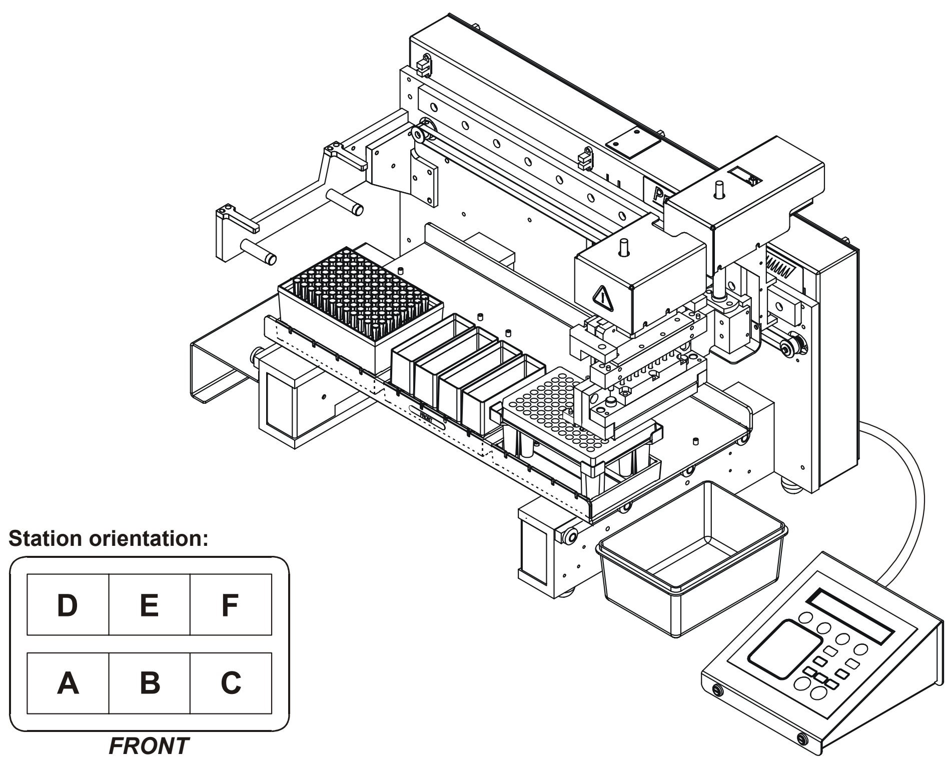
The instrument is shipped with a box of pipette tips, 50- or 65-ml capacity reagent vessels, holders for the tip box and reagent vessels, and holders with supports for microplates and microstrip frames.

> ❖ **Note:** ***Package Contents*** in ***Chapter 1*** lists all of the supplies and their Bio-Tek part numbers, in case you need to order additional supplies.

As you will learn in ***Chapter 4***, any of the supply stations can be loaded with any supply type, depending on how the fluid transfer program is written. For now, follow these steps to load supplies:

1. Place one holder without supports at Station A and one at Station B.
2. Place one holder with supports at Station C.
3. Unwrap and uncover the tip box. Set the box inside the holder at Station A.
4. Place the four reagent vessels inside the holder at Station B.
5. If you have a microplate or microstrips in a frame nearby, place it on the holder at Station C.

Your supply platform should now resemble the one in this drawing. The Precision 8-Channel Plus is pictured below. Tips and vessel orientation will be rotated 90° for Precision 12-Channel Plus and Universal instruments.

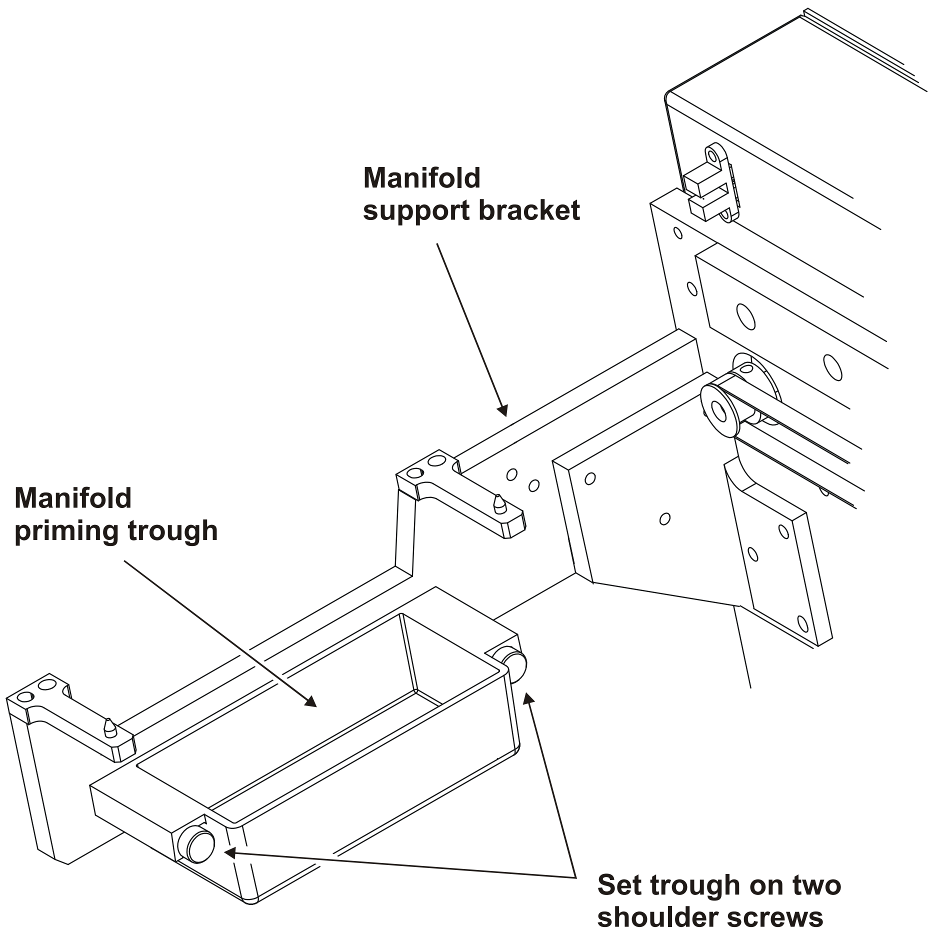


Manifold Priming Trough and Tubing Wire

❖ **Note:** If the unit is equipped with a manifold, the priming trough and tubing wire **must** be installed.

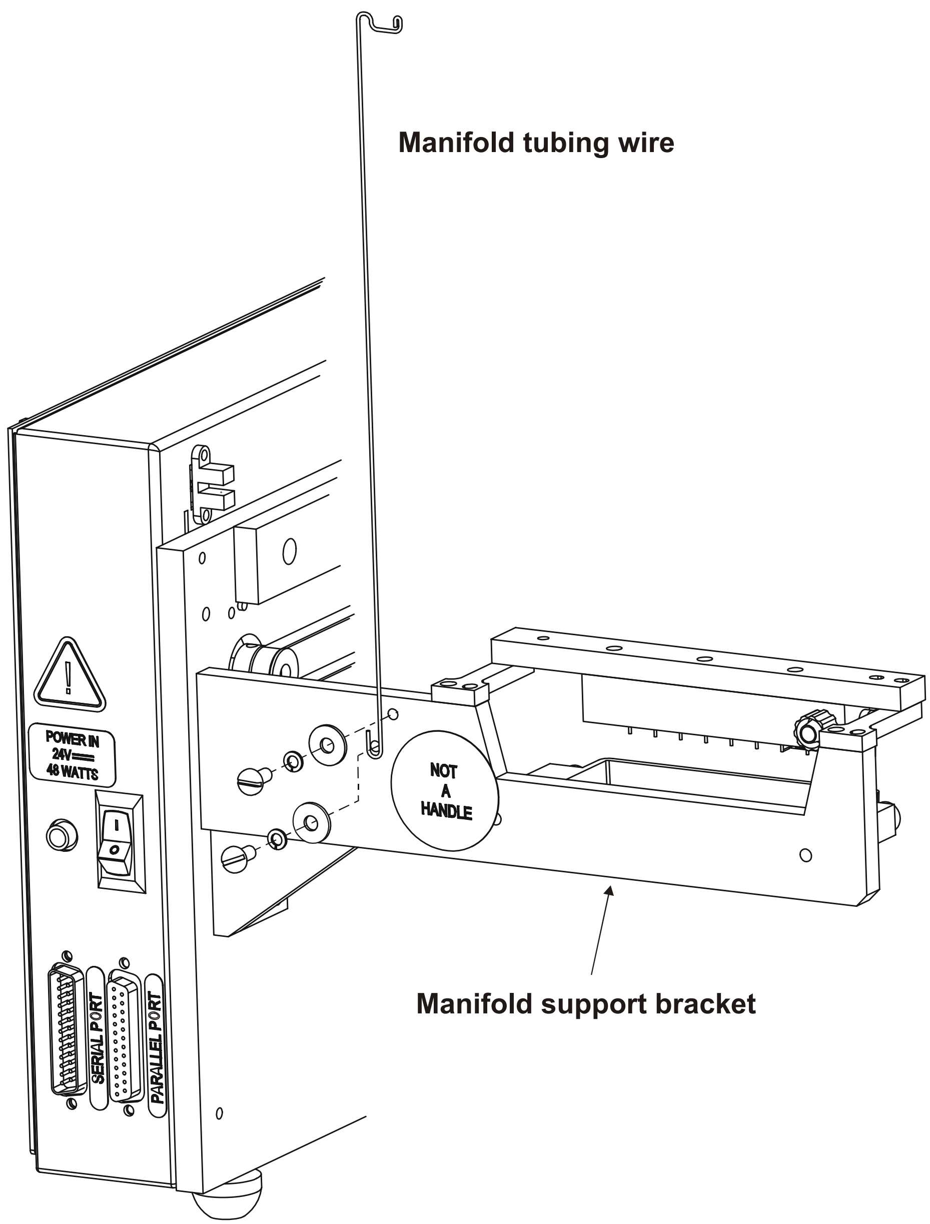
To install the manifold priming trough:

1. Set the trough against the manifold support bracket, on top of the **two shoulder screws**, as shown below:



To install the manifold tubing wire:

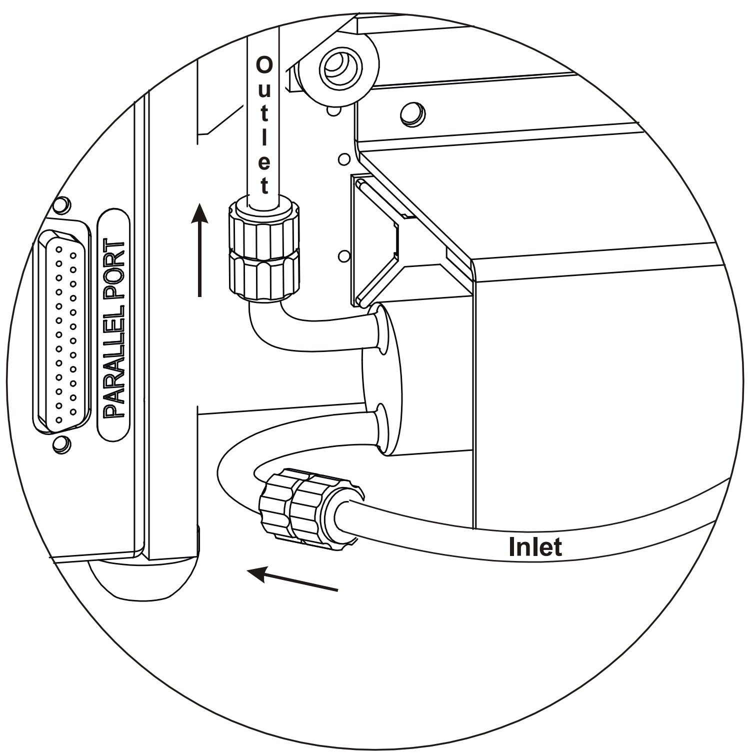
1. Locate the two sets of screws and washers on the **outside** of the manifold supporting bracket, near the **NOT A HANDLE** label.
2. Remove the screws and washers and set them aside.
3. Place the wire against the manifold support bracket, with the **U-shaped end down**.
4. Orient the wire as shown in the drawing below.
5. Attach the wire to the support bracket using the screws and washers removed in Step 2.

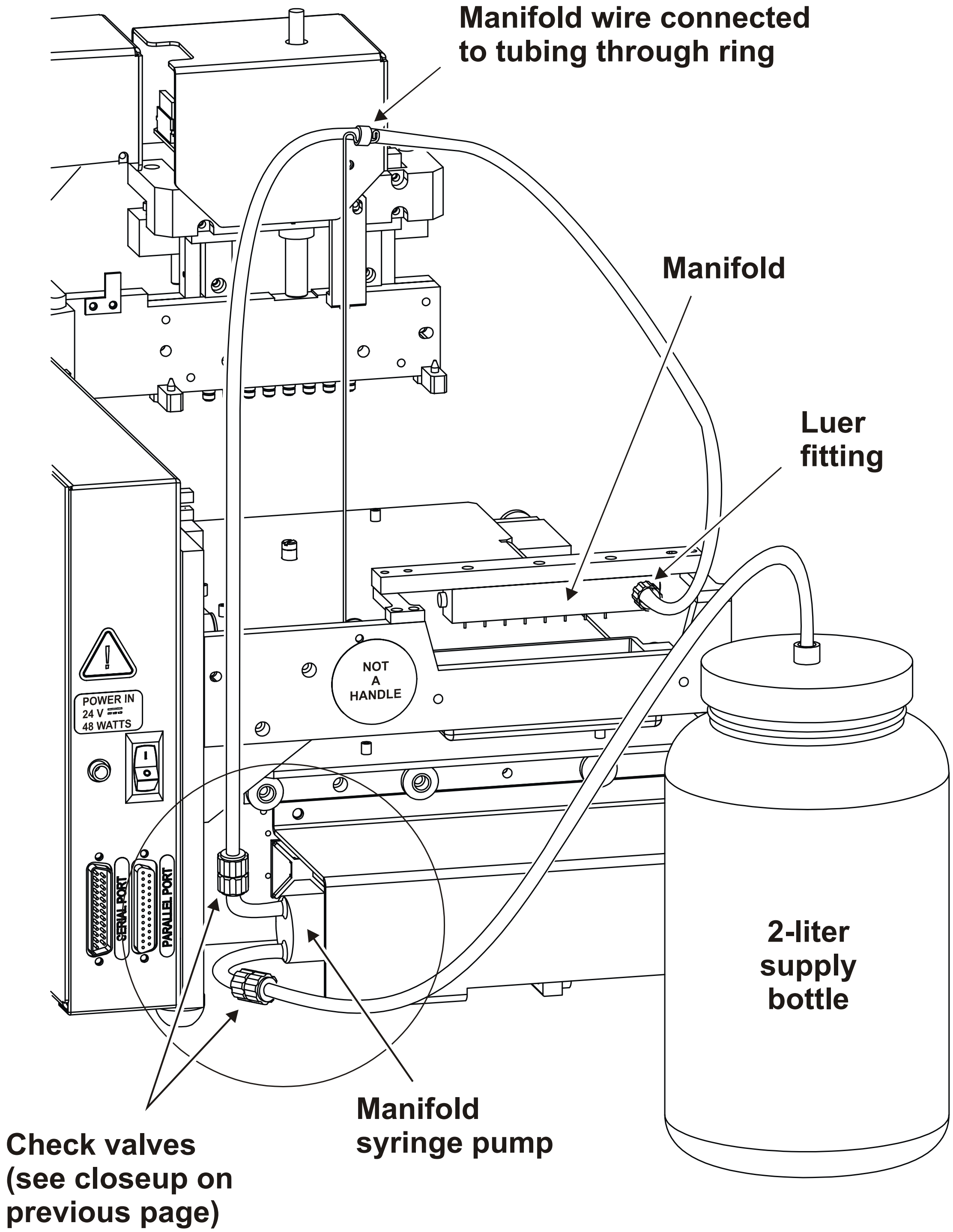


Manifold, Tubing, and Supply Bottle

To install the manifold, tubing, and supply bottle:

1. Connect the tubing to the manifold syringe pump (see close-up below).
   - Note the directional **arrows** on the check valves.
   - The **inlet tube** connects the bottom pump port with the supply bottle.
   - The **outlet tube** connects the top pump port with the manifold.
2. See the figure on the next page. Connect the inlet tube to the **supply bottle.**
3. Connect the outlet tube to the **manifold.**
   - Halfway down the outlet tube is a **rubber ring.** Slip the top part of the manifold tubing wire through the ring.
4. Set the manifold atop the **resting pins** on the manifold support bracket.




Manifold wire connected to tubing through ring
Manifold
Luer fitting
NOT A HANDLE
POWER IN 24 V 48 WATTS
SERIAL PORT
PARALLEL PORT
2-liter supply bottle
Manifold syringe pump
Check valves (see closeup on previous page)

Connect the External Power Supply and Cords

Warning! Power Rating. The symbol near the power connector indicates a potential shock hazard. Ensure the instrument is connected to an external power supply that provides voltage and current within the specified rating for the system. Use of an incompatible external power supply may produce electrical shock and fire hazards. See ***Technical Specifications*** in ***Chapter 1***.

Warning! Electrical Grounding. Never use a two-prong plug adapter to connect primary power to the external power supply. Use of a two-prong adapter disconnects the utility ground, creating a severe shock hazard. Always connect the power cord directly to a three-prong receptacle with a functional ground. See ***Technical Specifications*** in ***Chapter 1***.

To install the external power supply:

1. Connect the **power cord** to the external power supply.
2. Locate the **power inlet** on the left side of the instrument.
3. Plug the rounded end of the power supply's **line cord** into the power inlet.
4. Plug the **3-prong end** of the power cord into an appropriate power receptacle.

Serial Port and Parallel Port for Communication With Other Devices

The Precision has a 25-pin serial (RS-232) port and a parallel port located on the left side of the instrument below the power inlet and on/off switch (see the preceding illustration). The serial port allows the Precision to be computer controlled, using Precision Power for enhanced functionality, and is necessary for operation with the Bio-Stack Microplate Stacker. (See ***Installation of the Precision for Operation With the Bio-Stack***, on page 43.) The parallel port enables connection to most printers; the contents of a Precision file can be printed using the **Define|Print** options. (Refer to the ***Print*** section in ***Chapter 5*** and the ***PRINT Format for Programs*** section in ***Chapter 6***.)

STEP 4: Turn On the Precision/Run the System Test

Warning! Moving Parts. The symbol on the pipette shuttle indicates a potential for personal injury. At any given time during instrument operation, the pipette shuttle may be moving. There are potential pinch points on the mechanism, and opportunities for skin puncture with the pipette tips. Keep hands completely out of the way of the pipette shuttle when the instrument is in operation.

After installing the instrument and connecting the external power supply, turn on the instrument to run a **System Test.** The on/off switch is located on the left side.

The System Test begins by moving all components into their "home" locations. Once all axes are homed, each component is moved from one end of its travel range to the other. All components are then returned to their home positions.

- If an error is detected, the instrument will "beep" and display an error code. See ***Chapter 9*** for a list of error codes.
- If no errors are detected, the display on the external keypad will briefly show **SYSTEM TEST PASS**.

Following successful power-up of the Precision, the Main Menu appears:

```
BIO-TEK PRECISION
RUN    DEFINE    QC    UTIL
```

The Main Menu permits access to all on-board functions. Select

- **RUN** to run an existing fluid transfer program.
- **DEFINE** to create, edit, and maintain program, specification, and detail files.
- **QC** to run pre-defined programs designed to maintain the equipment in top condition, or to evaluate the instrument's dispense accuracy and precision.
- **UTIL** to run a system test, configure certain software parameters, run the Spec Utility, prime the manifold, or home all axes.

The System Test can also be performed manually by selecting **UTIL|TESTS|SLFCHK**. Refer to ***System and Checksum Tests***, ***Chapter 7*** for more information.

❖ **Note:** We strongly recommend that you take the time now to read ***Chapter 4***, ***Getting Started***. There you will learn the essential concepts for running the on-board software, and you'll create and run some simple fluid transfer programs.

STEP 5: Verify the Installation

Chapter 7**, **Instrument Qualification provides recommended Installation Qualification (IQ) procedures to be performed after the instrument is installed and set up as described in this chapter, and *before* the instrument is used in a laboratory environment.

The Installation Qualification procedures include:

- System and Checksum Test
- Seal Check
- Dispense Accuracy and Precision Test

The successful completion of the Installation Qualification tests verifies that the instrument is installed correctly and meets factory specifications.

❖ **Note:** An instrument qualification package (PN 7110524) for the Precision is available for purchase. The package contains thorough procedures for performing Installation Qualification, Operational Qualification and Performance Qualification (IQ-OQ-PQ) and preventive maintenance (PM). Extensive Checklists and Logbooks are included for recording results. Contact your local dealer for more information.

Installation of the Precision for Operation With the Bio-Stack

If you will be operating the Precision with Bio-Tek's **Bio-Stack™ Microplate Stacker**, you will need a PC equipped with two serial ports, and Bio-Tek's **Precision Power™ Software** and **Bio-Stack™ PC Control Software** installed on the PC. In this configuration, Precision Power uses one serial port to control the Bio-Stack (via the **ActiveX™** component of the Bio-Stack PC Control Software) and the second serial port to control the Precision.

Special alignment hardware also needs to be installed on the Precision and the Bio-Stack to properly align the two instruments with each other. Refer to your Bio-Stack Operator's Manual for instructions on mechanical alignment, and to the Precision Power User's Guide or Help System for instructions on configuration of the Precision for operation with the Bio-Stack.

❖ **Note:** The Precision may be operated with two Bio-Stacks. In this configuration, three serial ports are necessary: Precision Power uses one serial port to control the Bio-Stack and two serial ports to control the two Bio-Stacks.

STEP 6: Repackaging the Instrument for Shipping

If you need to ship the Precision to Bio-Tek for any reason, be sure to use the original packing. Other forms of commercially available packaging are not recommended and can **void the instrument's warranty.** If the original packing materials have been damaged or lost, contact Bio-Tek for replacement materials (PN 7113002). See ***Technical Assistance*** in ***Chapter 1*** for contact information.

Warning! If the Precision has been exposed to potentially hazardous material, decontaminate it to minimize the risk to all who come in contact with the instrument during shipping, handling, and servicing.

Decontamination prior to shipping is required by the U.S. Department of Transportation regulations. (See ***Chapter 8***, ***Maintenance*** for information on decontamination.)

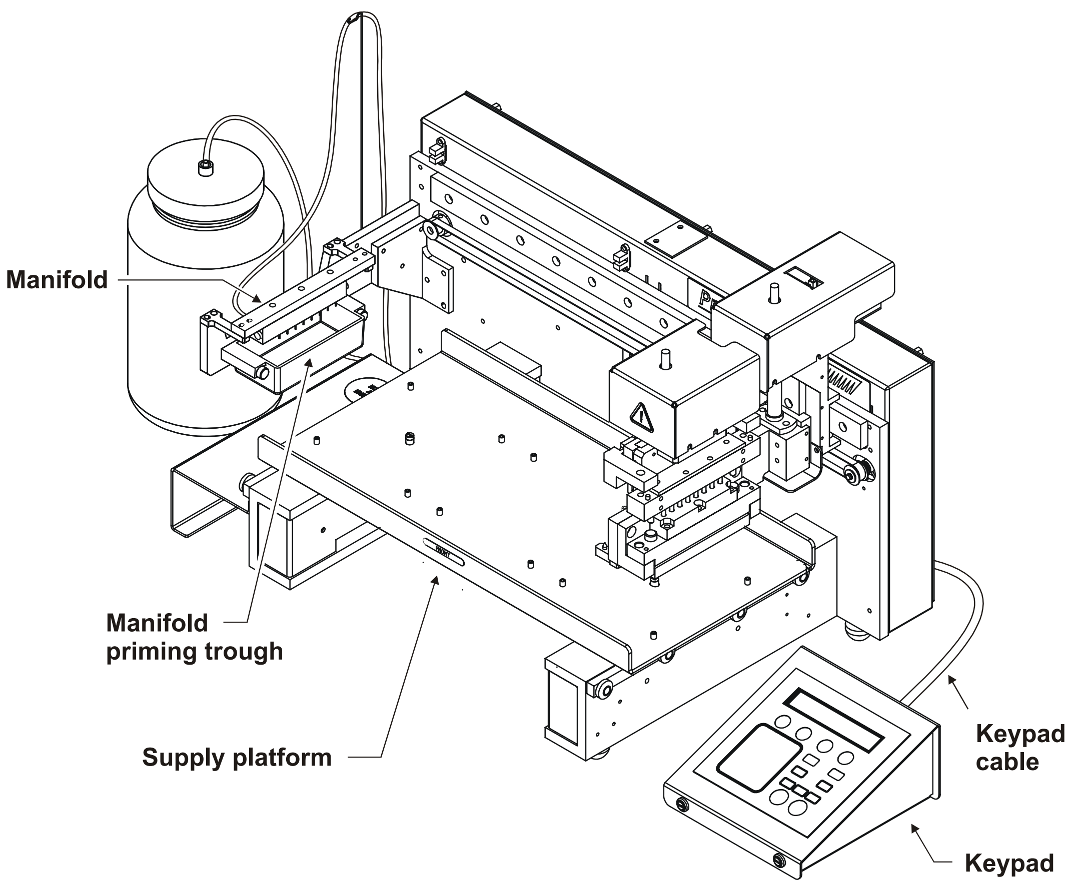
Before Repackaging the Instrument

Caution! Failure to re-attach the plywood shipping plate and pipette shipping bracket before shipment could result in irreparable damage to the instrument.

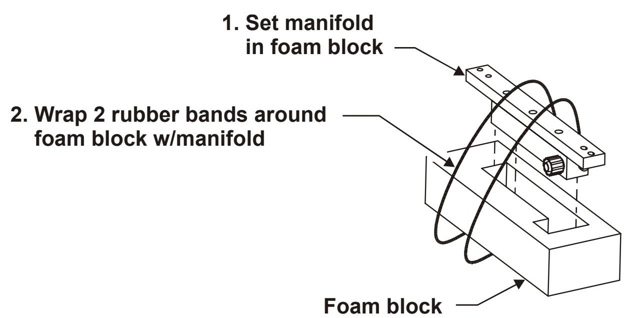
1. **Decontaminate** the instrument and its accessories. Refer to the ***Decontamination*** procedure in ***Chapter 8***, ***Maintenance***.
2. Replace all shipping hardware and package the instrument as described on the following pages. Failure to comply with these packaging instructions can **void the instrument's warranty**.
3. Obtain a **Return Materials Authorization (RMA)** number from Bio-Tek (see ***Chapter 1*** for contact information).
4. Include instructions regarding what is required of the Bio-Tek Service Department. Clearly state whether the instrument requires calibration, cleaning, periodic maintenance, warranty work, and/or repair. Make a note of any error messages displayed and their frequency.
5. Provide Bio-Tek with the name and telephone number of a person who may be contacted if questions arise.
6. Insure the instrument for full value.

Repackaging the Instrument and Its Accessories

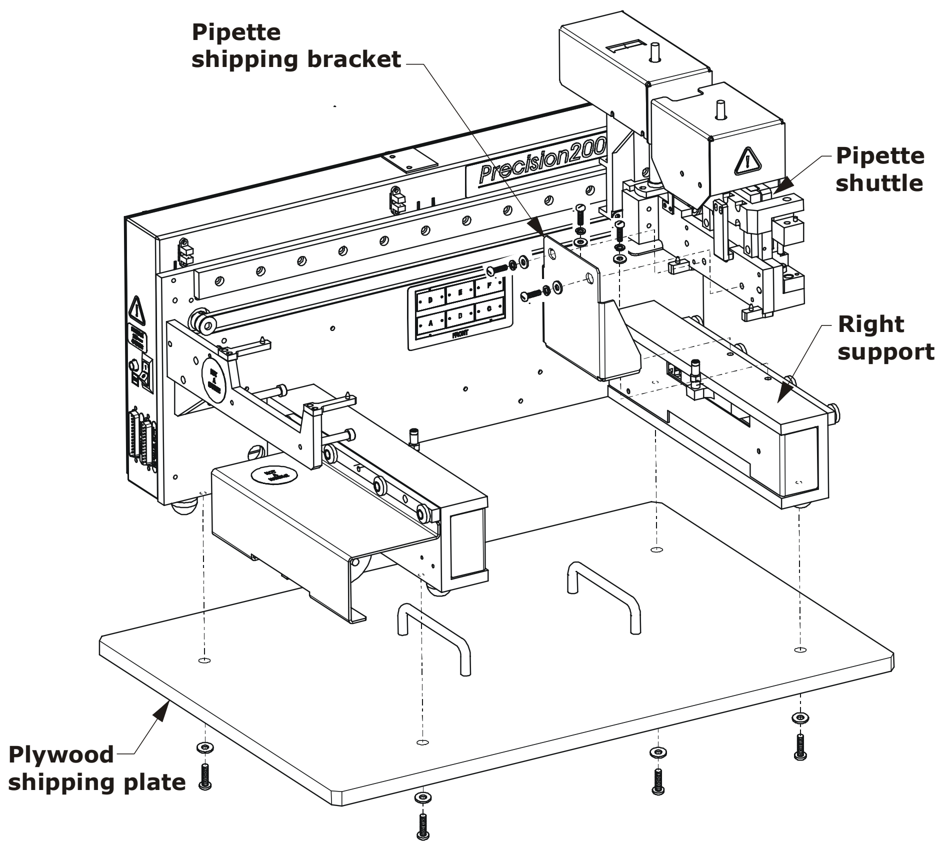
1. Turn off the instrument and unplug the power supply.
2. Disconnect the cable from the external keypad and from the rear of the instrument.
3. Wrap the external keypad in bubble wrap and set it aside.
4. Remove all supplies from the supply platform.
5. Remove the supply platform from the instrument by lifting it straight up and off its two resting pins.
6. Wrap the platform(s) in bubble wrap and set it aside.
7. For instruments with the manifold:
   - Remove the priming trough by lifting it up and off its two shoulder screws.
   - Remove the manifold by lifting it up and off its two resting pins.
   - Detach the tubing from the manifold, the supply bottle, and the manifold syringe pump. (See the drawing on page 40 for a better view of the tubing.)



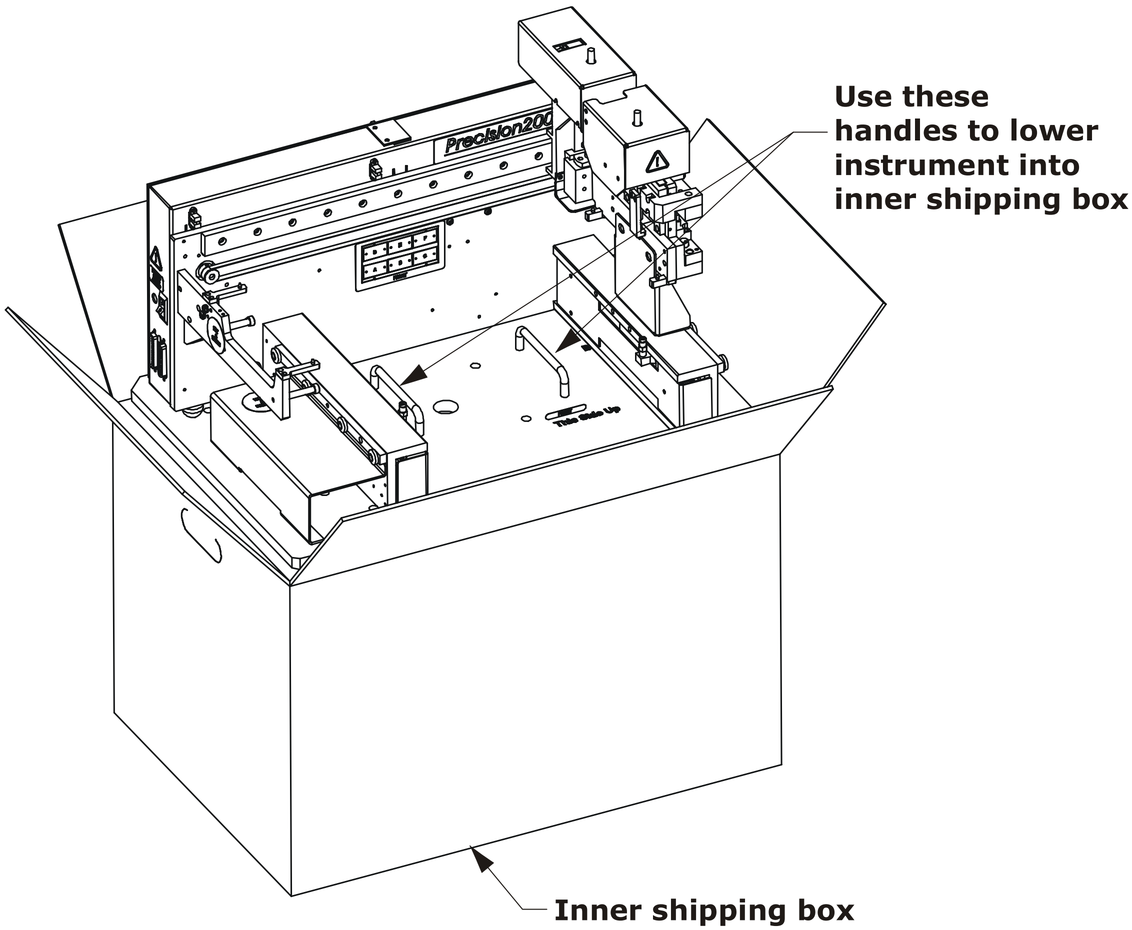
8. Set the manifold inside its shipping foam block (or bubble bags), then wrap with two rubber bands:



9. Gently slide the pipette shuttle to the **far right**; attach the **pipette shipping bracket** using four mounting screws and accompanying washers.
10. Carefully tip the instrument on its back and attach the **plywood shipping plate** using the four mounting screws and accompanying washers. **Note:** For easier installation of the plate, position the instrument at the edge of the bench or table so the instrument lies flat along the edge.
11. Carefully return the instrument to its upright position.

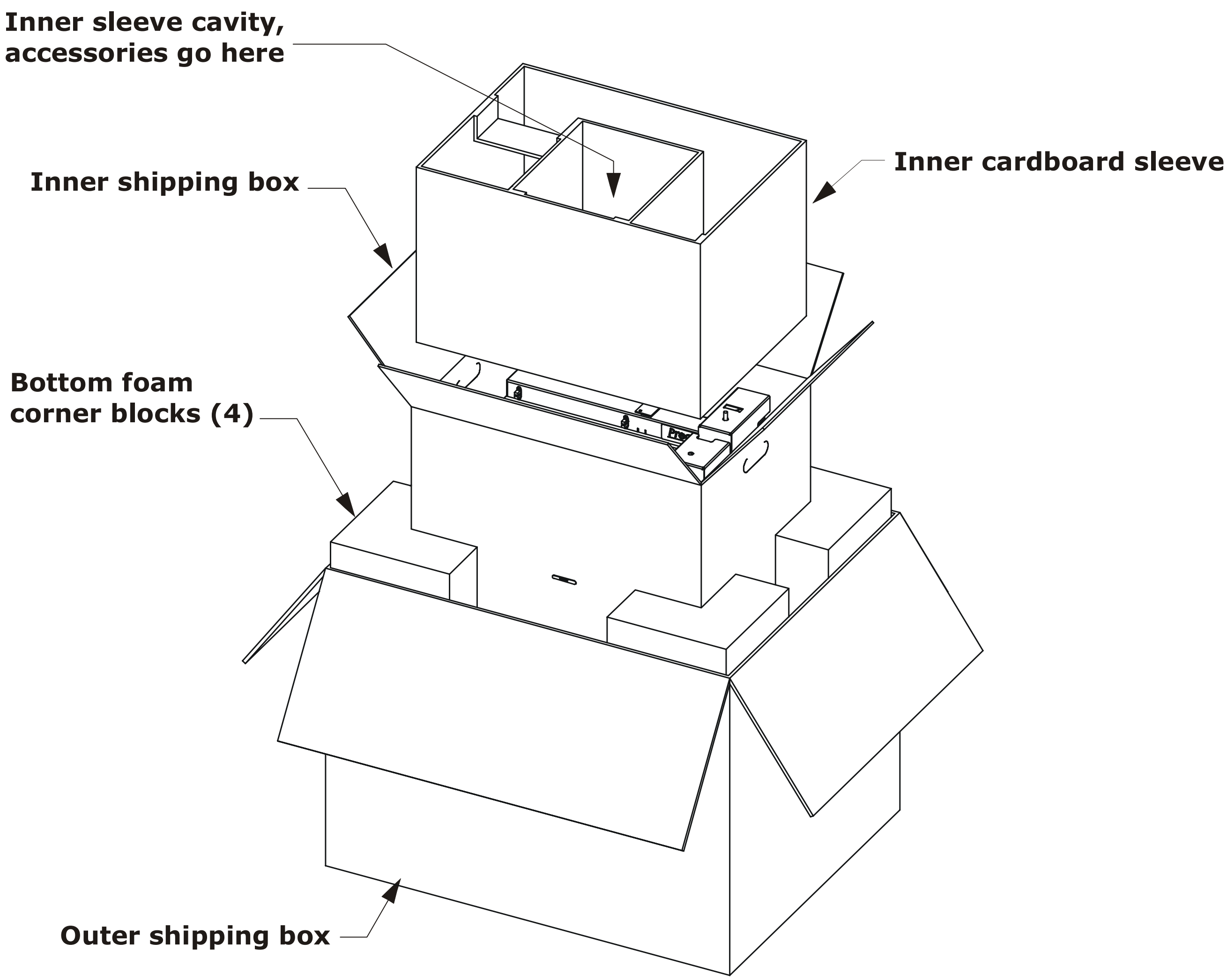


12. Grasp the two handles on the plywood shipping plate. Carefully lift the instrument and then lower it into the **inner shipping box.**

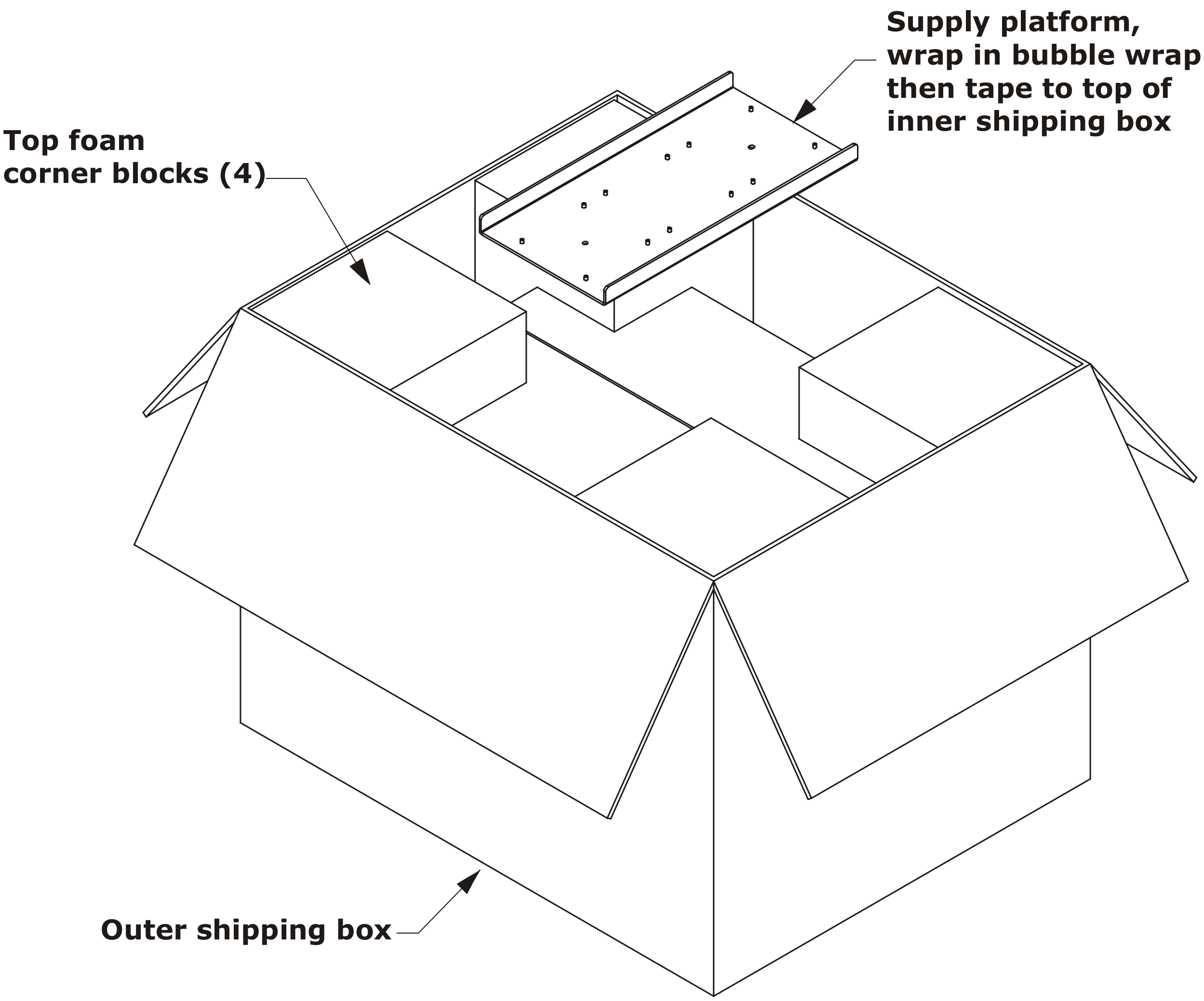


13. Attach the **bottom foam corner blocks** (four) to the inner shipping box.
14. Carefully lower the **inner shipping box** down into the outer shipping box.
15. Slide the **inner cardboard sleeve** down into the inner shipping box.

16. Place the **accessories** inside the inner sleeve cavity.
    - Make sure the **keypad** is wrapped in bubble wrap, and the **manifold** is in its foam shipping block, wrapped with rubber bands.
17. Fill the rest of the inner sleeve cavity with packing material.
18. Tape the **inner shipping box** shut.



19. Attach the **top foam corner blocks** (four) to the inner shipping box.
20. Tape the **supply platform(s)** (in bubble wrap) to the top of the inner shipping box.



21. Tape the **outer shipping box** shut.
22. Write "RMA" and the **Return Material Authorization** number in large, clear letters on the outside of the box and ship the instrument to the Bio-Tek address provided in the Technical Support section of Chapter ***1***.

Chapter 4

Getting Started

The goal of this chapter is to introduce you to the Precision on-board software and get you to the point where you can confidently create and run simple programs. A *program* is a file created through the keypad and stored in the software. It contains an ordered list of commands to tell the instrument how to perform a fluid transfer. You'll learn all about programs in this chapter!

Introduction

The Precision Microplate Pipetting System is both **powerful** and **easy to use**. How many times in your life have you heard such a claim? Stay with us for the next hour or so, and hopefully you will agree. We'll give you the basics on the next few pages, and tell you where to find more detailed information if you need it.

You are probably very familiar with manual pipettes, and what you can and cannot accomplish with them. Think of the Precision simply as an 8- or 12-channel pipette operated by a robot with you at the controls, telling the robot what to do. You can tell the robot to pick up tips, aspirate fluid, dispense fluid, and dispose of tips, just like you do manually.

You might be thinking, 'Why did I purchase this instrument when I can accomplish the same tasks with the manual pipette?' Because with just a few simple commands you can put the robot to work, leaving you free to do something else – hopefully something more pleasant and productive! And odds are, the robot will move more quickly and aspirate and dispense more accurately than even the most talented human beings.

The Hardware

Take a look at the instrument. It has a robot-controlled 8- or 12-channel pipette, possibly an 8- or 12-channel dispense manifold, an 8" x 17" platform with six or four supply stations, and an external keypad with a 2-line display. The supply stations can hold pipette tips, reagent troughs, and microplates.

When you run a program, the pipette travels from left to right / down and up to pick up tips, aspirate fluid, and dispense fluid. The manifold also moves from left to right/ down and up, and is used specifically to dispense fluid.

See ***Chapter 2***, ***Instrument Description***, for detailed information on the different hardware components.

The Software

On-board (Basecode) Software

Believe it or not, you can create, modify, and run even the most complex programs using just the keypad and its 2-line display. The software interface was designed with you in mind – the Main Menu provides easy access to the functions you will use most often, RUN and DEFINE (run programs and create or edit programs). Programs are stored under unique file names for easy recall.

❖ **Note:** ***Appendix A*** contains "menu maps," showing all of the possible function paths in a flowchart format.

Precision Power Software

Bio-Tek Instruments, Inc. has developed **Precision Power™**, a software program that further simplifies the programming of the Precision. Precision Power runs in a Microsoft Windows-based PC environment and allows the user to create, edit, and run programs using the computer's full keyboard, mouse, and graphic display.

Precision Power provides enhanced functionality as well, and is necessary for certain applications, such as operation of the Precision with Bio-Tek's **Bio-Stack™ Microplate Stacker**. In this configuration, Precision Power and the **Bio-Stack™ PC Control Software** must be installed on the controlling PC. Precision Power uses one serial port on the PC to control the Bio-Stack (via the **ActiveX™** component of the Bio-Stack PC Control Software) and a second serial port to control the Precision.

If you have purchased the Bio-Stack for operation with the Precision, please refer to your Bio-Stack Operator's Manual for information on initial setup and installation of the Bio-Stack with the Precision, and to the Precision Power User's Guide or Help System for information on configuration of the Precision for operation with the Bio-Stack.

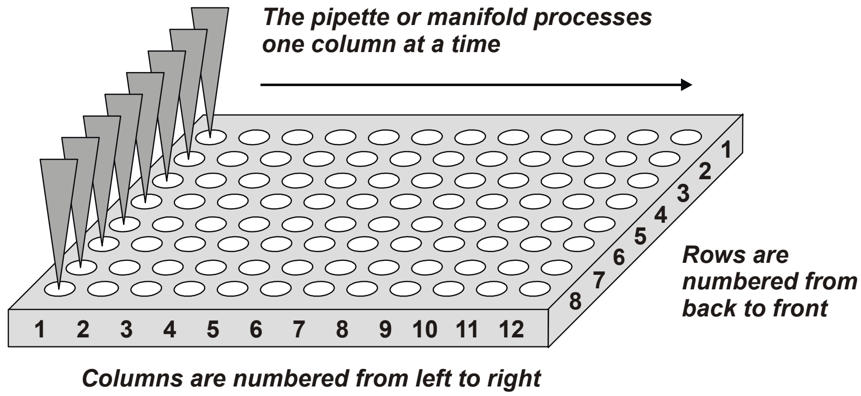
Call Bio-Tek Instruments, Inc. to learn more about the Precision Power application.

The Supplies

Before running a program to perform a fluid transfer, you need to load any required **supplies** onto the platform. "Supplies" can include pipette tips, reagent troughs, microstrips, and microplates. As you learn more about the software and its terminology, you will find that all possible supply types fall into one of just two categories: Tips or Vessels.

Tips is used when referring to the components of a rack of pipette tips. **Vessels** is used when referring to the components of any other supply, such as a reagent holder or a microplate.

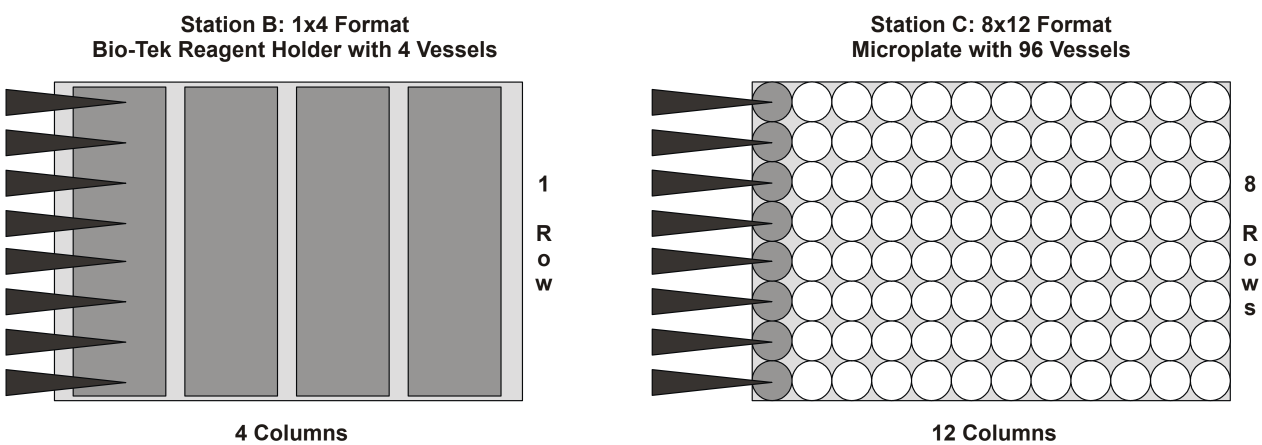
Tips and vessels are arranged in *row by column* formats. As the pipette or manifold moves across the supply platform, each station is processed one column at a time. The illustration on the following page shows the format of a standard 96-well microplate in an 8 x 12 format.



On the Precision, a rack of tips is defined as having 8 or 12 rows (because the pipette has 8 or 12 channels), with up to 12 columns. This 8 x 12 or 12 x 8 format is consistent with the way tips are usually packaged.

Vessels, on the other hand, can be arranged in many different formats. This allows the hardware and software to support a variety of reagent troughs, microstrips, and microplates. The software defines *one vessel* as the smallest entity capable of holding fluid.

The drawing below shows Bio-Tek's reagent holder at Station B and a standard microplate at Station C. The reagent holder has 4 vessels, in a 1 x 4 format. The microplate has 96 vessels, in an 8 x 12 format. In the drawing, the pipette tips are shown aspirating fluid from Column 1 at Station B, and then dispensing fluid to Column 1 at Station C.



We have much more to tell you about the different vessel formats and how they are specified in the software, but this is enough information to get you started. All of the example vessels in this chapter are in the 1 x 4 or 8 x 12 format.

Essential Concepts

There are a few basic concepts that you should fully understand before creating or modifying programs. If all you want to do right now is *run an existing program,* feel free to jump ahead to ***Chapter 5***. But be sure to return to this page when you're ready to take full advantage of the Precision's capabilities.

Precision Universal models may be run as 8-or 12-channel instruments. A program created in 8-channel mode must be run in that mode. See ***Chapter 6*** for instructions on switching from 8- to 12-channel mode.

For operation of the **Bio-Stack™ Microplate Stacker** with the Precision, under the control of **Precision™ Power** Software, the Bio-Stack is engaged by a Precision program through a Supply Command. Please refer to the Precision Power User's Guide or Help System for instructions on Bio-Stack usage in Precision programs.

Programs

During transfer of fluids from one station or vessel to another, a typical sequence might resemble (1) pick up tips, (2) aspirate fluid, (3) dispense fluid.

When pipetting manually, *you* are responsible for performing all tasks, and for keeping track of which tips to pick up and when to dispose of them, where to aspirate fluid, where to dispense fluid, what volumes of fluid to aspirate and dispense, when to reload supplies, and so on.

When pipetting with the Precision, the *instrument* performs all tasks and keeps track of all of the details for you. All you need to do is load the supplies and then press a few buttons to run a **program.** A program contains the sequence of commands required to complete a fluid transfer. It knows where the tips and vessels are located, and what to do with them.

The structure and creation of programs is discussed in detail later in this chapter. For the time being, you really just need to know that a program contains an ordered list of **commands**, which can be broken down into three different categories:

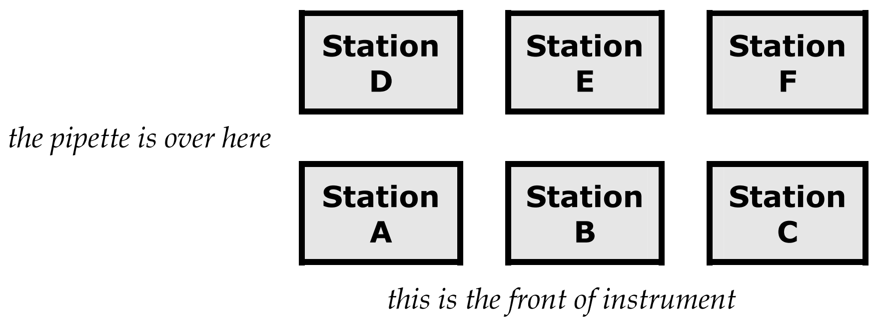
Category	Description	Commands in this category
Information	These commands contain important supply setup and program execution information.	MAP, L-MAX, REMARK
Action	Action commands tell the instrument what to do.	TIPS, ASPIR(ate), DISP(ense)
Control	Control commands describe how to execute a set of action commands.	L-ON, L-OFF, DELAY

The MAP, L-MAX, REMARK, TIPS, ASPIR, DISP, and DELAY commands have one or more **parameters** associated with them. Parameters allow you to customize the functionality of each command. For example, the ASPIR and DISP commands both have a "Volume" parameter, so you can specify the amount of fluid to aspirate or dispense.

Many of these commands are introduced in this chapter. All of the commands and their parameters are discussed in greater detail in ***Chapter 5***.

MAP Command

The instrument's platform has six or four supply stations, depending upon the model, labeled A through F. Any station can be loaded with any supply, such as a rack of pipette tips, a reagent vessel holder, or a microplate.



Every program needs to know what supplies are loaded in which stations before it can perform fluid transfers. The **MAP command** provides this information.

At least one MAP command must be defined for each station that contains a supply.

For example, if Station A is loaded with tips, Station B with a reagent vessel holder, and Station C with a microplate, the program needs three different MAP commands.

TIPS, ASPIR, and DISP Commands

Action commands are at the heart of any program. They tell the pipette to pick up tips, aspirate fluid, or dispense fluid, or tell the manifold to dispense fluid. The three action commands are TIPS, ASPIR(ate), and DISP(ense):

Command	Description
TIPS	Pick up tips from the specified station/column.
ASPIR	Aspirate fluid from the specified station/column.
DISP	Dispense fluid to the specified station/column.

In a program, the action commands are defined in the order in which the actions will occur.

For example, if you want to pick up one column of tips, aspirate fluid from one column of a plate, then dispense to three columns of another plate, your program would define the commands in this order:

TIPS

ASPIR

DISP

DISP

DISP

Looping

Let's say you want to transfer fluid from one 96-well microplate to another (we'll call them Plate 1 and Plate 2). You might aspirate from Column 1 of Plate 1, dispense to Column 1 of Plate 2, aspirate from Column 2 of Plate 1, dispense to Column 2 of Plate 2, and so on until all 12 columns of both plates have been processed.

To write a program to do this, you *could* define 12 aspirate (ASPIR) commands and 12 dispense (DISP) commands, like so:

ASPIRate from Column 1 of Plate 1

DISPense to Column 1 of Plate 2

ASPIRate from Column 2 of Plate 1

DISPense to Column 2 of Plate 2

...

ASPIRate from Column 12 of Plate 1

DISPense to Column 12 of Plate 2

A program structured this way *is* logical and valid. It would, however, be tedious for you to define those 24 commands. Fortunately, you have the power of **looping** to speed things up.

Looping allows you to define just a few commands and repeat them over and over until the fluid transfer is complete. The example below illustrates the loop used to reduce our program from 24 ASPIR/DISP commands down to 2:

The maximum number of loops that will be executed is **12 (L-MAX)**

Start the loop (L-ON)

ASPIRate from Plate 1 *Starting At Column = 1* *Increment Column By = 1*

DISPense to Plate 2 *Starting At Column = 1* *Increment Column By = 1*

End the loop (L-OFF)

The two steps inside the loop are executed 12 (**L-MAX**) times to complete the fluid transfer. This simple program is much more efficient than our equally valid but larger program.

The **Starting At Column** and **Increment Column By** parameters are important contributors to the efficiency of our program. They are both defined within an action command.

The first time an action command is executed, the column defined by the Starting At Column parameter is processed. The next time the action command is executed, the instrument advances to the next column according to the Increment Column By parameter.

In our example, the first time through the loop, Column 1 is processed because it is defined by the Starting At Column parameter. The second time through the loop, the Increment Column By value of 1 tells the instrument to advance by one column, so Column 2 is processed. Continuing in this way, columns 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 are processed in subsequent loops.

If instead Increment Column By is equal to 2, columns 1, 3, 5, 7, 9, and 11 are processed. If the Starting At Column value is 2 and the Increment Column By value is 3, columns 2, 5, 8, and 11 are processed.

The **Increment Column By** parameter is useful outside of a loop also. For example, a program may be written with the intention that it will be run multiple times in succession using the CONTINUE MENU key that is displayed at the completion of a program. The program may include a command to pick up tips before a loop of aspirate and dispense commands loading a plate with reagent.

If the tip command is set to increment by 1, then when the program is run multiple times using the CONTINUE key, it will increment to the next column of tips for each pass through the program. In this same program, enough reagent can be supplied to fill several plates. As long as the CONTINUE key is used, the software will keep track of the fluid level as additional plates are processed.

A single program can, in this way, be designed to process more than one plate. The program can be restarted using the CONTINUE key to use the next supply at a station and process multiple plates.

Nested Loops

Precision Power, a Bio-Tek Instruments, Inc. product, is a Microsoft Windows-based software tool for programming the Precision. Installed on a PC, Precision Power provides a platform for easily creating, editing, and running programs for the Precision. It also provides enhanced functionality including nested loops, programs of more than 99 commands, and supply replenishing during program execution. Contact Bio-Tek Instruments, Inc. for more information about Precision Power.

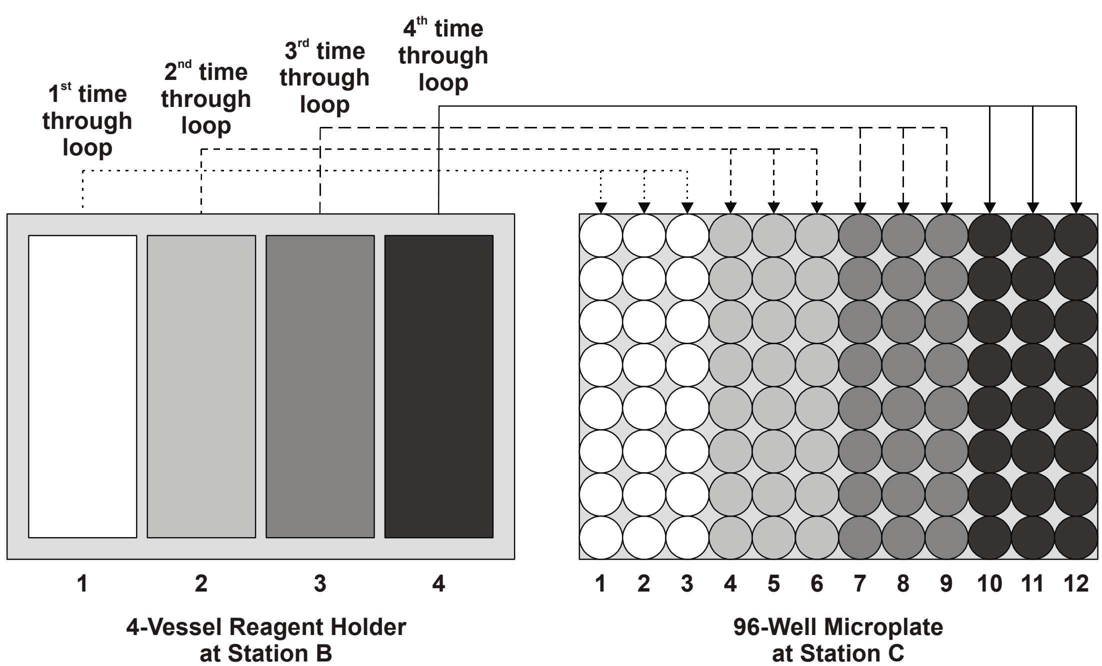
Defining a Run & Reloading Supplies

Imagine once again that you are transferring fluid from one 96-well plate to another, matching column for column. The source plate contains 200 µl of fluid in each well, and you want to transfer 100 µl to each well of the destination plate.

When the dispense to Column 12 of the destination plate is finished, **one run** is complete – the entire program has been executed once. To prepare to perform a second run, you would load a new source plate with 200 µl/well and an empty destination plate. The two supplies are **reloaded** at the same rate.

That was a pretty simple example to introduce **Run** and **Reload;** let's get a little more complicated…

Imagine that you are transferring fluid from a 4-vessel reagent holder to a 96-well microplate. Fluid aspirated from reagent vessels 1, 2, 3, and 4 is dispensed to plate columns 1-2-3, 4-5-6, 7-8-9, and 10-11-12, respectively, as illustrated in the table on the following page.



Let's say that the reagent vessels contain enough fluid to process *three* microplates. The reagent vessels and the plate will require reloading at different rates. Remember that one run is complete when the program has executed all of its commands. In this example, when one run is complete, one microplate has been processed. Therefore, each microplate is good for *one run* and the reagent vessels' fluid supply is good for *three runs*.

Let's also add a tip tray at Station A, with 12 columns of tips. One column of tips will be picked up before each fluid aspirate, to prevent any mixing of reagents. The tips will be disposed of after each dispense sequence (at the end of each loop). Since the program loops four times and there are 12 columns of tips, the set of tips at Station A is good for three runs.

The program will be smart enough to prompt the operator at the appropriate times to reload the different resources. How does the program know to do this? Each station's MAP command has a **Reload After Run** parameter to indicate how many times the program commands can be performed before the supply at that station needs to be reloaded.

Let's outline the program for this example, then walk through it:

MAP Station A with tips	*Reload After Run = 3*
MAP Station B with a 4-vessel reagent holder	*Reload After Run = 3*
MAP Station C with a 96-well microplate	*Reload After Run = 1*

The maximum number of times (L-MAX) this loop will be executed is 4

Start the loop (L-ON)

TIPS pickup from Station A	*Starting At Column = 1*	*Increment Column By = 1*
ASPIRate from a vessel at Station B	*Starting At Column = 1*	*Increment Column By = 1*
DISPense to the microplate at Station C	*Starting At Column = 1*	*Increment Column By = 3*
DISPense to the microplate at Station C	*Starting At Column = 2*	*Increment Column By = 3*
DISPense to the microplate at Station C	*Starting At Column = 3*	*Increment Column By = 3*

End the loop (L-OFF)

Based on the information defined in the three MAP commands, the program starts by prompting the operator to load the tips, the reagent vessels (with enough fluid to process three microplates), and empty Plate #1.

1. **First time through the loop:** The pipette picks up a column of tips, aspirates from the first vessel, then dispenses to columns 1, 2, and 3 of the plate.
2. **Second time through the loop:** The pipette disposes of the used tips and picks up a column of new tips, aspirates from the second vessel, then dispenses to columns 4, 5, and 6 of the plate. Notice that each command's index equals Starting at Column + Increment Column By.
3. **Third time through the loop:** The pipette disposes of the used tips and picks up a column of new tips, aspirates from the third vessel, then dispenses to columns 7, 8, and 9 of the plate.
4. **Fourth time through the loop:** The pipette disposes of the used tips and picks up a column of new tips, aspirates from the fourth vessel, then dispenses to columns 10, 11, and 12 of the plate.

   One run is complete.

   After a run completes, the program provides two options: CONTINUE (execute another run), and MENU (return to the Main Menu). If the Operator chooses CONTINUE, the program then provides two more options: START immediately, or display PROMPTS for the reloading of resources.

5. Our operator chooses CONTINUE and then PROMPTS

   Based on Station C's MAP command with its Reload After Run setting of 1, the program prompts the operator to load an empty plate at Station C. The operator loads Plate #2.

6. Steps 1 through 4 are repeated for Plate #2. Two runs are complete.
7. Our operator chooses CONTINUE and then PROMPTS. The program prompts for an empty plate to be loaded at Station C. The operator loads Plate #3.
8. Steps 1 through 4 are repeated for Plate #3. Three runs are complete.
9. Let's say the operator chooses CONTINUE and PROMPTS again. Based on all three MAP commands and their corresponding Reload After Run settings, the program prompts for a fresh supply of tips at Station A, a refill of fluid at Station B, and an empty plate at Station C.

Indexing

During program execution, only one column is being processed at any given time. When each command is executed, the software needs to know exactly which column of what station to process. The software accomplishes this by maintaining an **Index** *for each action command* defined in the program.

Think of an index as a pointer. When you begin a program, the index for each action command is pointing to the column defined by the **Starting At Column** parameter.

Remember that the Starting At Column parameter simply says 'The first time this command is executed, start at this column'.

To help illustrate the index's role as a pointer, let's start with a simple program:

MAP Station A with tips	*Reset Index After Run = 1*
MAP Station B with a 96-well microplate	*Reset Index After Run = 1*
MAP Station C with a 96-well microplate	*Reset Index After Run = 1*

The maximum number of loops to be performed is 12

Start the loop

TIPS pickup at Station A	*Starting At Column = 1*	*Increment Column By = 1*
ASPIRate from Station B	*Starting At Column = 1*	*Increment Column By = 1*
DISPense to Station C	*Starting At Column = 1*	*Increment Column By = 1*

Start the loop

For each action command:

- The first time through the loop, the index is set to the Starting At Column value.
- Each additional time through the loop, the index increments according to the Increment Column By value.

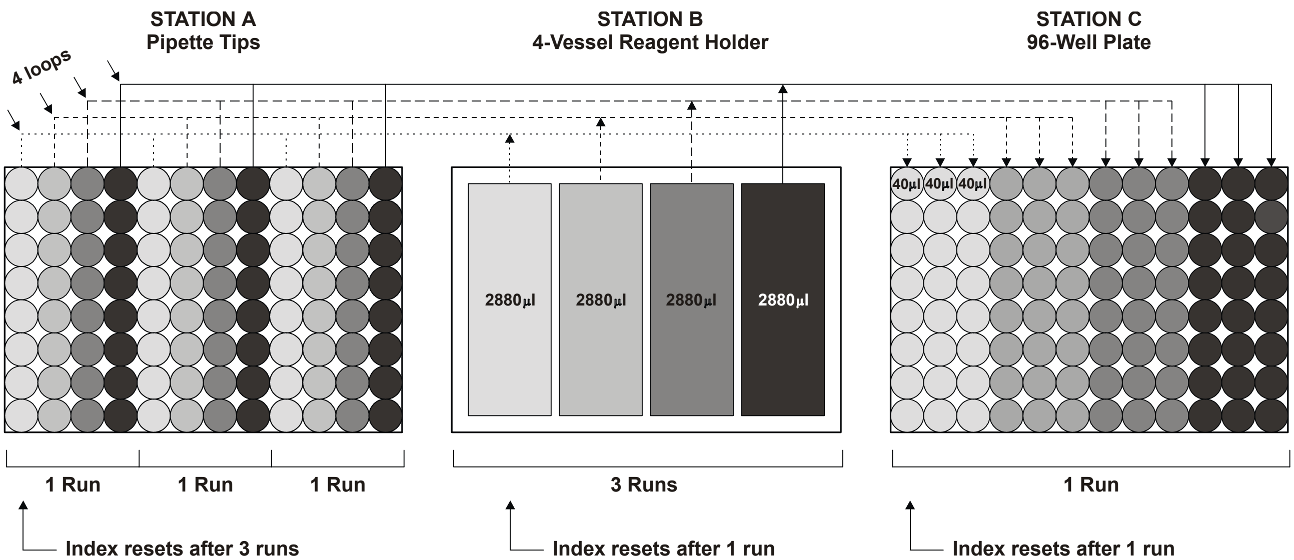
In our example, the first time through the loop the TIPS, ASPIR, and DISP indexes all are equal to 1 (they all point to Column 1 of their respective stations). The second time through our loop, all three indexes are equal to 2 (all point to Column 2). The third time through they are all equal to 3, and so on. When one run is complete, all three indexes are equal to 12, because the loop was executed 12 times.

What if we want to execute multiple runs, to process multiple plates? The program has to know what to do with each index at the end of a run. Should the index stay where it is, or should it reset to the Starting At Column value? This is where the **Reset Index After Run** parameter comes into play.

Each station's MAP command has a Reset Index After Run parameter, which affects the index for each action command executed at that station. Reset Index After Run indicates *after how many runs* an index should get reset to its corresponding Starting At Column value.

In our example on the previous page, all three MAP commands have a Reset Index After Run parameter set to **1.** Therefore, when **one run** is complete, all three action-command indexes are reset.

This example is very basic, because all of the indexes reset at the same rate, and also because all of the supplies have the same number of columns and are reloaded at the same rate. The following example provides more parameters:



Here is the example program. Notice there are three DISPense commands inside the loop:

MAP Station A with tips *Reload Supplies After Run = 3* *Reset Index After Run = 3*

MAP Station B with a 4-vessel reagent holder *Reload Supplies After Run = 3* *Reset Index After Run = 1*

MAP Station C with a 96-well microplate *Reload Supplies After Run = 1* *Reset Index After Run = 1*

The maximum number of loops to be performed is 4

Start the loop

TIPS pick up at Station A *Starting At Column = 1* *Increment Column By = 1*

ASPIRate 120 µl/tip from Station B *Starting At Column = 1* *Increment Column By = 1*

DISPense 40 µl/well to Station C *Starting At Column = 1* *Increment Column By = 3*

DISPense 40 µl/well to Station C *Starting At Column = 2* *Increment Column By = 3*

DISPense 40 µl/well to Station C *Starting At Column = 3* *Increment Column By = 3*

End the loop

- To dispense 40 µl/well to all 12 columns of the microplate at Station C, the loop executes 4 times. This represents **1 run.**
- The plate at Station C needs to be reloaded after **1 run.**
- Supplies at Stations A and B need to be reloaded after **3 runs.**
  - Station A contains enough tips to process three microplates (3 runs), because one column of tips supports a 3-column dispense.
  - Station B contains enough fluid to process three microplates (3 runs), because one aspirate command supports a 3-column dispense.

The table on the next page helps to illustrate the reloading of supplies and the resetting of the index.

Columns Processed

	Loop #	Station A Tips	Station B Reagent Vessels	Station C Microplate
		Load Tips *Set Index*	*Load Vessels* *Set Index*	*Load Plate* *Set Index*
Run 1	1	1	1	1, 2, 3
	2	2	2	4, 5, 6
	3	3	3	7, 8, 9
	4	4	4	10, 11, 12
			Reset Index	*Reload Plate* *Reset Index*
Run 2	1	5	1	1, 2, 3
	2	6	2	4, 5, 6
	3	7	3	7, 8, 9
	4	8	4	10, 11, 12
			Reset Index	*Reload Plate* *Reset Index*
Run 3	1	9	1	1, 2, 3
	2	10	2	4, 5, 6
	3	11	3	7, 8, 9
	4	12	4	10, 11, 12
		Reload Tips *Reset Index*	*Reload Vessels* *Reset Index*	*Reload Plate* *Reset Index*
Run 4	1	1	1	1, 2, 3
	2	2	2	4, 5, 6,
	3	3	3	7, 8, 9

This table shows how each column of each station is processed during program execution.

- You can see how the supply of tips in Station A is sufficient for three runs, and that the index for the TIP command gets reset after those three runs are complete.

- Notice how the four vessels at Station B are accessed. Although we said there is enough fluid in the vessels for three runs, the ASPIR command's index must be set back to the starting column after *each* run so the vessels are accessed in the required order (1-2-3-4, 1-2-3-4, and so on).
- The significant difference between processing Stations A or B and Station C is how frequently Station C's plate needs to be reloaded – after each run. And each time the supply is reloaded, the index is also reset.

Finally, here is the complete program, showing all of the parameters for all of the commands.

(Don't worry if you don't know what some of the parameters are, like "Spec File" or "Detail File," because you'll learn about everything in ***Program Structure***, later in this chapter.)

Command	Station	Load With	Spec File	First Column to Load	Last Column to Load	Initial Volume	Reload Supplies After Run	Reset Index After Run
MAP	A	Tips	RAININ	1	12	n/a	3	3
MAP	B	Vessels	R_1X4	1	4	2880 µl	3	1
MAP	C	Vessels	NF_8X12	1	12	0	1	1

Command	# of Loops
L-MAX	4

Command
L-ON

Command	Tip Detail File	Station	Starting At Column	Increment Column By
TIPS	TIPS01	A	1	1

Command	Aspirate Detail File	Volume	Station	Starting At Column	Increment Column By
ASPIR	ASP01	120 µl/tip	B	1	1

Command	Dispense Detail File	Volume	Station	Starting At Column	Increment Column By
DISP	DISP01	40 µl/well	C	1	3
DISP	DISP01	40 µl/well	C	2	3
DISP	DISP01	40 µl/well	C	3	3

Command
L-OFF

Detail Files

Detail Files describe how *action commands* should be executed in a program. The instrument uses the information from the Detail Files to know how quickly to aspirate or dispense fluid, whether to aspirate fluid from the top or bottom of a vessel, whether or not to “mix” the fluid in a vessel after dispensing, and much more. The information you put into a Detail File will to a large extent determine the accuracy, precision, and speed of your instrument when a program is running.

By referencing the Detail File name in your TIPS, ASPIR, and DISP commands, you save time because you don’t have to retype the same information into multiple programs. Notice how on the previous page, the TIPS01, ASP01, and DISP01 Detail Files are referenced in the different action commands.

In addition, a change to one Detail File will automatically be implemented in all of the action commands in all of the programs that reference it.

Your instrument comes with many Detail Files already installed, the contents of which were optimized in Bio-Tek’s testing laboratory. These files should cover a broad range of tasks you might wish to accomplish. Installed Detail Files tables for Tips, Pipette Aspirate, Pipette Dispense and Manifold Dispense Detail Files are included in ***Appendix B***.

To learn more about Detail Files, see ***Chapter 5***.

Specification Files

Specification Files contain information about the physical aspects of the tips or vessels you are processing. The instrument uses the information from the Specification Files to determine exactly how to position the hardware components for proper operation, and to ensure the best possible results for your fluid transfer.

By referencing the Specification File names in your program, you save time because you don't have to retype the same information into multiple programs. Notice how on the previous page, the RAININ, R_1X4, and NF_8X12 Specification Files are referenced in the different MAP commands.

In addition, a change to one Specification File will automatically be implemented in all of the MAP commands in all of the programs that reference it.

Your instrument comes pre-installed with Specification Files for the supplied Labcon and Rainin tips, the supplied reagent vessels, and for some commonly used microplates. Installed Files tables for Tip Specification and Vessel Specification Files are included in ***Appendix B***.

To learn more about Specification Files, see ***Chapter 5.***

Program Structure

The basic program structure consists of a combination of the nine possible commands described below:

Command	Description and Parameters (if applicable)							
MAP	Station (A-F)	Load with Tips or Vessels	Spec File Name	First Column to Load (1-48, depending on Spec File settings)	Last Column to Load (1-48, depending on Spec File settings)	Initial Volume (vessel only)	Reload Supplies after how many runs?	Reset Index after how many runs?
L-MAX	Indicates the maximum number of times the loop will be executed per run. When the program begins, the operator is prompted with the option to change this setting.							
L-ON	Indicates the start of the loop.							
TIPS	Tip Detail File		Pick up tips from Station (A-F)	Starting At Column (1-12)	Increment Column By			
ASPIR	Aspirate Detail File	Aspirate Volume	Aspirate from Station (A-F)	Starting At Column (1-48)	Increment Column By			
DISP	Dispense Detail File	Dispense Volume	Dispense to Station (A-F)	Starting At Column (1-48)	Increment Column By			
L-OFF	Indicates the end of the loop.							
DELAY	Defines a timed delay or a pause anywhere in the program.							
REMARK	Allows comments to be inserted anywhere in the program.							

When you are creating or modifying a program, keep the following in mind:

- At least one MAP command must be defined for each station to be processed.
- The MAP commands must precede the action commands.
- Every L-ON (start a loop) must have a corresponding L-OFF (end the loop).
- A program can have more than one loop, but there can only be one L-MAX command (all loops will be executed L-MAX times).
- Loops can be "nested," but only if **Precision Power** is used to create the program.
- If using the pipette, an ASPIR command must precede one (or a set of) DISP commands.

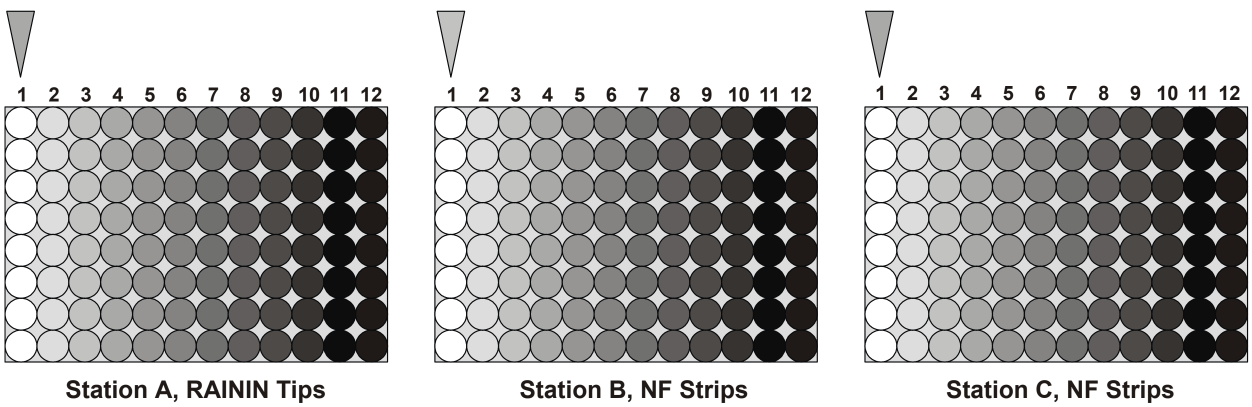
- Although it is not included in the table, the END command is always the last command in a program. You do not have to define this command, the software defines it automatically.

If all of these "rules" seem overwhelming, you need not worry! The software has a built-in **validation function** to find any syntax errors in your program. In addition, once your program is valid, you can run it in a **single-step mode** that executes one command at a time, to help you evaluate the functionality of your program.

See ***Chapter 9***, ***Error Codes*** for more information on the validation function, and ***Running an Existing Program*** in ***Chapter 5*** for more information on single-stepping through a program.

Example Program

Chapter 5 describes every command and parameter in greater detail. The information we've given you in ***Chapter 4***, however, should be sufficient for you to follow this simple example program that picks up tips and then transfers fluid from one 96-vessel supply to another, column-by-column.



This example program looks just like it would if you printed it from the instrument. The lines in **bold** are the actual command lines (sequence number + command name + parameter abbreviations), followed by the prompts that appear on the screen during program creation.

```
01 MAP: A 1-12 T RAININ_250NB 1 1

   MAP INFO FOR STATION:      A
   LOAD WITH:                 TIPS
   TIP SPECS FILE:            RAININ_250NB
   FIRST COLUMN TO LOAD:      1
   LAST COLUMN TO LOAD:       12
   RELOAD AFTER RUN:          1
   RESET INDEX AFTER RUN:     1
```

02 MAP: B 1-12 V NF_8X12STRPS 200 1 1

```
MAP INFO FOR STATION:      B
LOAD WITH:                 VESSEL
VESSEL SPECS FILE:         NF_8X12STRPS
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       12
INITIAL VOLUME:            200 UL
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

03 MAP: C 1-12 V NF_8X12STRPS 0 1 1

```
MAP INFO FOR STATION:      C
LOAD WITH:                 VESSEL
VESSEL SPECS FILE:         NF_8X12STRPS
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       12
INITIAL VOLUME:            0 UL
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

04 MAX: 12 # OF LOOPS

```
MAX NUMBER OF LOOPS:       12
TEXT:                      # OF LOOPS
```

05 ON: START OF LOOP

06 TIP: A 1 1 EXAMPLE TIP DTL

```
TIP DETAIL FILE:           EXAMPLE TIP DTL
GET TIPS FROM STATION:     A
STARTING AT COLUMN:        1
INCREMENT COLUMN BY:       1
```

07 ASP: 100 B 1 1 EXAMPLE ASP DTL

```
ASPIR DETAIL FILE:         EXAMPLE ASP DTL
ASPIRATE VOLUME:           100 ul/well
FROM STATION:              B
STARTING AT COLUMN:        1
INCREMENT COLUMN BY:       1
```

08 DISP: 100 C 1 1 EXAMPLE DSP DTL

```
DISP DETAIL FILE:          EXAMPLE DSP DTL
DISPENSE VOLUME:           100 ul/well
INTO STATION:              C
STARTING AT COLUMN:        1
INCREMENT COLUMN BY:       1
```

09 OFF: END OF LOOP

10 END:

In the next section, you will learn how to create this program for yourself…

In case you were wondering…

It's the Tip Detail File's responsibility to tell the instrument what to do with the tips after a dispense.

The **Place Tips In** parameter of the Tip Detail File gives you two tip disposal locations to choose from: *Rack* (tip tray), or *Dump* (waste collection box).

Creating and Running a Simple Program

If you have read all of the sections in this chapter, you're ready to create a simple plate-to-plate fluid transfer program, and then RUN IT! The instructions will start out very detailed and gradually become less so, to give you the opportunity to think for yourself. Have fun!

Before you do anything, get these supplies and load them on the instrument:

Station A:	96 Rainin FinePoint tips
Station B:	12 Nunc flat 1 x 8 microstrips (in a strip holder), with 200 µl water in every well
Station C:	12 Nunc flat 1 x 8 microstrips (in a strip holder), with 0 µl water in every well

When your supplies are loaded, follow these steps in order. To help guide you along, the settings, selections, and key presses are shown in **bold**:

- ❒ Turn on the instrument and let it go through its motions (system test and home all axes).
- ❒ From the Main Menu, select **DEFINE.**
- ❒ From the SELECT FILE ACTIVITY screen, select **CREATE.**
- ❒ From the SELECT FILE TYPE screen, select **PGRM.**
- ❒ At the NAME screen, type **96 2 96**, (press the right arrow key to insert a space), then press the **Enter key.**

  You will see a screen that looks like this:

```
01 END:
 INS
```

  This is your program! So far, it contains a single END command. Remember that a program is an *ordered* list of commands. You need to insert a new command ahead of the END command.

- ❒ Select **INS.** This moves the END command down the list to second place (02), allowing you to create a new command in first place (01).

  The SELECT COMMAND TYPE screen will appear:

```
SELECT COMMAND TYPE:
 MAP  DELAY REMARK  -->
```

❒ From the SELECT COMMAND TYPE screen, select **MAP.**

❖ **Note:** If MAP is not displayed in the current screen, select the **arrow (-->)** until MAP appears, then select it.

The MAP INFO FOR STATION screen will appear:

```
MAP INFO FOR STATION: A
  A      B      C      -->
```

Remember that the MAP commands should be defined before any other commands, and you need to define one for each station, A, B, and C.

❒ From the MAP INFO FOR STATION screen, select **A,** to define the MAP for Station A.

❒ From the LOAD WITH screen, select **TIPS.**

❒ From the TIP SPECS FILE screen, press the **Option key** until you see **RAININ_250NB**, then select it (this is one of the pre-installed Specification Files).

❒ From the FIRST COLUMN TO LOAD screen, press **Enter** to select the default setting of **1.**

❒ From the LAST COLUMN TO LOAD screen, press **Enter** to select the default setting of **12.**

❒ From the RELOAD AFTER RUN screen, press **Enter** to select the default setting of **1.**

❒ From the RESET INDEX AFTER RUN screen, press **Enter** to accept the default setting of **1.**

❒ Now the screen shows `02: END`. Select **INS** to insert another command.

❒ From the SELECT COMMAND TYPE, select **MAP.**

❒ Define the MAP command for Station B. Here are the parameter settings:

- Station **B**
- Load with **Vessels**
- Use Vessel Specs File **NF_8X12STRPS**
- First Column to Load **1**
- Last Column to Load **12**
- Initial Volume is **200 µl/well**
- Reload After Run **1**
- Reset Index After Run **1**

❒ When you see `03 END:`, select **INS** to insert another line.

❒ Define the MAP command for **Station C.**

The settings are the same as for Station B except that the INITIAL VOLUME is **0 µl/well**

- ❒ When you see `04 END:`, select **INS.**
- ❒ Now you can start setting up the loop. Select the **arrow** to cycle through the available commands until you find **L-MAX**, then select it.
- ❒ From the MAX NUMBER OF LOOPS screen, press **Enter** to select the default setting of **12.**
- ❒ From the TEXT: # OF LOOPS screen, press the **Enter key.**
- ❒ **INS**ert another line.
- ❒ Start the loop by selecting **L-ON.**
- ❒ **INS**ert another line.
- ❒ The first action in the loop is a tips pickup. Select the **arrow** to cycle through the available commands until you find **TIPS**, then select it.
- ❒ From the TIP DETAIL FILE screen, select the pre-installed file **EXAMPLE TIP DTL**, then press the **Enter key.**
- ❒ From the GET TIPS FROM STATION screen, select **A.**
- ❒ From the STARTING AT COLUMN screen, type **1**, then press the **Enter key.**
- ❒ From the INCREMENT COLUMN BY screen, type **1**, then press the **Enter key.**
- ❒ **INS**ert another line.
- ❒ The next action in the loop is an aspirate. Select the **ASPIR** command.
- ❒ Define the aspirate command parameters as follows:
  - Aspirate Detail File **EXAMPLE ASP DTL**
  - Aspirate Volume **100 µl/tip**
  - From Station **B**
  - Starting at Column **1**
  - Increment Column By **1**
- ❒ **INS**ert another line.
- ❒ The third action in the loop is the dispense. Select the **DISP** command.
- ❒ Define the dispense command parameters as follows:
  - Dispense Detail File **EXAMPLE DSP DTL**
  - Dispense Volume **100 µl/tip**
  - Into Station **C**
  - Starting at Column **1**
  - Increment Column By **1**
- ❒ **INS**ert another line.

- ❒ The contents of the loop have all been defined, so now you need to close the loop. Select the **arrow** to cycle through the available commands until you see **L-OFF**, then select it.
- ❒ You should now see `10 END:` Press the **Enter key.**
- ❒ At the OK TO SAVE FILE? screen, select **YES.** You will return to the SELECT FILE ACTIVITY screen.
- ❒ From the SELECT FILE ACTIVITY screen, select the **arrow** to cycle through the available activities until you see **VALIDATE**, then select it.
- ❒ Select the **96 2 96** program, then press the **Enter key.**
- ❒ If you followed all of the steps exactly, you should see the message **PROGRAM IS VALID.**

  If instead an error code is displayed, press the **Main Menu key**, then select **DEFINE**, **EDIT, PGRM, 96 2 96.** Follow all of the steps again to correct any mistakes. **Note:** ***Appendix D*** lists and describes all of the validation error codes.
- ❒ Return to the Main Menu. Select **RUN**, then select your new **96 2 96** program.
- ❒ From the START OR SEE PROMPTS? screen, select **PROMPTS.** You should see the following:

```
LOAD A 01-12 WITH
   TIPS RAININ_250NB
```

(The information for this prompt was extracted from the MAP command for Station A.)

- ❒ Press the **Enter key** and you should see the following prompt:

```
LOAD B 01-12 WITH  200UL
VESSELS NF_8X12STRPS
```

- ❒ Press the **Enter key** and you should see the following prompt:

```
LOAD C 01-12 WITH    0UL
VESSELS NF_8X12STRPS
```

- ❒ Press the **Enter key** once again and the # OF LOOPS: screen should appear, with a setting of 12 (this number comes from the L-MAX setting). Press the **Enter key** to accept this setting and continue.
- ❒ From the START OR SEE PROMPTS? screen, select **START** to start the program!

As the program is running, you will see this on the display:

```
ACTIVE: 96 2 96
PRESS <STOP> TO PAUSE
```

❒ When the run is complete (when the plate at Station C is full), the following prompt will appear:

```
DONE: 96 2 96
MENU CONTINUE
```

❒ At this point, you could reload supplies at all three stations and select CONTINUE to process another plate. But for now, select **MENU** to return to the Main Menu.

Congratulations! You just created and ran your first program!!

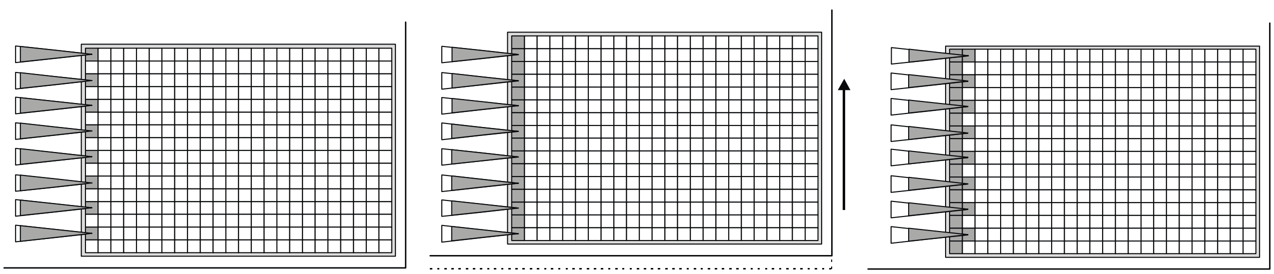
Where to Go From Here

- Continue on to the next section, ***Working with 384-Vessel Plates***.
- Read ***Running an Existing Program*** in ***Chapter 5***, then run one of the installed programs.
- Check ***Appendix B*** to see a listing of the program files already installed on your instrument.
- Read all of ***Chapter 5*** to learn more about program, detail, and specification files.
- Learn about the on-board utilities in ***Chapter 6***.
- Review and ***Chapter 7*** to learn about Instrument Verification tests that you should perform periodically to ensure that your instrument continues to meet its performance specifications.
- Review ***Chapter 8*** to learn how to maintain the Precision in top condition.
- Become familiar with ***Chapter 9***, especially the section on program validation errors.
- Make a photocopy of the menu maps in ***Appendix A***, and keep them near the instrument while you're still learning about the software.

Working with 384-Vessel Plates

All of the examples you've seen so far use microplates in the 8 row x 12 column format. The 8 rows line up with the 8 pipette tips or 8 manifold tubes, so it's fairly easy to visualize the fluid transfer when you're writing a program. As you know, the Precision also supports microplates with 384 vessels arranged in a 16 row x 24 column format or 24 row x 16 column format for 12-Channel Plus and Universal models. Program creation for this plate format requires extra consideration to ensure the vessels are processed as intended.

The supply platform is driven by two stepper motors, which enable it to move backward or forward in small steps. This capability not only allows the pipette tips or manifold tubes to access all six stations, but it also allows for finer adjustments, such as those required to access two sets of eight rows for each physical plate column, as demonstrated below:



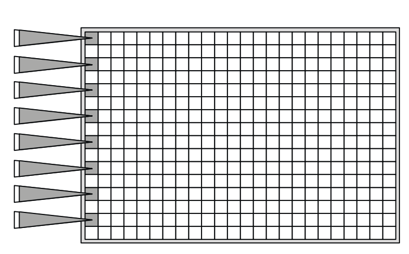
The supply platform is initially positioned so that the tips or tubes can access plate rows A, C, E, G, I, K, M, and O.

The supply platform then shifts back, allowing the tips or tubes to access plate rows B, D, F, H, J, L, N, and P.

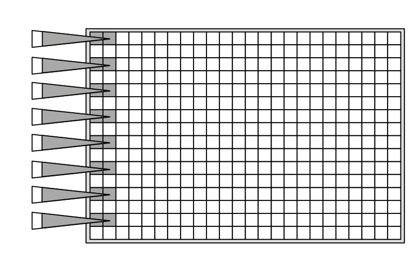
The supply platform shifts forward and the tips or tubes advance to the next plate column.

In the above example, the plate is processed using a **column-wise** method. All vessels in one column are processed before the pipette tips or manifold tubes move to the next column.

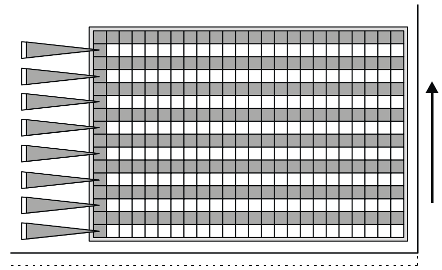
Alternatively, the plate can be processed using a **row-wise** method (as demonstrated below). All vessels in rows A, C, E, G, I, K, M, and O are processed, then the supply platform shifts back to provide access to the other eight rows.



The supply platform is initially positioned so that the tips or tubes can access plate rows A, C, E, G, I, K, M, and O of the first column.



The supply platform remains stationary while the tips or tubes advance to the next column.



When all columns of rows A, C, E, G, I, K, M, and O have been processed, the supply platform shifts to allow access to rows B, D, F, H, J, L, N, and P.

The processing direction is defined in the Vessel Specs File, using the FILL COLUMNWISE? parameter (a setting of YES indicates column-wise, NO indicates row-wise). See ***Vessel Specification File*** in ***Chapter 5*** for more information.

The following explanation of how the Precision processes 384-well plates refers to 8-channel models only. Precision 12-Channel Plus and Universal models process 384-well plates in a similar manner, but since there are 12 pipette tips and manifold tubes, the plates are a 24 row x 16 column matrix of wells.

Consider the hardware of a Precision 8-Channel Plus. The instrument's hardware is fixed with eight pipette tips or eight manifold tubes; the maximum number of vessels that can be processed at any one time is eight. Each of the **24** physical columns must be accessed **two times** to process all 16 vessels. To process all 384 vessels using eight tips or tubes, the plate must therefore be accessed **48 times.**

For 12-Channel Plus and Universal models, the software views a 384-well plate having 16 columns and 24 wells per column. The 12-channel pipette or manifold must dispense twice to fill all the wells of each column, so the software sees this vessel as having 32 columns (16 x 2).

In order to provide maximum flexibility with fluid transfer programs, the software thinks of the 384-vessel plate as having **48 columns.** You as the creator of fluid transfer programs must also think of this plate as having 48 columns.

The column numbering differs, depending upon whether the plate is processed using the **column-wise** or **row-wise** method. When you're creating a fluid transfer program, it's important to know the FILL COLUMNWISE? setting (YES or NO) in the Vessel Specs File referenced by the MAP command.

The drawing below shows column numbering if FILL COLUMNWISE? is YES:

Physical column numbering (top row); **Column numbering from the software's perspective** (cells)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A	**1**	**3**	**5**	**7**	**9**	**11**	**13**	**15**	**17**	**19**	**21**	**23**	25	27	29	31	33	35	37	39	41	43	45	47
B	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	26	28	30	32	34	36	38	40	42	44	46	48
C	**1**	**3**	**5**	**7**	**9**	**11**	**13**	**15**	**17**	**19**	21	23	25	27	29	31	33	35	37	39	41	43	45	47
D	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	22	24	26	28	30	32	34	36	38	40	42	44	46	48
E	**1**	**3**	**5**	**7**	**9**	**11**	**13**	**15**	17	19	21	23	25	27	29	31	33	35	37	39	41	43	**45**	**47**
F	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	18	20	22	24	26	28	30	32	34	36	38	40	42	44	**46**	**48**
G	**1**	**3**	**5**	**7**	**9**	**11**	13	15	17	19	21	23	25	27	29	31	33	35	37	39	**41**	**43**	**45**	**47**
H	**2**	**4**	**6**	**8**	**10**	**12**	14	16	18	20	22	24	26	28	30	32	34	36	38	40	**42**	**44**	**46**	**48**
I	**1**	**3**	**5**	**7**	9	11	13	15	17	19	21	23	25	27	29	31	33	35	**37**	**39**	**41**	**43**	**45**	**47**
J	**2**	**4**	**6**	**8**	10	12	14	16	18	20	22	24	26	28	30	32	34	36	**38**	**40**	**42**	**44**	**46**	**48**
K	**1**	**3**	5	7	9	11	13	15	17	19	21	23	25	27	29	31	**33**	**35**	**37**	**39**	**41**	**43**	**45**	**47**
L	**2**	**4**	6	8	10	12	14	16	18	20	22	24	26	28	30	32	**34**	**36**	**38**	**40**	**42**	**44**	**46**	**48**
M	1	3	5	7	9	11	13	15	17	19	21	23	25	27	**29**	**31**	**33**	**35**	**37**	**39**	**41**	**43**	**45**	**47**
N	2	4	6	8	10	12	14	16	18	20	22	24	26	28	**30**	**32**	**34**	**36**	**38**	**40**	**42**	**44**	**46**	**48**
O	1	3	5	7	9	11	13	15	17	19	21	23	**25**	**27**	**29**	**31**	**33**	**35**	**37**	**39**	**41**	**43**	**45**	**47**
P	2	4	6	8	10	12	14	16	18	20	22	24	**26**	**28**	**30**	**32**	**34**	**36**	**38**	**40**	**42**	**44**	**46**	**48**

The drawing below shows column numbering if FILL COLUMNWISE? is NO:

Physical column numbering (top row); **Column numbering from the software's perspective** (cells)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
B	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
C	**1**	**2**	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
D	**25**	**26**	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
E	**1**	**2**	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
F	**25**	**26**	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
G	**1**	**2**	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
H	**25**	**26**	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
I	**1**	**2**	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
J	**25**	**26**	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
K	**1**	**2**	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
L	**25**	**26**	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
M	**1**	**2**	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N	**25**	**26**	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
O	**1**	**2**	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
P	**25**	**26**	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48

Following are three sample programs that process 384-vessel plates. Create and run them for yourself, to see exactly how they work. Also, try changing the FILL COLUMNWISE? setting in the Vessel Specs File, to see the effects of the two different options.

Program # 1 uses the manifold to rapidly dispense 50 µl of fluid into all vessels of the plate:

01 MAP: A 1-48 V CSTR_384 1 1

```
MAP INFO FOR STATION:      A
LOAD WITH:                 VESSELS
VESSEL SPECS FILE:         CSTR_384
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       48
INITIAL VOLUME:            0
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

The vessel specs file is designed for the 16 x 24 plate format

Last Column to Load is set to 48

02 MAX: 48 # OF LOOPS

```
MAX NUMBER OF LOOPS:       48
TEXT:                      # OF LOOPS
```

L-MAX is 48, to execute the contents of the loop 48 times and process all vessels

03 ON: START OF LOOP

04 DSP: 50 A 1 1 DM1250044

```
DISP DETAIL FILE:          DM1250044
DISPENSE VOLUME:           50
INTO STATION:              1
STARTING AT COLUMN:        1
INCREMENT COLUMN BY:       01
```

Note: The program checks the dispense detail file for the dispensing device: pipettor or manifold (see Chapter 5)

05 OFF: END OF LOOP

06 END:

Program # 2 repeatedly aspirates fluid from one reagent vessel and dispenses it to all vessels in the plate. One column of tips is used for the entire program.

01 MAP: A 1-1 T RAININ_250NB 1 1

```
MAP INFO FOR STATION:      A
LOAD WITH:                 TIPS
TIP SPECS FILE:            RAININ_250NB
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       1
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

02 MAP: B 4-4 V R_1X4 1 1

```
MAP INFO FOR STATION:      B
LOAD WITH:                 VESSELS
VESSEL SPECS FILE:         R_1X4
FIRST COLUMN TO LOAD:      4
LAST COLUMN TO LOAD:       4
INITIAL VOLUME:            50
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

03 MAP: C 1-48 V CSTR_384 1 1

```
MAP INFO FOR STATION:      C
LOAD WITH:                 VESSELS
VESSEL SPECS FILE:         CSTR_384
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       48
INITIAL VOLUME:            0
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

04 TIP: A 1 0 TRR

```
TIP DETAIL FILE:           TRR
GET TIPS FROM STATION:     A
STARTING AT COLUMN:        1
INCREMENT COLUMN BY:       00
```

05 MAX: 48 # OF LOOPS

```
MAX NUMBER OF LOOPS:       48
TEXT:                      # OF LOOPS
```

06 ON: START OF LOOP

07 ASP: 50 B 4 0 A000N440

```
ASPIR DETAIL FILE:         A000N440
ASPIRATE VOLUME:           50
FROM STATION:              B
STARTING AT COLUMN:        4
INCREMENT COLUMN BY:       00
```

08 DSP: 50 C 1 1 DP0481040

```
DISP DETAIL FILE:          DP0481040
DISPENSE VOLUME:           50
INTO STATION:              C
STARTING AT COLUMN:        1
INCREMENT COLUMN BY:       01
```

09 OFF: END OF LOOP

10 END:

Program # 3 uses pipette tips to perform a sample transfer from one 384-vessel plate to another. Stations A, B, D, and E are loaded with tips, C and F each contain a 384-vessel plate.

To prevent any mixing of samples, two columns of tips are used to process each physical plate column. Since there are 24 physical columns, the program needs 48 columns of tips, or four full tip boxes, to complete the transfer.

01 MAP: A 1-12 T RAININ_250NB 1 1

```
MAP INFO FOR STATION:      A
LOAD WITH:                 TIPS
TIP SPECS FILE:            RAININ_250NB
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       12
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

02 MAP: B 1-12 T RAININ_250NB 1 1

```
MAP INFO FOR STATION:      B
LOAD WITH:                 TIPS
TIP SPECS FILE:            RAININ_250NB
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       12
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

03 MAP: D 1-12 T RAININ_250NB 1 1

```
MAP INFO FOR STATION:      D
LOAD WITH:                 TIPS
TIP SPECS FILE:            RAININ_250NB
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       12
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

04 MAP: E 1-12 T RAININ_250NB 1 1

```
MAP INFO FOR STATION:      E
LOAD WITH:                 TIPS
TIP SPECS FILE:            RAININ_250NB
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       12
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

05 MAP: C 1-48 V CSTR_384 1 1

```
MAP INFO FOR STATION:      C
LOAD WITH:                 VESSELS
VESSEL SPECS FILE:         CSTR_384
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       48
INITIAL VOLUME:            100
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

06 MAP: F 1-48 V CSTR_384 1 1

```
MAP INFO FOR STATION:      F
LOAD WITH:                 VESSELS
VESSEL SPECS FILE:         CSTR_384
FIRST COLUMN TO LOAD:      1
LAST COLUMN TO LOAD:       48
INITIAL VOLUME:            0
RELOAD AFTER RUN:          1
RESET INDEX AFTER RUN:     1
```

07 MAX: 12 # OF LOOPS

```
MAX NUMBER OF LOOPS:       12
TEXT:                      # OF LOOPS
```

L-MAX is 12 because there are 12 columns of tips in each box

08 ON: START OF LOOP

09 TIP: A 1 01 TRR

```
TIP DETAIL FILE:           TRR
GET TIPS FROM STATION:     A
STARTING AT COLUMN:        1
INCREMENT COLUMN BY:       01
```

10 ASP: 50 C 1 01 A000N440

```
ASPIR DETAIL FILE:         A000N440
ASPIRATE VOLUME:           50
FROM STATION:              C
STARTING AT COLUMN:        1
INCREMENT COLUMN BY:       01
```

The first set of ASP/DSP commands processes “columns” 1 through 12

11 DSP: 50 F 1 01 DP0481040

```
DISP DETAIL FILE:          DP0481040
DISPENSE VOLUME:           50
INTO STATION:              F
STARTING AT COLUMN:        1
INCREMENT COLUMN BY:       01
```

12 OFF: END OF LOOP

13 ON: START OF LOOP

14 TIP: B 1 01 TRR

```
TIP DETAIL FILE:           TRR
GET TIPS FROM STATION:     B
STARTING AT COLUMN:        1
INCREMENT COLUMN BY:       01
```

15 ASP: 50 C 13 01 A000N440

```
ASPIR DETAIL FILE:          A000N440
ASPIRATE VOLUME:            50
FROM STATION:               C
STARTING AT COLUMN:         13
INCREMENT COLUMN BY:        01
```

The second set of ASP/DSP commands processes “columns” 13 through 24

16 DSP: 50 F 13 01 DP0481040

```
DISP DETAIL FILE:           DP0481040
DISPENSE VOLUME:            50
INTO STATION:               F
STARTING AT COLUMN:         13
INCREMENT COLUMN BY:        01
```

17 OFF: END OF LOOP

18 ON: START OF LOOP

19 TIP: D 1 01 TRR

```
TIP DETAIL FILE:            TRR
GET TIPS FROM STATION:      D
STARTING AT COLUMN:         1
INCREMENT COLUMN BY:        01
```

20 ASP: 50 C 25 01 A000N440

```
ASPIR DETAIL FILE:          A000N440
ASPIRATE VOLUME:            50
FROM STATION:               C
STARTING AT COLUMN:         25
INCREMENT COLUMN BY:        01
```

The third set of ASP/DSP commands processes “columns” 25 through 36

21 DSP: 50 F 25 01 DP0481040

```
DISP DETAIL FILE:           DP0481040
DISPENSE VOLUME:            50
INTO STATION:               F
STARTING AT COLUMN:         25
INCREMENT COLUMN BY:        01
```

22 OFF: END OF LOOP

23 ON: START OF LOOP

24 TIP: E 1 01 TRR

```
TIP DETAIL FILE:            TRR
GET TIPS FROM STATION:      E
STARTING AT COLUMN:         1
INCREMENT COLUMN BY:        01
```

25 ASP: 50 C 37 01 A000N440

```
ASPIR DETAIL FILE:          A000N440
ASPIRATE VOLUME:            50
FROM STATION:               C
STARTING AT COLUMN:         37
INCREMENT COLUMN BY:        01
```

The last set of ASP/DSP commands processes "columns" 37 through 48

26 DSP: 50 F 37 01 DP0481040

```
DISP DETAIL FILE:           DP0481040
DISPENSE VOLUME:            50
INTO STATION:               F
STARTING AT COLUMN:         37
INCREMENT COLUMN BY:        01
```

27 OFF: END OF LOOP

28 END:

Chapter 5

Program, Detail, & Specification Files

This chapter discusses many aspects of program, detail, and specification files, including creation and modification. If you have not already done so, please take time now to read ***Chapter 4*, *Getting Started***. There you will learn essential concepts for running the on-board software, and you'll create and run some simple programs.

Introduction

Similar to the way a computer uses files to organize data, the Precision's on-board software uses **files** to store fluid handling information. These files can be created, edited, copied, deleted, renamed, and printed, all through the instrument's keypad.

The Precision defines three different types of files:

Program File:	Contains the sequence of commands required to complete a fluid transfer, such as 'pick up tips', 'aspirate fluid', and 'dispense fluid'. When you "run" a program, you are essentially instructing the instrument to execute all of the commands in a particular program file. A program file typically references multiple *Detail* and *Specification Files*.
Detail File:	Contains important information about how a certain command within a program should be executed. There are three kinds of detail files: Tip, Aspirate, and Dispense.
Specification File:	Contains important information about a supply to be used during the fluid transfer. There are two kinds of specification files: Tip and Vessel.

Program File, containing a list of commands to execute a fluid transfer

```
FILE NAME:  SMPL96_96_100UL

01 MAP: A 1-12 T RAININ_250NB 1 1

02 MAP: B 1-12 V NF_8X12STRPS 1 1

03 MAP: C 1-12 V NF_8X12STRPS 1 1

04 MAX: 12 # OF LOOPS

05  ON: START OF LOOP

06 TIP: A 1 1 TRR

07 ASP: 110 B 1 1 A00N440

08 DSP: 100 C 1 1 DP0484040

09 OFF: END OF LOOP

10 END:
```

Name of a Tip Specs File, containing maximum volume, distance to rim, distance to engage tips, distance to lift tips, distance to first/last column, distance to first row

Name of a Vessel Specs File, containing unit of measure, distance to vessel bottom, maximum, volume, distance to max volume, calculated minimum volume, distance to top, number of rows/columns, distance to first/last column, distance to first row, fill column-wise

Name of a Tip Detail File, containing where to put used tips, what to do with residual fluid

Name of an Aspirate Detail File, containing horizontal aspirate position, pre-air volume, mix cycles, pick from bottom, aspirate rate, fluid exit rate

Name of a Dispense Detail File, containing dispensing device, manifold prime volume, horizontal dispense position, dispense height, dispense rate, mix cycles, fluid exit rate, post-air volume

Program Files

In the process of transferring fluids from one station or vessel to another, a sequence of steps is usually repeated several times in order to complete the fluid transfer. A simple sequence might resemble (1) pick up tips, (2) aspirate fluid, (3) dispense fluid.

When pipetting manually, *you* are responsible for performing all tasks, and for keeping track of which tips to pick up and when to dispose of them, where to aspirate fluid, where to dispense fluid, what volumes of fluid to aspirate and dispense, when to reload supplies, and so on.

When pipetting with the Precision, the *instrument* performs all tasks and keeps track of all of the details for you. All you need to do is load the supplies and then press a few buttons to run a **program.** A program contains the sequence of **commands** required to complete a fluid transfer. It knows where the tips and vessels are located, and what to do with them.

There are nine program commands, which can be broken down into three different categories. Each program can contain up to 99 commands.

Category	Description	Commands in this category
Information	These commands contain important supply setup and program execution information.	MAP, L-MAX, REMARK
Action	Action commands tell the instrument what to do.	TIPS, ASPIR(ate), DISP(ense)
Control	Control commands describe how to execute a set of action commands.	L-ON, L-OFF, DELAY

The MAP, L-MAX, REMARK, TIPS, ASPIR, DISP, and DELAY commands have one or more **parameters** associated with them. Parameters allow you to customize the functionality of each command. For example, the ASPIR and DISP commands both have a “Volume” parameter, so you can specify the amount of fluid to aspirate or dispense.

❖ **Note:** For operation of the **Bio-Stack™** with the Precision (under the control of **Precision Power™ Software** on a host PC) the Bio-Stack is engaged by a Precision program through a Supply Command. You must define a SUPPLY command in the program for each time you want the Bio-Stack to provide, remove, or exchange a plate. Please refer to the **Precision Power User’s Guide** for instructions on using the Bio-Stack in Precision programs.

Creating a New Program File

The most important part of the program creation process is figuring out exactly what it is you want to accomplish.

To create a program file, follow these steps:

1. From the Main Menu, select **DEFINE.**
2. From the SELECT FILE ACTIVITY screen, select **CREATE.**
3. From the SELECT FILE TYPE screen, select **PGRM.**
4. The file name entry screen appears. Use the keypad to enter a unique name for the program file:

```
NAME:     _
ALPHA   NUM   SYMBOL
```

- A file name can contain any combination of up to 16 alphanumeric characters and symbols:
  - Letters A-Z, and space
  - Numbers 0 to 9
  - Symbols _ # & % / * + - = : ; . , ! @ ? ( ) [ ] { } < >
- The default character type is **ALPHA.** Select **NUM** to change the character type to numeric. Select **SYMBOL** to change the character type to symbols.
- Pressing the **Options key** cycles forward through the list of available characters, **Shift+Options** cycles backward through the list.
- To enter a **space**, press the **right arrow key** to move the cursor to the right.
- To clear the entire name field, press the **CLEAR key.**

5. When the name entry is complete, press the **Enter key** to continue. The program command entry screen appears, with the single command END in position 01. This command will be the *last* command in your program.

```
01 END:
 INS
```

6. Select **INS** to insert a new command in front of the END command. The SELECT COMMAND TYPE screen appears:

```
SELECT COMMAND TYPE:
 MAP  DELAY REMARK  -->
```

7. Select a command, or select the arrow key to see additional commands. The supported command types are:

MAP:	Define characteristics about the supply loaded at each station.
DELAY:	Define a timed delay or infinite pause during program execution.
REMARK:	Insert a short comment within the program (remarks have no effect on program execution).
L-MAX:	Define the maximum number of times to execute the commands inside the loop(s).
L-ON:	Indicate the beginning of a loop.
L-OFF:	Indicate the end of a loop.
TIPS:	Pick up a column of tips.
ASPIR:	Aspirate a volume of fluid, using tips.
DISP:	Dispense a volume of fluid, using tips or the manifold.

❖ These commands are described on the following pages. Many examples are provided.

8. Define all of the fluid handling commands, in order of occurrence. Refer to the table and "rules" found under ***Program Structure*** in ***Chapter 4***. Once you have defined a command, you have the option to delete it, edit it, or insert another command in front of it:

```
03 MAP: C 1-1  V NF_8X12
 INS   DEL   EDIT
```

- To navigate within this type of display while you're creating the program:
  - ➢ Select **INS** to insert a new command in front of this one.
  - ➢ Select **DEL** to delete the command. **Note:** You cannot paste the command somewhere else.
  - ➢ Select **EDIT** to edit the parameters for this command.
  - ➢ Press the **Enter key** to view the next command.
  - ➢ Press the **Previous Screen key** to view the previous command.

9. To save the program and return to the main menu, press the **Main Menu** key. The OK TO SAVE FILE? screen appears:

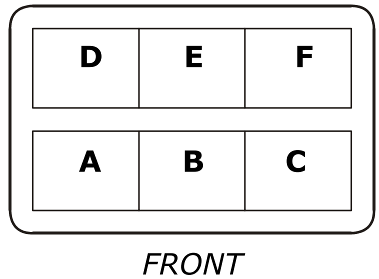
```
OK TO SAVE FILE?     YES
 YES  NO
```

- Select **YES** to save the program file with the changes.
- Select **NO** to discard the changes and leave the original file contents intact.

MAPping the Stations

In order for a program to accurately and precisely pick up tips, aspirate fluid, or dispense fluid, each station containing supplies must have at least one **MAP command** defined for it. The MAP command contains important information about the supply, including its type, size, and number of columns, its initial volume (if the supply is a vessel), and how many program runs can be executed before the supply needs to be reloaded or the index must be reset.

The information provided in a MAP command can also be used to **prompt** the operator so that he or she knows exactly what supplies should be loaded at which stations.

Parameter	Description	Options
Map Info for Station	The station for which this MAP command is defined.  	A, B, C, D, E, or F A, B, C, or D for 12-Channel Models
Load With	The supply type this station will be loaded with, pipette tips or vessels. (Choose VESSELS for any supply other than pipette tips.)	TIPS or VESSELS
Specs File Name	The name of the Tip Specs File or the Vessel Specs File associated with the supply at this station. It is very important that the correct file name be referenced. A specs file contains information about the physical aspects of the tips or vessels. The instrument uses this information to determine exactly how to position the hardware components during program execution.	Choose from a list of existing file names
First Column to Load	The first column to be loaded with tips or vessels. For example, if the station will be loaded with a full box of 96 pipette tips, First Column to Load is 1. **Note:** If the supply at this station is a 16 x 24 plate, the software thinks of it as having 48 columns, not 24. See ***Working with 384-Vessel Plates*** at the end of ***Chapter 4***.	Tips: 1 to 12 columns Vessels: 1 to the number of columns in the spec file
Last Column to Load	The last column to be loaded with tips or vessels. For example, if the station is loaded with six 1 x 8 microstrips *and* First Column to Load is 1, Last Column to Load is 6. **Note:** If the supply at this station is a 16 x 24 plate, the software thinks of it as having 48 columns, not 24. See ***Working with 384-Vessel Plate****s* at the end of ***Chapter 4***.	Tips: 1 to 12 Vessels: 1 to the number of columns in the spec file

Parameter	Description	Options
Initial Volume	If Load With is set to Vessels, the Initial Volume prompt appears. This is the total starting volume of the fluid in each vessel before the program begins. *All vessels in all specified columns must contain this initial volume.* The unit of measure is UL or ML, which is defined in the Vessel Specs File. The Initial Volume cannot exceed the Maximum Volume defined in the Vessel Specs File.	0 to the maximum volume capacity of the vessel, in UL or ML
Reload After Run	The number of program runs that can be executed before the supply at this station needs to be replaced or refilled (see ***Defining a Run & Reloading Supplies*** in ***Chapter 4***).	1 to 99 program runs
Reset Index After Run	For each action command executed at this station, the number of program runs that can be executed before the index is reset to the Starting At Column value (see ***Indexing*** in ***Chapter 4***).	1 to 99 program runs

In this example, Station A is loaded with 96 pipette tips, Station B is loaded with twelve 1 x 8 microstrips (200 µl/vessel), and Station C is loaded with 12 microstrips (0 µl/vessel). After one program run, all three supplies need to be reloaded, and their indexes are all reset.

```
01 MAP: A 1-12 T RAININ_250NB 1 1
    MAP INFO FOR STATION:  A
    LOAD WITH:          TIPS
    TIP SPECS FILE:       01 (RAININ_250NB)
    FIRST COLUMN TO LOAD:  1
    LAST COLUMN TO LOAD:  12
    RELOAD AFTER RUN:      1
    RESET INDEX AFTER RUN: 1

02 MAP: B 1-12 V NF_8X12STRPS 1 1
    MAP INFO FOR STATION:  B
    LOAD WITH:       VESSELS
    VESSEL SPECS FILE:    02 (NF_8X12STRPS)
    FIRST COLUMN TO LOAD:  1
    LAST COLUMN TO LOAD:  12
    INITIAL VOLUME:      200
    RELOAD AFTER RUN:      1
    RESET INDEX AFTER RUN: 1
```

```
03 MAP: C 1-12 V NF_8X12STRPS 1 1
    MAP INFO FOR STATION:  C
    LOAD WITH:       VESSELS
    VESSEL SPECS FILE:    02 (NF_8X12STRPS)
    FIRST COLUMN TO LOAD:  1
    LAST COLUMN TO LOAD:  12
    INITIAL VOLUME:        0
    RELOAD AFTER RUN:      1
    RESET INDEX AFTER RUN: 1
```

In this example, Station A contains 96 pipette tips, Station B contains four reagent vessels, and Station C contains twelve 1 x 8 microstrips. Supplies are refreshed and indexes are reset at different rates (you can see the full program in ***Chapter 4***, under ***Indexing***).

```
01 MAP: A 1-12 T RAININ_250NB 3 3
    MAP INFO FOR STATION:  A
    LOAD WITH:          TIPS
    TIP SPECS FILE:       01 (RAININ_250NB)
    FIRST COLUMN TO LOAD:  1
    LAST COLUMN TO LOAD:  12
    RELOAD AFTER RUN:      3
    RESET INDEX AFTER RUN: 3

02 MAP: B 1-4 V R_1X4 3 1
    MAP INFO FOR STATION:  B
    LOAD WITH:       VESSELS
    VESSEL SPECS FILE:    01 (R_1X4)
    FIRST COLUMN TO LOAD:  1
    LAST COLUMN TO LOAD:   4
    INITIAL VOLUME:     2880
    RELOAD AFTER RUN:      3
    RESET INDEX AFTER RUN: 1

03 MAP: C 1-12 V NF_8X12STRPS 1 1
    MAP INFO FOR STATION:  C
    LOAD WITH:       VESSELS
    VESSEL SPECS FILE:    02 (NF_8X12STRPS)
    FIRST COLUMN TO LOAD:  1
    LAST COLUMN TO LOAD:  12
    INITIAL VOLUME:        0
    RELOAD AFTER RUN:      1
    RESET INDEX AFTER RUN: 1
```

This example shows how it is possible to define more than one MAP command for a single station. Station C is loaded with a microstrip holder containing two different types of strips.

```
03 MAP: C 1-6 V NF_8X12STRPS 1 1
    MAP INFO FOR STATION:  C
    LOAD WITH:       VESSELS
    VESSEL SPECS FILE:    02 (NF_8X12STRPS)
    FIRST COLUMN TO LOAD:  1
    LAST COLUMN TO LOAD:   6
    INITIAL VOLUME:      100
    RELOAD AFTER RUN:      1
    RESET INDEX AFTER RUN: 1

04 MAP: C 7-12 V NR_8X12STRPS 1 1
    MAP INFO FOR STATION:  C
    LOAD WITH:       VESSELS
    VESSEL SPECS FILE:    03 (NR_8X12STRPS)
    FIRST COLUMN TO LOAD:  7
    LAST COLUMN TO LOAD:  12
    INITIAL VOLUME:      100
    RELOAD AFTER RUN:      1
    RESET INDEX AFTER RUN: 1
```

Setting a DELAY

The DELAY command sets a timed delay or an infinite pause during program execution.

- A **timed delay** halts program execution, waits the specified amount of time, then automatically resumes. During the delay, the screen changes to resemble the following:

```
000:57 DELAYING...
PRESS <STOP> TO PAUSE
```

  - The display shows the time remaining, in MMM:SSS.
  - The delay text is customizable, and can contain up to 16 alphanumeric characters. In the example above, "DELAYING…" is the customizable text (it is also the default text).

- Pressing the **Stop key** puts the program into a paused mode (see ***Running a Program*** later in this chapter for more information).

- An **infinite pause** requires operator intervention to end the pause and resume program execution. During the pause, the screen changes to resemble the following:

```
PAUSED: INCUB PLT 10MIN.
ABORT RESUME STEP
```

- The pause text is customizable, and can contain up to 16 alphanumeric characters. In the example above, `INCUB PLT 10MIN.` is the customizable text.
- The operator can **ABORT** the program, **RESUME** execution, or execute just the next **STEP** (see ***Running a Program*** later in this chapter for more information).

Parameter	Description	Options
Minutes to Delay	How many *minutes* to delay, if this is a timed delay that will last longer than 59 seconds. Enter 0 if the timed delay will be less than 60 minutes, or to indicate an infinite pause (if seconds is also set to 0).	1 to 240 minutes, or 0
Seconds to Delay	How many *seconds* to delay, if this is a timed delay. Enter 0 if the timed delay is in whole minutes, or to indicate an infinite pause (if minutes is also set to 0).	1 to 59 seconds, or 0
Delay Action	Select an action to occur during the delay. **NONE:** The shuttle remains in its current position. **PARK:** If using tips, the shuttle positions the tips over the waste collection bin. If using the manifold, the shuttle positions the manifold over the priming trough. *(Continued on next page)*	NONE, PARK, or UNLOAD

Parameter	Description	Options
(Delay Action)	**UNLOAD:** If using tips, they are disposed of. If the manifold is currently engaged, the manifold is returned to its home location and unloaded. **Note:** You can use UNLOAD to prime the manifold before the next dispense command (see the **Tip** below).	NONE, PARK, or UNLOAD
Text	Descriptive text to be presented to the operator during the delay. The default text is "DELAYING…".	0 to 16 alphanumeric characters

> The maximum time delay in one DELAY command is 240 minutes (4 hours). Define two or more contiguous DELAY commands if you need a longer delay.

> The Delay Action UNLOAD (see next page) can be used to "force" a manifold prime before the next dispense command is executed.
>
> The manifold is primed only when it is being engaged (picked up). If you want to prime between dispense commands, add a DELAY command with the UNLOAD action enabled so that the manifold is unloaded and then re-engaged.
>
> See ***Creating Programs that use the Manifold*** on page 113 for additional information.

Defining a REMARK

The REMARK command allows you to enter comments in a program. Remark text is primarily provided for use by program creators and editors, and is not displayed during program execution. Remark text *does* appear on program file printouts.

Here is an example program with two REMARK commands:

```
01 MAP: A 1-1 T RAININ_250NB 1 1

02 MAP: B 1-12 V NF_8X12STRPS 1 1

03 MAP: C 1-12 V NF_8X12STRPS 1 1

04 MAX: 12 # OF LOOPS

05 ON:  START OF LOOP
```

```
06 TIP: A 1 0 TRR
07 REM: ASP 10UL EXTRA
08 REM: FOR DSP ACCURACY
09 ASP: 110 B 1 1 A000N440
10 DSP: 100 C 1 1 DP0481040
11 OFF: END OF LOOP
12 END:
```

Repeating Commands Using a Loop

After defining the MAP commands, you can build an entire fluid transfer program using just the TIPS, ASPIR, and DISP commands that you will soon be reading about. They are *action* commands, they tell the instrument to *do* something.

Let's say you want to transfer fluid from one 96-well microplate to another (we'll call them Plate 1 and Plate 2). You might aspirate from Column 1 of Plate 1, dispense to Column 1 of Plate 2, aspirate from Column 2 of Plate 1, dispense to Column 2 of Plate 2, and so on until all 12 columns of both plates have been processed. To write a program to do this, you *could* define 12 aspirate (ASPIR) commands and 12 dispense (DISP) commands, like so:

ASPIRate from Column 1 of Plate 1

DISPense to Column 1 of Plate 2

ASPIRate from Column 2 of Plate 1

DISPense to Column 2 of Plate 2

...

ASPIRate from Column 12 of Plate 1

DISPense to Column 12 of Plate 2

To learn much more about the power of looping, please read ***Looping***, ***Defining a Run & Reloading Supplies***, and ***Indexing*** in ***Chapter 4***

A program structured this way *is* logical and valid. It would, however, be tedious for you to define those 24 commands. Fortunately, you have the power of **looping** to speed things up. Looping allows you to define just a few commands and repeat them over and over until the fluid transfer is complete. The example on the following page illustrates the loop used to reduce our program from 24 ASPIR/DISP commands down to 2.

Execute this loop 12 times (L-MAX)

Start the loop (L-ON)

ASPIRate from Plate 1 *(start at column 1, increment columns by 1)*

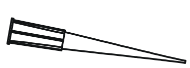
DISPense to Plate 2 *(start at column 1, increment columns by 1)*

End the loop (L-OFF)

The two steps inside the loop are executed 12 times to complete the fluid transfer. This simple program is much more efficient than our equally valid but larger program.

L-ON and L-OFF have no parameters associated with them. L-MAX has two parameters, Max Number of Loops and Text, described below:

L-MAX Parameters	Description	Options
Max Number of Loops	This number represents the maximum number of times the loop will be executed. At program run-time, the operator has the opportunity to override this value (see Text below).	1 to 99 loops
Text	At program run-time, if the operator chooses to view PROMPTS, the L-MAX text will appear as one of the prompts. The operator can accept the default Max Number of Loops, or override it by entering a smaller number (see the **Tip** on next page). The default text is "# OF LOOPS".	1 to 16 alphanumeric characters



The option to override the programmed L-MAX value by entering a smaller number allows the operator to run the same program on a **partial plate.**

For example, if the program is initially created with an L-MAX of 12 to process columns 1-12, the operator can change the L-MAX to 6 at run-time to process columns 1-6.

This program transfers sample from one 8 x 12 plate to another, matching well-for-well. With each execution of the loop, one column of tips is picked up from Station A, fluid is aspirated from one column at Station B, and fluid is dispensed to one column at Station C. L-MAX is set to 12 because there are 12 columns to be processed.

```
01 MAP: A 1-12 T RAININ_250NB 1 1
02 MAP: B 1-12 V NF_8X12STRPS 1 1
03 MAP: C 1-12 V NF_8X12STRPS 1 1
04 MAX: 12 # OF LOOPS
05 ON:  START OF LOOP
06 TIP: A 1 1 TRR
07 ASP: 120 B 1 1 A000N440
10 DSP: 120 C 1 1 DP0481040
11 OFF: END OF LOOP
12 END:
```

This program repeatedly transfers reagent from one column of a 1x4 vessel at Station B to *three* columns of an 8 x 12 plate at Station C. The loop is executed *four* times to completely process the 12 columns at Station C.

```
01 MAP: A 1-12 T RAININ_250NB 3 3
02 MAP: B 1-4 V R_1X4 3 1
03 MAP: C 1-12 V NF_8X12STRPS 1 1
04 MAX: 4 # OF LOOPS
05 ON:  START OF LOOP
06 TIP: A 1 1 TRR
07 ASP: 120 B 1 1 A000N440
08 DSP: 40 C 1 3 DP0481040
09 DSP: 40 C 2 3 DP0481040
10 DSP: 40 C 3 3 DP0481040
11 OFF: END OF LOOP
12 END:
```

Special parameters within the Tips, Aspirate, and Dispense commands tell the instrument which column to process. These parameters are discussed in detail under ***ASPIRating Fluid*** and ***DISPensing Fluid***, later in this chapter.

Nested Loops

Precision Power software is a Bio-Tek Instruments, Inc. product designed to simplify the programming of Precision and to enhance its functionality. When programs are created and run using Precision Power, it is possible to use nested loops. Contact Bio-Tek Instruments, Inc. for more information about Precision Power.

Picking up TIPS

If a program uses the pipette for fluid transfer, it needs a **TIPS command** to pick up a column of tips before aspirating fluid. TIPS is an *action* command, and its parameters include the location of the tips, how exactly to access them, and what to do with the used tips and residual fluid after a dispense.

> ❖ **Note**: You do not need a separate command to dispose of the tips.

Parameter	**Description**	**Options**
Tip Detail File	The name of the Tip Detail File to be associated with this TIPS command. The tip detail file's parameters include Put Used Tips Into and Dispense Residual Into (into rack or waste collection bin). See *Detail Files* later in this chapter for more info.	Choose from a list of existing file names
Get Tips From Station	The station to be accessed by this TIPS command.	A, B, C, D, E, or F A, B, C, or D for 12-Channel Models
Starting At Column	The first column of tips to be picked up. This is the starting point for the index (see *Indexing* in Chapter 4).	1 to 12
Increment Column By	The number to increment (or decrement) the index by, each time this command is processed in a run, to find the *next* column. Here are some examples: Starting Column = 1, Increment Column By = 1: Columns 1, 2, 3, … 12 are processed. Starting Column = 2, Increment Column By = 2: Columns 2, 4, 6, 8, 10, and 12 are processed. Starting Column = 12, Increment Column By = -1: Columns 12, 11, 10, … 1 are processed.	-12 to 12

In this example, the TIPS command is defined outside a loop containing the aspirate and dispense commands. The instrument picks up just one column of tips for the entire fluid transfer.

```
04 TIP: A 1 1 TDD
   TIP DETAIL FILE:      02 (TDD)
   GET TIPS FROM STATION: A
   STARTING AT COLUMN:    1
   INCREMENT COLUMN BY:  00
05 MAX: 12 # OF LOOPS
06 ON: START OF LOOP
07 ASP: 55 B 1 1 A000N440
08 DSP: 50 C 1 1 DP123456
09 OFF: END OF LOOP
```

> This program picks up 55 µl of fluid per well, but dispenses only 50 µl. The Tip Detail File tells the instrument where to dispense the residual fluid, into the waste collection bin, or back into the tip rack.

In this example, the TIPS command is inside a loop with the aspirate and dispense commands. The instrument will pick up one column of tips for each fluid transfer.

```
04 MAX: 12 # OF LOOPS
05 ON: START OF LOOP
06 TIP: A 1 1 TDD
   TIP DETAIL FILE:      02
   GET TIPS FROM STATION: A
   STARTING AT COLUMN:    1
   INCREMENT COLUMN BY:  01
07 ASP: 50 B 1 1 A000N440
08 DSP: 50 C 1 1 DP123456
09 OFF: END OF LOOP
```

The example program on the following page performs a sample transfer from one 384-vessel plate to another. Stations A, B, D, and E are loaded with tips; C and F each contain a 384-vessel plate. The program has four loops, one to process each box of tips. See ***Working with 384-Vessel Plates*** in ***Chapter 4*** for a more detailed explanation of this program.

```
01 MAP: A 1-12 T RAININ_250NB 1 1
02 MAP: B 1-12 T RAININ_250NB 1 1
03 MAP: C 1-48 V CSTR_384 1 1
04 MAP: D 1-12 T RAININ_250NB 1 1
05 MAP: E 1-12 T RAININ_250NB 1 1
06 MAP: F 1-48 V CSTR_384 1 1
07 MAX: 12 # OF LOOPS
08 ON:  START OF LOOP
09 TIP: A 1 01 TRR                (Station A)
   TIP DETAIL FILE:      01
   GET TIPS FROM STATION: A
   STARTING AT COLUMN:    1
   INCREMENT COLUMN BY:  01
10 ASP: 50 C 1 01 A000N440
11 DSP: 50 F 1 01 DP0481040
12 OFF: END OF LOOP
13 ON:  START OF LOOP
14 TIP: B 1 01 TRR                (Station B)
   TIP DETAIL FILE:      01
   GET TIPS FROM STATION: B
   STARTING AT COLUMN:    1
   INCREMENT COLUMN BY:  01
15 ASP: 50 C 13 01 A000N440
16 DSP: 50 F 13 01 DP0481040
17 OFF: END OF LOOP
18 ON:  START OF LOOP
19 TIP: D 1 01 TRR                (Station D)
   TIP DETAIL FILE:      01
   GET TIPS FROM STATION: D
   STARTING AT COLUMN:    1
   INCREMENT COLUMN BY:  01
```

```
20 ASP: 50 C 25 01 A000N440

21 DSP: 50 F 25 01 DP0481040

22 OFF: END OF LOOP

23 ON:  START OF LOOP
```

24 TIP: E 1 01 TRR *(Station E)*

```
   TIP DETAIL FILE:      01
   GET TIPS FROM STATION: E
   STARTING AT COLUMN:    1
   INCREMENT COLUMN BY:  01

25 ASP: 50 C 37 01 A000N440

26 DSP: 50 F 37 01 DP0481040

27 OFF: END OF LOOP

28 END:
```

ASPIRating Fluid

The **ASPIR command** tells the instrument to pick up fluid. ASPIR is an *action* command, and its parameters include where to get the fluid from, how much fluid to aspirate, which detail file to use, and how exactly to access the vessel(s) containing fluid.

It is possible, when creating a program, to select a Detail File that uses an aspirate flow rate that is incompatible with the aspirate volume. The error will be reported when a program using an incompatible combination is validated. Validation is automatic and occurs when a program is selected to be run. To avoid this error, refer to the tables in ***Appendix D*** to ensure the flow rates specified in a Detail File and the volumes specified in a program are compatible.

- **Note:** Before creating or modifying programs for 384-vessel plates, you should read ***Working with 384-Vessel Plates*** at the end of Chapter 4 to fully understand column numbering for the 16 x 24 format.

Parameter	**Description**	**Options**
Aspirate Detail File	The name of the Aspirate Detail File to be associated with this ASPIRate command. The aspirate detail file's parameters include Horizontal Aspirate Position, Pre-Air Volume, Number of Mix Cycles (and related parameters), Pick From Bottom?, Aspirate Rate, Fluid Exit Rate, and Post-Air Volume. See ***Detail Files*** later in this chapter for more info.	Choose from a list of existing file names
Aspirate Volume	The volume of fluid to pick up per tip.	0 to 120 µl/tip
From Station	The station to be accessed by this ASPIR command.	A, B, C, D, E, or F A, B, C, or D for 12-Channel Models
Starting At Column	The first column of vessel(s) to be processed. This is the starting point for the index (see ***Indexing*** in ***Chapter 4***). *The valid range is determined by the 'Number of Columns' parameter in the Vessel Specs File that is referenced by the MAP command for this station.	1 to 48*
Increment Column By	The number to increment (or decrement) the index by, each time this command is processed in a run, to find the *next* column. Here are some examples: Starting Column = 1, Increment Column By = 1: Columns 1, 2, 3, … 12 are processed. Starting Column = 2, Increment Column By = 2: Columns 2, 4, 6, 8, 10, and 12 are processed. Starting Column = 12, Increment Column By = -1: Columns 12, 11, 10, … 1 are processed.	-24 to 24

In the example below, fluid is aspirated from a column at Station B and dispensed to a column at Station C. This sequence is repeated 12 times to process all columns at Stations B and C.

```
01 MAP: A 1-1 T RAININ_250NB 1 1
02 MAP: B 1-12 V NF_8X12STRPS 1 1
03 MAP: C 1-12 V NF_8X12STRPS 1 1
04 MAX: 12 # OF LOOPS
05 ON:  START OF LOOP
06 TIP: A 1 0 TRR
07 ASP: 105 B 1 1 A000N440
   ASPIR DETAIL FILE:   05
   ASPIRATE VOLUME:    105
   FROM STATION:         B
   STARTING AT COLUMN:   1
   INCREMENT COLUMN BY: 01
08 DSP: 100 C 1 1 DP0481040
09 OFF: END OF LOOP
10 END:
```

> 
> If you need to improve the dispense accuracy, try aspirating a small amount of excess fluid. This program aspirates 105 µl/tip and dispenses 100 µl/vessel. The 5 µl residual is dispensed into the rack or the waste collection bin, as specified by the Tip Detail File.

In the following example, fluid is aspirated from a single reagent vessel at Station B and then dispensed to a strip at Station C. This sequence is repeated 12 times to process all 12 columns of Station C. Notice that one column of tips is used for the entire plate.

```
01 MAP: A 1-1 T RAININ_250NB 1 1

02 MAP: B 4-4 V R_1X4 1 1

03 MAP: C 1-12 V NF_8X12STRPS 1 1

04 TIP: A 1 0 TRR

05 MAX: 12 # OF LOOPS

06 ON:  START OF LOOP

07 ASP: 50 B 4 0 A000N440

   ASPIR DETAIL FILE:   05
   ASPIRATE VOLUME:     50
   FROM STATION:         B
   STARTING AT COLUMN:   4
   INCREMENT COLUMN BY: 00

08 DSP: 50 C 1 1 DP0481040

09 OFF: END OF LOOP

10 END:
```

> Another way to improve the dispense accuracy is to aspirate a small volume of air before aspirating fluid. This will help to force the fluid out during the dispense. Define the Pre-Air Volume in the Aspirate Detail File.

DISPensing Fluid

The **DISP command** tells the instrument to dispense fluid. DISP is an *action* command, and its parameters contain important information about the fluid dispense, including which station to dispense the fluid into, how much fluid to dispense, which detail file to use, and how exactly to access the vessel(s) containing fluid.

It is possible, when creating a program, to select a Detail File that uses a dispense flow rate that is incompatible with the dispense volume. The error will be reported when a program using an incompatible combination is validated. Validation is automatic and occurs when a program is selected to be run. To avoid this error, refer to the tables in ***Appendix D*** to ensure that the flow rates specified in a Detail File and the volumes specified in a program are compatible.

❖ **Note:** Before creating or modifying programs for 384-vessel plates, you should read ***Working with 384-Vessel Plates*** at the end of Chapter 4 to fully understand column numbering for the 16 x 24 format.

Parameter	**Description**	**Options**
Dispense Detail File	The name of the Dispense Detail File to be associated with this DISPense command. The dispense detail file's parameters include Dispensing Device (and related parameters), Horizontal Dispense Position, Dispense Height, Dispense Rate, Number of Mix Cycles (and related parameters), Fluid Exit Rate, and Post-Air Volume. See ***Detail Files*** later in this chapter for more information.	Choose from a list of existing file names
Dispense Volume	The volume of fluid to dispense per pipette tip or manifold tube.	0 to 120 µl/tip or tube
Into Station	The station to be processed by this DISP command.	A, B, C, D, E, or F A, B, C, or D for 12-Channel Models
Starting At Column	The first column of vessel(s) to be processed. This is the starting point for the index (see ***Indexing*** in ***Chapter 4***). *The valid range is determined by the 'Number of Columns' parameter in the Vessel Specs File that is referenced in the MAP command for this station.	1 to 48*
Increment Column By	The number to increment (or decrement) the index by, each time this command is processed in a run, to find the *next* column. Here are some examples: Starting Column = 1, Increment Column By = 1: Columns 1, 2, 3, … 12 are processed. Starting Column = 2, Increment Column By = 2: Columns 2, 4, 6, 8, 10, and 12 are processed. Starting Column = 12, Increment Column By = -1: Columns 12, 11, 10, … 1 are processed.	-24 to 24

In the program on the following page, reagent is transferred from one trough to a 96-vessel plate. The same set of tips is used for all dispenses.

```
01 MAP: A 1-1 T RAININ_250NB 1 1
02 MAP: B 4-4 V R_1X4 1 1
03 MAP: C 1-12 V NF_8X12STRPS 1 1
04 MAX: 12 # OF LOOPS
05 TIP: A 1 0 TRR
06 ON:  START OF LOOP
07 ASP: 100 B 4 0 A000N440
08 DSP: 100 C 1 1 DP0481040
    DISP DETAIL FILE:    05 (DP0481040)
    DISPENSE VOLUME:    100
    INTO STATION:         C
    STARTING AT COLUMN:   1
    INCREMENT COLUMN BY: 01
09 OFF: END OF LOOP
10 END:
```

In this program, fluid is transferred from one 96-vessel plate to another, matching well-for-well.

```
01 MAP: A 1-12 T RAININ_250NB 1 1
02 MAP: B 1-12 V NF_8X12STRPS 1 1
03 MAP: C 1-12 V NF_8X12STRPS 1 1
04 MAX: 12 # OF LOOPS
05 ON:  START OF LOOP
06 TIP: A 1 1 TRR
07 ASP: 50 B 1 1 A000N440
08 DSP: 50 C 1 1 DP0481040
    DISP DETAIL FILE:    05 (DP0481040)
    DISPENSE VOLUME:     50
    INTO STATION:         C
    STARTING AT COLUMN:   1
    INCREMENT COLUMN BY: 01
09 OFF: END OF LOOP
10 END:
```

> To mix the contents of the vessels after dispensing fluid, define one or more Mix Cycles in the Dispense Detail File. You can specify the number of cycles, the volume to mix, and the mix aspirate rate.

In this example, fluid is repeatedly transferred from one column of a 1 x 4 reagent vessel at Station B to *three* columns of an 8 x 12 plate at Station C. The loop contains three DISPense commands, one for each column.

```
01 MAP: A 1-12 T RAININ_250NB 3 3
02 MAP: B 1-4 V R_1X4 3 1
03 MAP: C 1-12 V NF_8X12STRPS 1 1
04 MAX: 4 # OF LOOPS
05 ON:  START OF LOOP
06 TIP: A 1 1 TRR
07 ASP: 120 B 1 1 A000N440
08 DSP: 40 C 1 3 DP0481040
    DISP DETAIL FILE:    05
    DISPENSE VOLUME:     40
    INTO STATION:         C
    STARTING AT COLUMN:   1
    INCREMENT COLUMN BY: 03
09 DSP: 40 C 2 3 DP0481040
    DISP DETAIL FILE:    05
    DISPENSE VOLUME:     40
    INTO STATION:         C
    STARTING AT COLUMN:   2
    INCREMENT COLUMN BY: 03
10 DSP: 40 C 3 3 DP0481040
    DISP DETAIL FILE:    05
    DISPENSE VOLUME:     40
    INTO STATION:         C
    STARTING AT COLUMN:   3
    INCREMENT COLUMN BY: 03
11 OFF: END OF LOOP
12 END:
```

With these Starting At Column and Increment Column By parameters:

1st time through the loop, fluid is dispensed to columns 1, 2, and 3.

2nd time through the loop, fluid is dispensed to columns 4, 5, and 6.

3rd time through the loop, fluid is dispensed to columns 7, 8, and 9.

4th time through the loop, fluid is dispensed to columns 10, 11, and 12.

Creating Programs that Use the Manifold

The manifold can be used to dispense fluid to 96- or 384-vessel plates:

- The manifold has eight or twelve dispensing tubes, which line up with the rows of a 96-vessel plate.
- When processing 384-vessel plates with 16 or 24 rows, the supply platform shifts back and forth in small steps allowing the manifold to perform two dispenses for each column. See ***Working with 384-Vessel Plates*** at the end of ***Chapter 4*** for more information.
- When dispensing from the manifold, put the DISP command inside a loop so that multiple columns are processed.

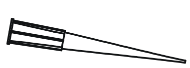
The option to use the manifold is defined by the Disp Device Is parameter in the Dispense Detail File, which is then referenced by the program's DISPense command(s):

```
01 MAP: A 1-12 V NF_8X12STRPS 1 1
02 MAX: 12 # OF LOOPS
03  ON: START OF LOOP
04 DSP: 100 C 1 1 DM1253003
05 OFF: END OF LOOP
06 END:
```

```
DISP DEVICE IS:           MANIFOLD
MANIFOLD PRIME VOLUME:         125
MANIFOLD ASPIR RATE:             3
HORIZONTAL DSP POS:              0
DISPENSE HEIGHT:                 0
DISPENSE RATE:                   3
```

Before running a program that uses the manifold, the fluid supply tubing and the manifold tubes must be primed with the dispensing fluid. There are two methods available for priming:

- Define a small prime (1 to 250 µl/tube) through the Manifold Prime Volume parameter in the Dispense Detail File, then reference the detail file name in the program's DISPense command(s). See ***Dispense Detail Files*** later in this chapter for more information.



This prime only occurs when the manifold is engaged by the execution of the dispense command. If the manifold is already engaged when the dispense command executes, the software assumes it does not need to be primed. This assumption allows for rapid dispensing to multiple plates on the supply platform. You can "force" a prime between dispense commands by inserting a DELAY command with the UNLOAD option specified. This causes the manifold to be unloaded and then re-engaged and reprimed. See ***Setting a Delay*** on page 97 for more information.

- If you need a larger prime (1 to 100 ml total) for flushing the manifold and tubing, or if you don't want to specify a prime in the dispense detail file, run the **Prime Utility** before running the program. Access this utility under the UTIL Main Menu function. See ***PRIME*** in ***Chapter 6*** for instructions.

Some sample programs are shown on the following pages. Create and run them yourself to see exactly how they work.

Program # 1 dispenses 100 µl into one 96-vessel plate at Station A:

```
01 MAP: A 1-12 V NF_8X12STRPS 1 1
   MAP INFO FOR STATION:  A
   LOAD WITH:       VESSELS
   VESSEL SPECS FILE:    01
   FIRST COLUMN TO LOAD:  1
   LAST COLUMN TO LOAD:  12
   INITIAL VOLUME:        0
   RELOAD AFTER RUN:      1
   RESET INDEX AFTER RUN: 1
02 MAX: 12 # OF LOOPS
   MAX NUMBER OF LOOPS:  12
   TEXT: # OF LOOPS
03  ON: START OF LOOP
04 DSP: 100 A 1 1 DM1250044
   DISP DETAIL FILE:     02
   DISPENSE VOLUME:     100
   INTO STATION:          A
   STARTING AT LOCATION:  1
   INCREMENT COLUMN BY:  01
05 OFF: END OF LOOP
06 END:
```

This program can easily be modified to dispense to multiple plates. For each plate, create a MAP command and add another loop, as shown below:

```
01 MAP: A 1-12 V NF_8X12STRPS 1 1
02 MAP: B 1-12 V NF_8X12STRPS 1 1      ← Plate at Station B
03 MAP: C 1-12 V NF_8X12STRPS 1 1      ← Plate at Station C
04 MAX: 12 # OF LOOPS
05  ON: START OF LOOP
06 DSP: 100 A 1 1 DM1250044
07 OFF: END OF LOOP
08  ON: START OF LOOP                  ← Loop for Station B
09 DSP: 100 B 1 1 DM1250044
10 OFF: END OF LOOP
11  ON: START OF LOOP                  ← Loop for Station C
12 DSP: 100 C 1 1 DM1250044
13 OFF: END OF LOOP
14 END:
```

Program # 2 dispenses 50 µl into a 384-vessel plate at Station A:

```
01 MAP: A 1-48 V CSTR_384 1 1
   MAP INFO FOR STATION:  A
   LOAD WITH:       VESSELS
   VESSEL SPECS FILE:    01
   FIRST COLUMN TO LOAD:  1
   LAST COLUMN TO LOAD:  48
   INITIAL VOLUME:        0
   RELOAD AFTER RUN:      1
   RESET INDEX AFTER RUN: 1
```

Note: Although this plate contains 24 physical columns, the software thinks of it as having 48 columns. Read ***Working with 384-Vessel Plates*** at the end of ***Chapter 4*** to learn more.

```
02 MAX: 48 # OF LOOPS
   MAX NUMBER OF LOOPS:  48
   TEXT: # OF LOOPS

03  ON: START OF LOOP

04 DSP: 50 A 1 1 DM1250044
   DISP DETAIL FILE:     02
   DISPENSE VOLUME:      50
   INTO STATION:          A
   STARTING AT LOCATION:  1
   INCREMENT COLUMN BY:  01

05 OFF: END OF LOOP

06 END:
```

This program can easily be modified to dispense to multiple plates. For each plate, create a MAP command and add another loop.

Program #3 shows how the manifold is used to dispense fluid and pipette tips are used to aspirate the fluid. The first loop in this program uses the manifold to dispense 100 µl into 96 vessels (8 x 12 format) at Station A. The second loop picks up tips, aspirates the fluid, then dispenses it into the waste collection bin (the Tip Detail File tells the instrument where to dispense the “residual” fluid).

```
01 MAP: A 1-12 T RAININ_250NB 1 1
   MAP INFO FOR STATION:  A
   LOAD WITH:          TIPS
   TIP SPECS FILE:       01
   FIRST COLUMN TO LOAD:  1
   LAST COLUMN TO LOAD:  12
   RELOAD AFTER RUN:      1
   RESET INDEX AFTER RUN: 1
02 MAP: B 1-12 V NF_8X12STRPS 1 1
   MAP INFO FOR STATION:  B
   LOAD WITH:       VESSELS
   VESSEL SPECS FILE:    01
   FIRST COLUMN TO LOAD:  1
   LAST COLUMN TO LOAD:  12
   INITIAL VOLUME:        0
   RELOAD AFTER RUN:      1
   RESET INDEX AFTER RUN: 1
```

```
03 MAX: 12 # OF LOOPS

04  ON: START OF LOOP

05 DSP: 100 B 1 1 DM1250044
   DISP DETAIL FILE:      02
   DISPENSE VOLUME:      100
   INTO STATION:           B
   STARTING AT LOCATION:   1
   INCREMENT COLUMN BY:   01

06 OFF: END OF LOOP

07  ON: START OF LOOP

08 TIP: A 1 1 TDR
   TIP DETAIL FILE:       02
   GET TIPS FROM STATION: A
   STARTING AT LOCATION:   1
   INCREMENT COLUMN BY:   01

09 ASP: 100 B 1 1 A000N440
   ASP DETAIL FILE:       02
   ASPIRATE VOLUME:      100
   FROM STATION:           B
   STARTING AT LOCATION:   1
   INCREMENT COLUMN BY:   01

10 OFF: END OF LOOP

11 END:
```

To mix the contents of the vessels after aspirating fluid, define one or more Mix Cycles in the Aspirate Detail File. You can specify the number of cycles, the volume to mix, and the mix dispense rate.

Modifying an Existing Program

Before modifying an existing program file, consider the following:

- Print out the contents of the file before making any modifications, in case you need to refer to the original.
- Instead of modifying an existing program, you can make a copy of it and modify the copy.
- A locked file cannot be modified, and it may be locked for a reason. You might want to copy this file, then unlock and modify the copy.
- Identify what it is you want to modify. Rather than modifying the actual program, you may need to modify a referenced specification or detail file. For example, to change the aspiration rate for a program, either change that parameter in the aspirate detail file, or reference a different aspirate detail file.

After making modifications:

- Validate the program to check for errors (via DEFINE ➔ VALIDATE).
  - ➢ If an error is detected, refer to ***Chapter 9***, ***Error Codes***.
- When your program is complete and valid, we strongly suggest that you perform a test run using deionized water. Once you are confident the program executes the way you want it to, you can go ahead and run it with real reagent or samples.

To modify an existing program:

1. From the Main Menu, select **DEFINE.** The SELECT FILE ACTIVITY screen appears:

```
SELECT FILE ACTIVITY:
CREATE EDIT  COPY   -->
```

2. Select **EDIT.** The SELECT FILE TYPE screen appears:

```
SELECT FILE TYPE:
PGRM  DETAIL SPECS
```

3. Select **PGRM.** The SELECT PROGRAM screen appears:

```
SELECT PROGRAM:        01
NAME:    SMPL96_96_100UL
```

4. If you know the program number, simply enter the number using the keypad. Otherwise, press the **Options key** to scroll through the available program names. When the correct program name appears, press the **Enter key** to select it.

The first line of the program appears. The first line is typically (but not necessarily), a MAP command, as shown in the example screen below:

```
01 MAP: A 1-12 T RAININ_
 INS    DEL    EDIT
```

5. From within this screen, you can do any of the following:

- Select **INS** to insert a new command before this one.
- Select **DEL** to delete this command.
- Select **EDIT** to edit this command.
- Press the **Enter key** to view the next command.
  - ➢ If the program has been modified, pressing the Enter key *at the END command* brings up the OK TO SAVE FILE? screen. Select YES or NO accordingly.
- Press the **Previous Screen key** to view the previous command (if there is one).
  - ➢ If the program has been modified, pressing the Enter key *at the first command* in the program brings up the OK TO SAVE FILE? screen. Select YES or NO accordingly.
- Press the **Main Menu key** to return to the Main Menu.
  - ➢ If the program has been modified, pressing the Main Menu key *at any time* brings up the OK TO SAVE FILE? screen. Select YES or NO accordingly.

The next two pages explain how to insert, delete, and edit commands.

INSerting a Command

A program file contains a list of commands, numbered sequentially starting at 01. When you choose to insert a new command, it is positioned in front of the current command. For example, if the screen shows `04 MAX: 12 # OF LOOPS` when INSert is selected, the new command is inserted in position 04, and the L-MAX command moves down to position 05.

Program before command insertion:

```
01 MAP: A 1-12 T RAININ_250NB 1 1
02 MAP: B 1-12 V NF_8X12STRPS 1 1
03 MAP: C 1-12 V NF_8X12STRPS 1 1
04 MAX: 12 # OF LOOPS
05  ON: START OF LOOP
06 TIP: A 1 1 TRR
07 ASP: 100 B 1 1 A000N330
08 DSP: 100 C 1 1 DP003030
09 OFF: END OF LOOP
10 END:
```

Program after command insertion:

```
01 MAP: A 1-12 T RAININ_250NB 1 1
02 MAP: B 1-12 V NF_8X12STRPS 1 1
03 MAP: C 1-12 V NF_8X12STRPS 1 1
04 (inserted command goes here)
05 MAX: 12 # OF LOOPS
06  ON: START OF LOOP
07 TIP: A 1 1 TRR
08 ASP: 100 B 1 1 A000N330
09 DSP: 100 C 1 1 DP003030
10 OFF: END OF LOOP
11 END:
```

To insert a command:

1. Choose to edit the program file (via DEFINE → EDIT).
2. When the file opens, press the **Enter key** until you see the command where you want to insert a new command (*in front of it)*:

```
04 MAX: 12 # OF LOOPS
 INS    DEL    EDIT
```

3. Select **INS.** The SELECT COMMAND TYPE screen appears:

```
SELECT COMMAND TYPE:
 MAP  DELAY REMARK  -->
```

   - Selecting the **arrow** presents additional commands to choose from.
   - The available command types are MAP, DELAY, REMARK, L-MAX, L-ON, L-OFF, TIPS, ASPIR, and DISP.

4. Select the desired command. The subsequent screen is command type-dependent.
5. Define the required parameters for the command. All commands and their parameters are described in the ***Creating a New Program File*** section of this chapter, starting on page 91.

DELeting a Command

When a command is deleted, it is permanently removed from the program file. All remaining commands are renumbered.

To delete a command:

1. Choose to edit the program file (via DEFINE → EDIT).
2. When the file opens, press the **Enter key** until you see the command that you want to delete:

```
04 MAP: D 1-12 NF_8X12ST
 INS    DEL    EDIT
```

3. Select **DEL.** The REMOVE FROM LIST? screen appears:

```
REMOVE FROM LIST?    YES
 YES     NO
```

4. Select **YES** to delete the command, or **NO** to keep the command.
   - If you select YES, the command is permanently deleted, and the remaining commands are renumbered accordingly.

EDITing a Command

When a command is edited, its position in the command list remains unchanged.

> ❖ **Note:** You cannot move a command to a new position in the file. If you want to reposition a command, you must INSert a new command and DELete the old one.

To edit a command:

1. Choose to edit the program file (via DEFINE → EDIT).
2. When the file opens, press the **Enter key** until you see the command that you want to edit:

```
07 ASP: 100 B 1 1 A000N3
 INS    DEL    EDIT
```

3. Select **EDIT.** The subsequent screen contains the first parameter.

```
ASPIR DETAIL FILE:    01
NAME:    A000N330
```

- Press the **Enter key** to cycle through the parameters.
- Make the desired change(s).
    - ➢ All commands and their parameters are described in the ***Creating a New Program File*** section of this chapter, starting on page 91.

Running an Existing Program

A program file contains the sequence of commands required to complete a fluid transfer, such as 'pick up tips', 'aspirate fluid', and 'dispense fluid'. When you "run" a program, you are essentially instructing the instrument to execute all of the commands in a particular program file.

Only Precision Universal models may be run as 8-or 12-channel instruments. To run in 8-or 12-channel mode, the instrument must first be configured as an 8- or 12-channel device. See ***SETUP*** in ***Chapter 6*** to learn how to configure the instrument.

The Precision can store up to 80 different program files. Each program file can reference multiple Detail and Specification files. If you are unsure about the exact contents of a particular program, detail, or specification file, you can print out the file via **DEFINE → PRINT.**

❖ **Note:** If you are running a *newly-created program for the first time*, consider executing a "test run" using deionized water in all of the vessels instead of real reagent or sample. If the program, for example, accidentally references a specification file for a 96-well plate instead of the desired 384-well plate, the tips may not line up correctly with the wells. Once the program is running perfectly, you can confidently run it with all of its intended supplies.

To run an existing program:

1. Load the station(s) with the required supplies.
    - If you are unsure what the supply requirements are for this program, go ahead and initiate the run (see step 2), then choose **PROMPTS** at the START OR SEE PROMPTS? screen.
2. Initiate the run.

- From the Main Menu, select **RUN.** The SELECT PROGRAM screen appears:

```
SELECT PROGRAM:        01
NAME:    SMPL_96_100UL
```

- If you know the program number, simply enter it using the keypad. Otherwise, press the **Options key** to scroll through the available program names. When the correct program name appears, press the **Enter key** to select it.
- At this time, the software automatically checks the validity of the program you selected. If an error is detected, the screen will change to resemble the following:

```
PGRM:    SMPL96_96_100UL
 ERR:4019 C:03 L:04 R:02
```

  - ➢ A program cannot be run if it contains an error. Turn to ***Chapter 9, Error Codes*** to look up an error code and find out how to fix the program.

- If the program is valid, the START OR SEE PROMPTS? screen will appear.

```
START OR SEE PROMPTS?
START PROMPTS
```

- If all of the necessary supplies are loaded, select **START** to start the program immediately.
- To view the supply requirements before running the program and/or to change the number of loops to be performed, select **PROMPTS.** The screen will change to resemble the following:

```
LOAD A 01-12 WITH
TIPS RAININ_250NB
```

  - ➢ This example means "Load Station A, columns 1 through 12, with Rainin tips."

- Press the **Enter key** to view the remaining supply requirements.

- If a prompt appears to change the number of loops, you can either press the **Enter key** to accept the default value, or change the number.

```
# OF LOOPS:            12
(1..12)
```

> The option to override the programmed L-MAX value by entering a smaller number allows you to run the same program on a **partial plate.**
>
> For example, if the program is initially created with a L-MAX of 12 to process columns 1-12, the operator can change the L-MAX to 6 at run-time to process columns 1-6.

  - A change here does not change the L-MAX setting in the actual program. See ***Looping*** and ***Defining a Run & Reloading Supplies*** in ***Chapter 4*** for more information.

- When the START OR SEE PROMPTS? screen reappears, if all supplies are loaded, select START to begin the program run.
- While the program is running, the opportunity to pause processing is available:

```
ACTIVE: SMPL96_96_100UL
PRESS <STOP> TO PAUSE
```

  - Pressing the **Stop key** will halt processing. The following screen will then appear:

```
PAUSED: SMPL96_96_100UL
ABORT RESUME STEP
```

    – Select **ABORT** to completely abort the run. If tips are currently engaged, they will be returned to the tip tray or will be disposed of in the waste collection container, depending on the Tip Detail File settings. All axes will home.

    – Select **RESUME** to continue running the program.

    – Select **STEP** to execute only the next action. It is possible to step through an entire program one command at a time using the STEP key.

Warning! Moving Parts. The symbol on the pipette shuttle indicates a potential for personal injury. At any given time during instrument operation, the pipette shuttle may be moving. There are potential pinch points on the mechanism, and opportunities for skin puncture with the pipette tips.

Keep hands completely out of the way of the pipette shuttle when the instrument is in operation.

3. Watch (or listen) for alerts.
   - If the program specifies a DELAY command, the screen will change to indicate when the delay has begun. Depending on how the system is configured, a "beep" may also sound. Follow the directions on the screen, if any are provided.

```
000:57 DELAYING...
PRESS <STOP> TO PAUSE
```

     - Pressing the **Stop key** puts the run into a paused mode, and the PAUSED screen will appear (see previous page). The delay timer is also cleared.

4. Re-run the program, or return to the Main Menu.
   - When the run is complete, all axes return to their home positions and the following screen appears:

```
DONE:    SMPL96_96_100UL
MENU  CONTINUE
```

     - Select **CONTINUE** to execute another run of the same program. Program indexes are reset if specified by the program, and the software continues to keep track of vessel fluid levels. (See ***Chapter 4*** for an introduction to the run, indexing, and supply reloading concepts.)

       The START OR SEE PROMPTS? screen reappears. It is strongly recommended that you select **PROMPTS**, to see if any supplies need to be reloaded. Select **START** to begin the run.

     - Select **MENU** to return to the Main Menu. All program indexes are reset, and the software is no longer keeping track of the vessel fluid levels.

Detail Files

Detail Files describe how *action commands* (TIPS, ASPIR, and DISP), should be executed in a program. The instrument uses the information from the Detail Files to know how quickly to aspirate or dispense fluid, whether to aspirate fluid from the top or bottom of a vessel, whether or not to "mix" the fluid in a vessel after dispensing, and much more. The information you put into a Detail File will to a large extent determine the accuracy, precision, and speed of your instrument when a program is running.

Detail Files also help to make program creation more efficient. If, for example, you have five different programs that all dispense using the manifold under the same conditions, you need only specify one Dispense Detail File that all five programs can reference.

Your instrument comes with many Detail Files already installed, the contents of which were optimized in Bio-Tek's testing laboratory. These files should cover a broad range of tasks you might wish to accomplish.

To create or edit a Detail File:

1. Start at the Main Menu and select **DEFINE**, then **CREATE/EDIT.** The SELECT FILE TYPE screen appears:

```
SELECT FILE TYPE:
PGRM  DETAIL  SPECS
```

2. Select DETAIL**.** The DETAIL INFO FOR screen appears:

```
DETAIL INFO FOR:
TIPS  ASPIR  DISP
```

3. Select the type of file, **TIPS**, **ASPIR**, or **DISP.**
4. If this is a new file, use the **keypad** to enter a file name, using up to 16 alphanumeric characters, then press the **Enter key.** If you are editing an existing file, press the **Options key** to scroll through the available names, then press the **Enter key** to make a selection. Subsequent screens are file type dependent.

Detail File parameters are discussed on the following pages.

Tip Detail File

Parameter	Description	Options
File Name	A unique, descriptive name for the Tip Detail File.	1 to 16 chars
Put Used Tips Into	Where to dispose of used tips. *Dump* represents the waste collection bin. *Rack* represents the original location in the tip tray.	Dump or Rack
Disp Residual Into	Where to dispense any residual fluid. This prompt only appears if Put Used Tips Into is set to Rack. *Dump* represents the waste collection bin. *Rack* represents the tip tray.	Dump or Rack
OK to Save File?	Select Yes to save the file, or No to discard the changes.	Yes or No

Aspirate Detail File

Parameter	Description	Options
File Name	A unique, descriptive name for the Aspirate Detail File.	1 to 16 chars
Horizontal Asp Pos	Horizontal Aspirate Position. This represents the left/right positioning of the tips during aspiration. When set to 0 (the default), the tips aspirate from the center of the vessel(s). A negative setting positions the tips further to the left, a positive setting positions them further to the right. The display shows the corresponding measurement in millimeters for the current setting. 0 mm represents the vessel center.	-999 to 999 quarter steps -45.674 to 45.674 mm Shift +Options key to enter negative numbers
Pre-Air Volume	Aspirate a volume of air before aspirating fluid. This can help improve dispense accuracy by forcing air, along with any remaining fluid, out of the tip and into the vessel.	0 to 120 µl/tip

Aspirate Detail File, Cont'd

Parameter	Description	Options
Number of Mix Cycles	The number of repeated aspirate/dispense sequences within a vessel to mix the solution.	0 to 20 cycles
Volume Per Cycle	The volume of fluid to aspirate/dispense per tip per mix cycle.	1 to 120 µl/tip
Mix Dispense Rate	The rate at which fluid is dispensed back into the vessel during the mix cycle(s). The same rate is used for all cycles. Select a higher rate for more vigorous mixing, a lower rate for gentler mixing. Options range from 1 to 5, where 1 = Slowest, 5 = Fastest. The display shows the corresponding µl/sec value for each option.	1 to 5 75 µl/sec to 300 µl/sec
Pick From Bottom?	If set to Yes, the tips aspirate from a position close to the bottom of the vessel. The precise location is based on the calculated Minimum Volume from the Vessel Specs file. No fluid level tracking takes place. If set to No, the tips are positioned to just below the top of the fluid level after the aspirate is complete (at a depth controlled by the system). During aspiration, the tips track the fluid level as it goes down, so they remain just below the top of the fluid. This fluid level tracking ability is based on the amount of fluid to be aspirated, the volume of fluid in the vessel prior to the aspirate, and the dimensions of the vessel.	Yes or No
Aspirate Rate	The rate at which fluid is aspirated from the vessel(s) into the pipette tips. This is also used during the mix cycle(s), if mixing is enabled. Options range from 1 to 5, where 1 = Slowest, 5 = Fastest. The display shows the corresponding µl/sec value for each option.	1 to 5 75 µl/sec to 300 µl/sec

Aspirate Detail File, Cont'd

Parameter	Description	Options
Fluid Exit Rate	The rate at which the tips move up out of the fluid. Options range from 1 to 5, where 1 = Slowest, 5 = Fastest. The display shows the corresponding mm/sec value for each option.	1 to 5 1.6 mm/sec to 38.1 mm/sec
Post-Air Volume	Aspirate a volume of air after aspirating fluid. This helps to prevent droplets from forming on the tips.	0 to 120 µl/tip
OK to Save File?	Select Yes to save the file, or No to discard the changes.	Yes or No

Dispense Detail File

Parameter	Description	Options
File Name	A unique, descriptive name for the Dispense Detail File.	1 to 16 chars
Disp Device	The dispensing device, Pipette or Manifold.	Pipette or Manifold
Manifold Prime Vol (Manifold only)	The volume of fluid used to prime the manifold tubes before dispense. The fluid comes from the supply bottle. **Note:** The prime only occurs if the manifold is not engaged when the DISPense command is executed. For example, if a program contains two DISPense commands that specify a Manifold Prime Volume > 0 *and* the manifold is not unloaded between the two commands, the prime only occurs with the first DISPense command.	0 to 250 µl/channel
Manifold Aspir Rate (Manifold only)	The rate at which the fluid will be aspirated from the supply bottle into the manifold tubes during the prime. Options range from 1 to 5, where 1 = Slowest, 5 = Fastest. The display shows the corresponding µl/sec value for each option.	1 to 5 75 to 310 µl per well per second

Dispense Detail File, Cont'd

Parameter	Description	Options
Horizontal Dsp Pos	Horizontal Dispense Position. This represents the left/right positioning of the pipette tips or manifold tubes during aspiration. When set to 0 (the default), the tips/tubes dispense at the center of the vessel(s). A negative setting positions the tips/tubes further to the left, a positive setting positions them further to the right. The display shows the corresponding measurement in millimeters for the current setting. 0 mm represents the vessel center.	-999 to 999 quarter steps -45.674 to 45.674 mm Shift +Options key to enter negative numbers
Dispense Height	Dispense Height represents the vertical positioning of the tips or tubes during a dispense. This provides the option to dispense with tips/tubes wet or dry. The default setting is 0 for both the pipette and manifold. A negative setting raises the tips/tubes, a positive setting lowers them. 0 represents the following: Best accuracy will result from a dispense height setting that leaves the tips below the surface of the liquid in the vessel. When dispensing small volumes into empty wells, it is best to dispense near the bottom of the vessel. The surface tension between the liquid and vessel bottom will pull the droplets from the pipette tips onto the surface of the vessel. *Pipette:* The tips are positioned so that they will be at the top of the fluid level after the dispense is done. This position is based on the amount of fluid to be dispensed, the volume of fluid in the vessel prior to the dispense, and the dimensions of the vessel.	-999 to 999 steps -31.718 to 31.718 mm Shift +Options key to enter negative numbers
Dispense Height	*Manifold:* The tubes are positioned high enough above the vessels so the manifold can travel as quickly as possible from column to column across the station without having to vertically adjust before and after each dispense. The display shows the corresponding measurement in millimeters for the current setting.	

Dispense Detail File, Cont'd

Parameter	Description	Options
Dispense Rate	The rate at which the fluid is dispensed from the tips/tubes into the vessel(s). This rate is also used during the mix cycle(s), if mixing is enabled. Options range from 1 to 5, where 1 = Slowest, 5 = Fastest. The display shows the corresponding µl/sec value for each option.	1 to 5 75 to 300 µl/sec
Number of Mix Cycles (Pipette only)	The number of repeated aspirate/dispense sequences within a vessel to mix the solution.	0 to 20
Volume Per Cycle	The volume of fluid to aspirate/dispense per tip per mix cycle.	1 to 120 µl/tip
Mix Aspirate Rate	The rate at which fluid is aspirated from the vessel during mixing. Select a higher rate for more vigorous mixing, a lower rate for gentler mixing. Options range from 1 to 5, where 1 = Slowest, 5 = Fastest. The display shows the corresponding µl/sec value for each option.	1 to 5 75 µl/sec to 300 µl/sec
Fluid Exit Rate (Pipette only)	The rate at which the tips move up out of the fluid. Options range from 1 to 5, where 1 = Slowest, 5 = Fastest. The display shows the corresponding mm/sec value for each option.	1 to 5 1.6 mm/sec to 38.1 mm/sec
Post-Air Volume (Pipette only)	Aspirate a volume of air after dispensing fluid. This helps to prevent droplets from forming on the tips.	0 to 120 µl/tip
OK to Save File?	Select Yes to save the file, or No to discard the changes.	Yes or No

Important! Exercise caution when adjusting the **Dispense Height**, especially if dispensing with the manifold. Do not set the Dispense Height so low that the manifold hits the tops of the vessels.

Specification Files

Specification Files contain information about the physical aspects of the tips or vessels that you are processing. The instrument uses the information from the Specification Files to determine exactly how to position the hardware components for proper operation, and to ensure the best possible results for your fluid transfer.

Specification Files also help to make program creation more efficient. If for example you have five different programs that all use the same 96-well microplate, you need only specify one Vessel Specs File that all five programs can reference.

Your instrument comes pre-installed with Specification Files for the supplied disposable pipette tips, the supplied reagent vessels, and for some commonly-used microstrips and microplates.

To create or edit Specification Files:

1. Start at the Main Menu and select DEFINE, then CREATE/EDIT.

   The SELECT FILE TYPE screen appears:

   ```
   SELECT FILE TYPE:
   PGRM  DETAIL  SPECS
   ```

2. Select **SPECS.**

   The SPECIFICATIONS FOR screen appears:

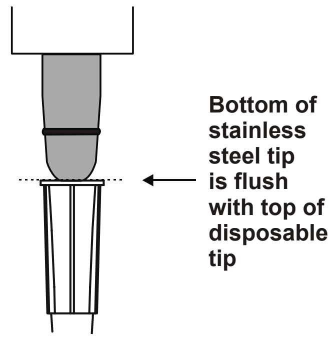
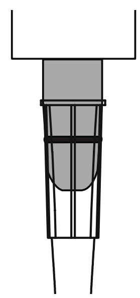
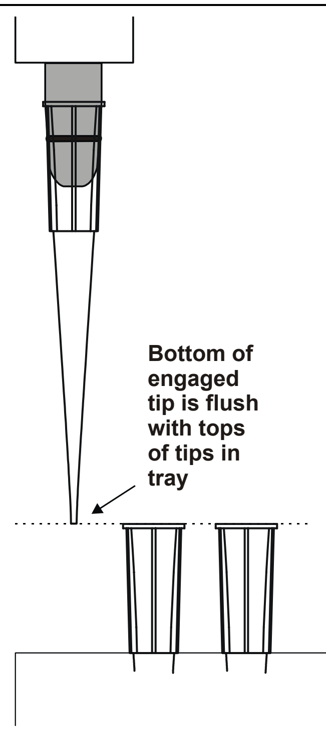
   ```
   SPECIFICATIONS FOR:
   TIPS  VESSELS
   ```

3. Select **TIPS** or **VESSELS.**
4. If this is a new file, use the **keypad** to enter a file name, using up to 16 alphanumeric characters, then press the **Enter key.** If you are editing an existing file, press the **Options key** to scroll through the available names, then press the **Enter key** to make a selection.

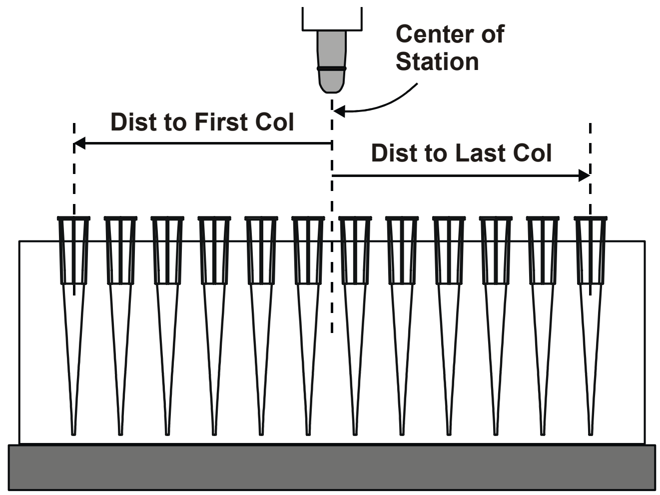
   Specification File parameters are discussed on the next five pages.

> **Important!** All distance settings in the specification files MUST be determined by using the **Spec Utility.** Instructions for using this utility are provided in ***Chapter 6***.

Tip Specification File

Parameter	Description	Options
File Name	A unique, descriptive name for the Tip Specs File.	1 to 16 chars
Tip Max Volume	The maximum volume capacity per tip. This is the actual volume capacity of the tip. It may not all be usable, due to syringe capacity.	1 to 250 µl/tip
Dist to Tip Rim	The distance the pipette must travel down until the bottom of the plunger is flush with the top of the pipette tip. Use the Spec Utility to determine this number. See ***Chapter 6***. 	-9999 to 9999 quarter steps
Dist to Engage Tip	The distance the pipette must travel down to successfully engage the tips. Use the Spec Utility to determine this number. See ***Chapter 6***. 	-9999 to 9999 quarter steps
Dist to Lift Tips	The distance the pipette must travel up after engaging the tips, until the bottoms of the engaged tips are flush with the tops of the tips in the rack. Use the Spec Utility to determine this number. See ***Chapter 6***. **Note:** The instrument internally adds a fixed number of steps to this value to ensure the engaged tips will "clear" the tops of the other tips as the pipette moves across the station. 	-9999 to 9999 quarter steps

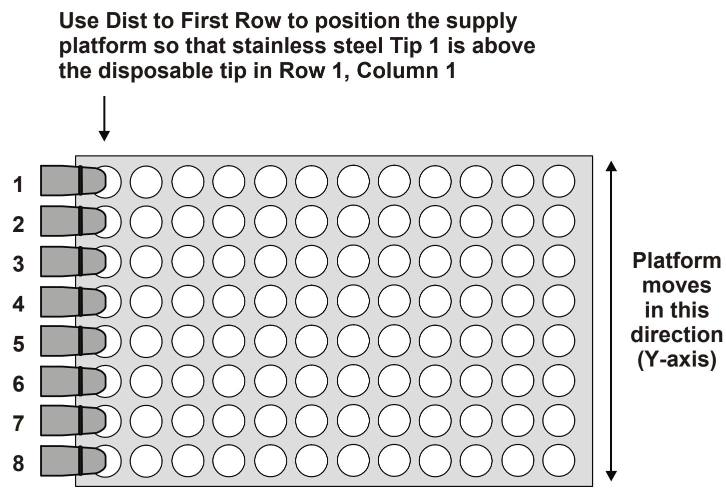
Tip Specification File, Cont'd

Parameter	Description	Options
Dist to First Col	The number of steps the pipette must travel left from the station's center to reach the center of the first column. Use the Spec Utility to determine this number (see ***Chapter 6***).  	-9999 to 9999 quarter steps
Dist to Last Col	The number of steps the pipette must travel right from the station's center to reach center of the last column. Use the Spec Utility to determine this number (see ***Chapter 6***).	-9999 to 9999 quarter steps

Tip Specification File, Cont'd

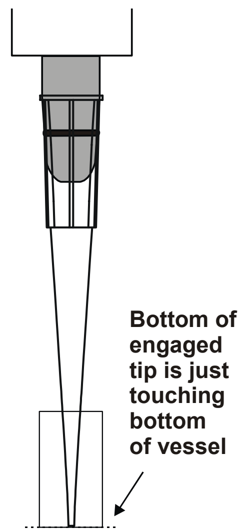
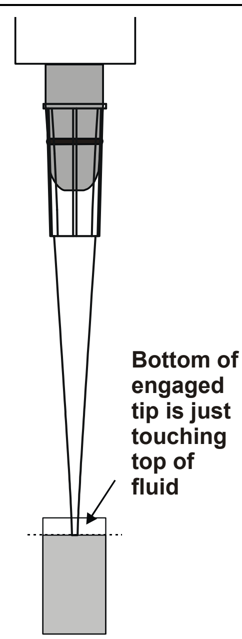
<table>
<tr><th>Parameter</th><th>Description</th><th>Options</th></tr>
<tr><td>Dist to First Row</td><td>The number of steps the supply platform must travel from a known default location to line up the stainless steel pipette tips and the disposable tips correctly.

Use the Spec utility to determine this number (see Chapter 6).

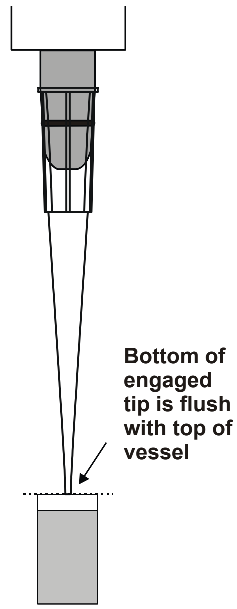


96 Tips in 8 Rows x 12 Columns</td><td>-9999 to 9999 quarter steps</td></tr>
<tr><td>OK to Save File?</td><td>Select Yes to save the file, or No to discard the changes.</td><td>Yes or No</td></tr>
</table>

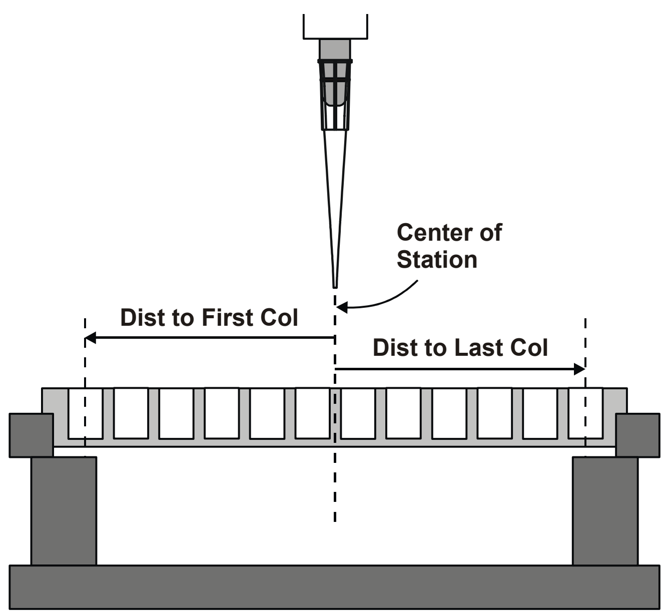
Vessel Specification File

Parameter	Description	Options
File Name	A unique, descriptive name for the Vessel Specs File.	1 to 16 chars
Volume in Units of	The unit of measure for fluid volume. UL (microliters) is typically used when referring to a vessel in a microplate or microstrip. ML (milliliters) is typically used when the referring to a vessel in a reagent trough holder.	UL or ML
Dist to Vessel Bottom	The distance the pipette must travel down until the engaged tips just touch the bottom of the vessel. Use the Spec Utility to determine this number. See ***Chapter 6***.  	-9999 to 9999 quarter steps
Vessel Maximum Vol	The maximum fluid volume the vessel can hold.	1 to 9999 µl or ml
Dist to Max Vol	The distance the pipette must travel down until the bottom of the tip is flush with the top of fluid that represents the Vessel Maximum Volume. Use the Spec Utility to determine this number. See ***Chapter 6***.  	-9999 to 9999 quarter steps

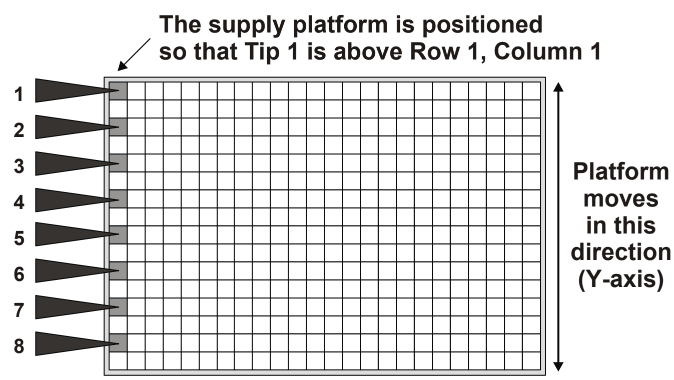
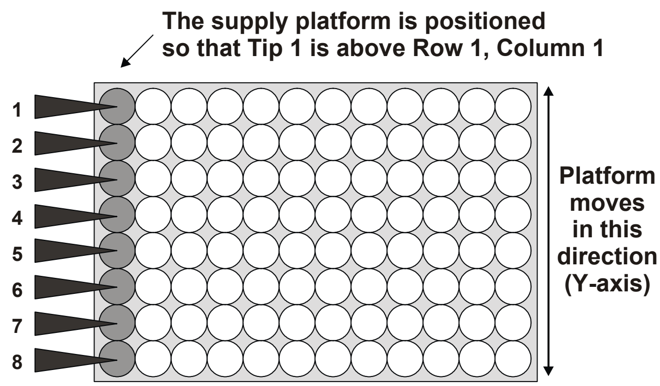
Vessel Specification File, Cont'd

Parameter	Description	Options
Dist to Vessel Top	The distance the pipette must travel down until the bottom of the tip is flush with the top of the vessel. Use the Spec Utility to determine this number. See ***Chapter 6***. 	-9999 to 9999 quarter steps
Calculated Min Vol	The software calculates this value based on the parameter values entered up to this point. This is the volume of fluid that cannot be aspirated from the vessel. If for example, a MAP command specifies an initial volume for the vessel of 300 µl and the Calculated Minimum Volume is 20 µl, the vessel has 280 µl *usable* volume.	1 to 9999 µl or ml
Number of Rows	Defines how many rows there are of this vessel type. This value determines how many tips there are per vessel, so that fluid volumes are tracked accurately. A standard 96-well microplate has 96 vessels arranged in 8 rows. A microstrip holder with six 1x8 strips has 48 vessels arranged in 8 rows. A standard 384-well plate has 384 vessels arranged in 16 rows. Bio-Tek's reagent holder has 4 vessels arranged in 1 row (if all 4 vessels are used).	1, 2, 4, 8, or 16 rows

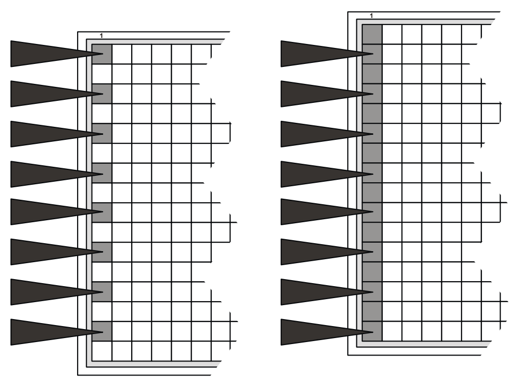
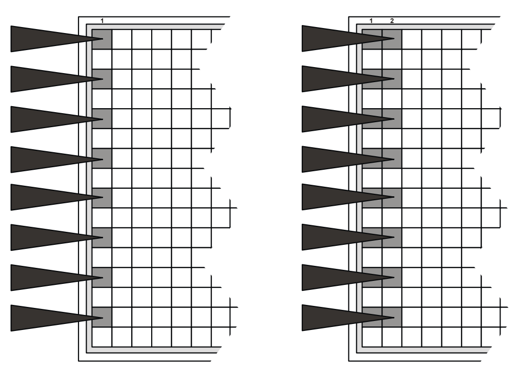
Vessel Specification File, Cont'd

Parameter	Description	Options
Number of Columns	Defines how many columns there are of this vessel type. A standard 96-well microplate has 96 vessels arranged in 12 columns. A microstrip holder with six 1x8 strips has 48 vessels arranged in 6 columns. A standard 384-well plate has 384 vessels arranged in 24 columns. Bio-Tek's reagent holder has 4 vessels arranged in 4 columns.	1 to 24 columns
Dist to First Col	The number of steps the pipette must travel *left* from the station's center to reach the center of the first column. Refer to the drawing below. Use the Spec Utility to determine this number (see ***Chapter 6***). **Note:** This number is determined with tips engaged. The software makes an internal adjustment when a program uses the manifold.  	-9999 to 9999 quarter steps

Vessel Specification File, Cont'd

Parameter	Description	Options
Dist to Last Col	The number of steps the pipette must travel *right* from the station's center to reach center of the last column. Refer to the drawing above. Use the Spec Utility to determine this number (see ***Chapter 6***). **Note:** This number is determined with tips engaged. The software makes an internal adjustment when a program uses the manifold.	-9999 to 9999 quarter steps
Dist to First Row	The number of steps the supply platform must travel from a known default location to ensure the pipette(s) and the vessel(s) line up correctly. Refer to the drawings below. Use the Spec utility to determine this number (see ***Chapter 6***).  384 Vessels in 16 Rows x 24 Columns  96 Vessels in 8 Rows x 12 Columns	-9999 to 9999 quarter steps

Vessel Specs File, Cont'd

Parameter	Description	Options
Fill Column-Wise?	This only appears if Number of Rows is 16, indicating a 384-vessel plate. Selecting Yes fills all vessels of a column before moving to the next column. The supply platform shifts after each dispense. Selecting No essentially means "fill row-wise" – fill all vessels of a row before moving to the next row. The supply platform shifts after the entire set of rows is filled. **Fill Column-Wise = YES**  **Tips dispense to vessels of Column 1 as shown** **Platform then shifts so that the remaining vessels in Column 1 can be processed** **Fill Column-Wise = NO**  **Tips dispense to vessels of Column 1 as shown** **Platform remains stationary, tips dispense to vessels of Column 2 as shown**	Yes or No
OK to Save File?	Select Yes to save the file, or No to discard the changes.	Yes or No

File Activities

Under the Main Menu option **DEFINE**, there are several functions available for manipulating program, detail, and specification files: CREATE, EDIT, COPY, DELETE, PRINT, RENAME, LOCK, and VALIDATE. With the exception of the VALIDATE function which is reserved for program files, all functions apply to all three file types. These functions are described below and on the following pages.

File names are assigned numbers and are ordered sequentially, as 01, 02, 03, and so on. This allows you to access a file by entering its number, as an alternative to pressing the Options key to cycle through the list of names. When a new file is created (via CREATE or COPY), it is added to the list of files in the *first available location*. The first available location may be at the end of the file list (ex. number 10 following files 01 through 09), or it may take the place of a file that was recently deleted. For example, let's say you have ten program files. If you delete the file in location 05, the remaining nine files are reordered as 01 through 09, but the "space" that the deleted file occupied in memory still exists. If you create a new file, it takes that open space and becomes number 05, and the files are again reordered.

> If you use file numbers to access files, consider printing an updated list of all file names and their locations (select **UTIL, LIST, YES**).

CREATE

CREATE is used to create a new file (COPY can also be used to create a new file).

- A newly created file is added to the appropriate file list in the first available location.
- The on-board software can store up to 80 program files, 80 detail files, and 80 specification files.
- For Precision Universal instruments, it is important to know if the instrument is configured as an 8- or 12-channel device before creating a program. The software will configure the new program according to the instrument configuration at the time the program is created. To check or change the instrument configuration, select **UTIL**, **SETUP**, →, and **8/12**.

To create a new file:

1. Start at the Main Menu and select **DEFINE**, **CREATE.** The SELECT FILE TYPE screen appears.

```
SELECT FILE TYPE:
PGRM   DETAIL   SPECS
```

2. Select a file type of **PGRM**, **DETAIL**, or **SPECS.**
   - If you selected **DETAIL**, select **TIPS**, **ASPIR**, or **DISP** from the DETAIL INFO FOR screen.
   - If you selected **SPECS**, select **TIPS** or **VESSELS** from the SPECIFICATIONS FOR screen.
3. The file name entry screen appears. Use the keypad to enter a unique name for the file:

```
NAME:      _
ALPHA    NUM    SYMBOL
```

   - A file name can contain any combination of up to 16 alphanumeric characters and symbols:
     - Letters A-Z, and space
     - Numbers 0 to 9
     - Symbols _ # & % / * + - = : ; . , ! @ ? ( ) [ ] { } < >
   - The default character type is **ALPHA.** Select **NUM** to change the character type to numeric. Select **SYMBOL** to change the character type to symbols.
   - Pressing the **Options key** cycles forward through the list of available characters, **Shift+Options** cycles backward through the list.
   - To enter a **space**, press the **right arrow key** to move the cursor to the right.
   - To clear all characters, press the **Clear key.**
4. When the name entry is complete, press the **Enter key** to continue. Subsequent screens are file type-dependent.
     - If the system "beeps", the file name already exists. The file name must be unique for the file type.

EDIT

EDIT can be used to change or view the parameters of an existing program, detail, or specification file.

- Editing a file does not change its position in the file sequence. For example, if you edit the program in position 09, it remains at position 09.
- If a file is "locked," its contents can be viewed but they cannot be edited.

To edit an existing file:

1. Start at the Main Menu and select **DEFINE**, **EDIT.** The SELECT FILE TYPE screen appears.

```
SELECT FILE TYPE:
PGRM  DETAIL  SPECS
```

2. Select a file type of **PGRM**, **DETAIL**, or **SPECS.**
   - If you selected **DETAIL**, select **TIPS**, **ASPIR**, or **DISP** from the DETAIL INFO FOR screen.
   - If you selected **SPECS**, select **TIPS** or **VESSELS** from the SPECIFICATIONS FOR screen.
3. The file name selection screen appears. Select a file:

```
ASPIR DETAIL FILE:     01
NAME:    A000N440
```

   - If you know the **number** of the file you're looking for, use the keypad to enter it.
   - Press the **Options key** to cycle through the available file names.
   - When the desired file name appears, press the **Enter key** to select it. Subsequent screens are file type-dependent.
     - If the "LOCKED! WON'T SAVE EDITS <ENTER> TO CONTINUE" message appears, the file is locked and its contents are available for viewing only. See *LOCK* later in this section for information on unlocking files.

COPY

An existing file can be copied into a new file and given a different name. This is particularly useful if you are creating several files with very similar parameter settings.

- A newly copied file is added to the appropriate file list, in the first available location.
- If you copy a locked file, the new file will also be locked. See *LOCK* later in this section for information on unlocking files.

- If the instrument is a Precision Universal, be sure to check if the instrument is configured as an 8- or 12-channel device before proceeding to copy. The software designates the new program as 8 or 12 according to the configuration of the instrument at the time the new program was created. To check or change the configuration, select **UTIL**, **SETUP**, →, and **8/12**.

  Note that this is not true for SPECS files. SPECS files remain 8 or 12 regardless of the instrument configuration when copied.

To copy a file:

1. Start at the Main Menu and select **DEFINE**, **COPY.** The SELECT FILE TYPE screen appears.
2. Select a file type of **PGRM**, **DETAIL**, or **SPECS.**
   - If you selected **DETAIL**, select **TIPS**, **ASPIR**, or **DISP** from the DETAIL INFO FOR screen.
   - If you selected **SPECS**, select **TIPS** or **VESSELS** from the SPECIFICATIONS FOR screen.
3. The file name selection screen appears. Select the file that you want to copy:

```
SELECT PROGRAM:          01
NAME:    REAG96_100UL
```

   - If you know the **number** of the file you're looking for, use the keypad to enter it.
   - Press the **Options key** to cycle through the available file names.
   - When the desired file name appears, press the **Enter key** to select it.
4. The file name entry screen appears. Use the keypad to enter a unique name for the new file:

```
NAME:     _
ALPHA   NUM   SYMBOL
```

   - A file name can contain any combination of up to 16 alphanumeric characters and symbols:
     - Letters A-Z, and space
     - Numbers 0 to 9
     - Symbols _ # & % / * + - = : ; . , ! @ ? ( ) [ ] { } < >

- The default character type is **ALPHA.** Select **NUM** to change the character type to numeric. Select **SYMBOL** to change the character type to symbols.
- Pressing the **Options key** cycles forward through the list of available options, **Shift+Options** cycles backward through the list.
- To enter a **space**, press the **right arrow key** to move the cursor to the right.
- When the name entry is complete, press the **Enter key** to continue.
  - If the system "beeps," the file name already exists. The file name must be unique for the file type.

5. Select **YES** to copy the file, or **NO** to cancel the procedure.

```
OK TO COPY FILE?      YES
 YES    NO
```

DELETE

DELETE is used to permanently remove a file from the on-board software's memory.

- When a file is deleted, the remaining files are reordered.
- A detail or specification file cannot be deleted if it is "in use" by a program file.
- A locked file cannot be deleted.

To delete a file:

1. Start at the Main Menu and select **DEFINE**, **DELETE**. The SELECT FILE TYPE screen appears.
2. Select a file type of **PGRM**, **DETAIL**, or **SPECS.**
   - If you selected **DETAIL**, select **TIPS**, **ASPIR**, or **DISP** from the DETAIL INFO FOR screen.
   - If you selected **SPECS**, select **TIPS** or **VESSELS** from the SPECIFICATIONS FOR screen.
3. The file name selection screen appears. Select a file:

```
TIP SPECS FILE:        01
NAME:    RAININ_250NB
```

   - If you know the **number** of the file you're looking for, use the keypad to enter it.

- Press the **Options key** to cycle through the available file names.
- When the desired file name appears, press the **Enter key** to select it.
  - ➢ If the message "CAN'T DELETE, IN USE BY PGRM: xxxxx" appears, the spec or detail file is currently referenced by the displayed program file, and it cannot be deleted. Press the **Enter key** to return to the SELECT FILE ACTIVITY screen.
  - ➢ If the message "CAN'T DELETE LOCKED FILE <ENTER> TO CONTINUE" appears, the file is locked and cannot be deleted. Press the **Enter key** to return to the SELECT FILE ACTIVITY screen. See ***LOCK*** on page 149 for information on unlocking files.

4. Select **YES** to permanently delete the file, or **NO** to cancel the procedure.

```
OK TO DELETE FILE?   YES
 YES    NO
```

PRINT

The contents of any file can be sent to a printer attached to the instrument's parallel port.

- Program files can be printed in a *short* format (just the command lines), or a *long* format (command lines with the full descriptions). To switch between the short and long format, select **UTIL**, **SETUP**, then **PRINT.** At the PGRM IN LONG FORMAT? prompt, select **YES** for long format or **NO** for short.

> A list of all file names and their current positions can be printed by selecting **UTIL**, **LIST**, **YES.**

To print the contents of any file:

1. Connect the printer to the parallel port of the instrument. Make sure the printer is online and contains paper.
2. Start at the Main Menu and select **DEFINE**, **PRINT.** The SELECT FILE TYPE screen appears.
3. Select a file type of **PGRM**, **DETAIL**, or **SPECS.**
   - If you selected **DETAIL**, select **TIPS**, **ASPIR**, or **DISP** from the DETAIL INFO FOR screen.
   - If you selected **SPECS**, select **TIPS** or **VESSELS** from the SPECIFICATIONS FOR screen.

4. The file name selection screen appears. Select a file:

```
SELECT PROGRAM:         03
NAME:     SMPL96_96_100UL
```

- If you know the **number** of the file you're looking for, use the keypad to enter it.
- Press the **Options key** to cycle through the available file names.
- When the desired file name appears, press the **Enter key** to select it. The report will print.

Here is a sample program file printout, in the short format:

```
File Type: PROGRAM      File Name: SMPL96_96_100UL

01 MAP: A 1-12 T RAININ_250NB 1 1

02 MAP: B 1-12 V NF_8X12STRPS 1 1

03 MAP: C 1-12 V NF_8X12STRPS 1 1

04 MAX: 12 # OF LOOPS

05  ON: START OF LOOP

06 TIP: A 1 1 TDD

07 ASP: 110 B 1 1 A000N440

08 DSP: 100 C 1 1 DP0484040

09 OFF: END OF LOOP

10 END:
```

RENAME

The name of any file can be changed.

- The renaming of a file does not affect its contents, or its position in the sequence of files.
  For example, if you rename the program file in position 05, it remains at position 05.
- If a detail or specification file is renamed, any programs that reference that file automatically update to reflect the name change.
- A locked file cannot be renamed (it must be unlocked first).

To rename a file:

1. Start at the Main Menu and select **DEFINE**, **RENAME.** The SELECT FILE TYPE screen appears.
2. Select a file type of **PGRM**, **DETAIL**, or **SPECS.**
   - If you selected **DETAIL**, select **TIPS**, **ASPIR**, or **DISP** from the DETAIL INFO FOR screen.
   - If you selected **SPECS**, select **TIPS** or **VESSELS** from the SPECIFICATIONS FOR screen.
3. The file name selection screen appears. Select a file:

```
ASPIR DETAIL FILE:     07
NAME:     A000N550
```

   - If you know the **number** of the file you're looking for, use the keypad to enter it.
   - Press the **Options key** to cycle through the available file names.
   - When the desired file name appears, press the **Enter key** to select it.
4. The file name entry screen appears. Use the keypad to enter a unique name for the file:

```
NAME:       _
ALPHA   NUM   SYMBOL
```

   - A file name can contain any combination of up to 16 alphanumeric characters and symbols:
     - ➢ Letters A-Z, and space
     - ➢ Numbers 0 to 9
     - ➢ Symbols _ # & % / * + - = : ; . , ! @ ? ( ) [ ] { } < >
   - The default character type is **ALPHA.** Select **NUM** to change the character type to numeric. Select **SYMBOL** to change the character type to symbols.
   - Pressing the **Options key** cycles forward through the list of available options, **Shift+Options** cycles backward through the list.
   - Pressing the **Clear key** deletes all of the characters.
   - To enter a **space**, press the **right arrow key** to move the cursor to the right.
   - When the name entry is complete, press the **Enter key** to continue.

- If the message "CAN'T RENAME LOCKED FILE <ENTER> TO CONTINUE", the file is locked and cannot be renamed. Press the **Enter key** to return to the SELECT FILE ACTIVITY screen.
- If the system "beeps", the file name already exists. The file name must be unique for the file type.

5. Select **YES** to rename the file, or **NO** to cancel the procedure.

```
OK TO RENAME FILE?   YES
 YES    NO
```

LOCK

The software provides a basic method for protecting files from inadvertent modification, renaming, or deletion. No passwords are required to change a file's protection setting.

- A detail or specification file can be locked or unlocked even if it is in use by a program file.
- If a locked file is copied, the copy is also locked.

To lock or unlock a file:

1. Start at the Main Menu and select **DEFINE**, **LOCK.** The SELECT FILE TYPE screen appears.
2. Select a file type of **PGRM**, **DETAIL**, or **SPECS.**
   - If you selected **DETAIL**, select **TIPS**, **ASPIR**, or **DISP** from the DETAIL INFO FOR screen.
   - If you selected **SPECS**, select **TIPS** or **VESSELS** from the SPECIFICATIONS FOR screen.
3. The file name selection screen appears. Select a file:

```
VESSEL SPECS FILE:    03
NAME:    CSTR_384
```

   - If you know the **number** of the file you're looking for, use the keypad to enter it.
   - Press the **Options key** to cycle through the available file names.
   - When the desired file name appears, press the **Enter key** to select it.
4. Select **LOCK** to lock the file, or **UNLOCK** to unlock it.

```
SET FILE PROTECTION:
 LOCK UNLOCK
```

5. Select **YES** to save the file, or **NO** to cancel the procedure.

```
OK TO SAVE FILE?      YES
 YES    NO
```

VALIDATE

The software provides a utility to ensure the validity of program files before they are actually run. This utility also executes automatically when you choose to run a program. *A program must be error-free before you can run it.*

During validation, the software runs the program in a simulation mode, checking to see if:

- The syntax of the program is correct.
- Supplies are mapped legally for a station.
- All indices are calculated within the “mapped” range.
- All volumes are within a “valid” range.

> ❖ **Note:** The validation utility does not know what your desired procedure is, and therefore cannot verify or evaluate your program for applicability. If your program is free of errors, consider running it once with deionized water to make sure that it works the way you want it to.

When validation is complete, either the “`PROGRAM IS VALID`” message or an error code is displayed. If the program is valid, it is ready to be run. See ***Chapter 9*** for information on error codes and their probable causes.

To validate a program:

1. Start at the Main Menu and select **DEFINE**, **VALIDATE.**
2. The SELECT PROGRAM screen appears. Select a program file:

```
SELECT PROGRAM:        03
NAME:    SMPL96_96_100UL
```

- If you know the **number** of the file you’re looking for, use the keypad to enter it.
- Press the **Options key** to cycle through the available file names.
- When the desired file name appears, press the **Enter key** to select it.

3. When validation is complete, one of two screens will appear:

```
PGRM:    SMPL96_96_100UL
PROGRAM IS VALID.
```

- No errors were detected. You can run the program.

```
PGRM:    SMPL96_96_100UL
 ERR:4019 C:08 L:07 R:01
```

- One or more errors were detected. The error(s) must be fixed before the program can be run. See ***Program Validation Error Codes*** in ***Chapter 9*** for assistance with fixing your program.

Chapter 6

Utilities

This chapter describes the on-board utilities, available under the Main Menu option UTIL.

TESTS

The Self Test and the Checksum Test are performed automatically whenever the instrument is turned on. They can also be performed manually through the Main Menu.

- The **Self Test** checks the movement of the pipette shuttle, syringes, and supply platform.
- The **Checksum Test** displays part number and version information for the software currently loaded on the instrument. This information is useful when contacting Bio-Tek for technical assistance.

To run the system tests:

1. From the Main Menu, select **UTIL.** The SELECT UTILITY screen appears.

```
SELECT UTILITY:
TESTS SETUP  LIST    -->
```

2. From the Select Utility screen, select **TESTS.** The SELECT A SYSTEM TEST screen appears.

```
SELECT A SYSTEM TEST:
SYSTEM CHKSUM
```

3. Select **SLFCHK** to run the Self Test, or **CHKSUM** to run the Checksum Test.
   - When the Self Test is run and no errors are detected, the software briefly displays “SYSTEM TEST PASS,” and then returns to the Main Menu. If an error is detected, the instrument “beeps” and displays an error code. See ***Chapter 9***, ***Error Codes*** for more information.
   - When the Checksum Test is run, the following information displays:

```
7110200     VERSION 1.00
CODE CHECKSUM:     (085D)
```

The **on-board (basecode) software** part number, version number, and checksum display first.

After a few moments, a second screen appears:

```
7110203-FW  V1.00.00
```

The second screen shows the **configuration software** part number and version number. After a few moments, the software returns to the Main Menu.

SETUP

A few system configuration parameters can be viewed or changed with the Setup utility. They include system "beeps" to alert the operator to the start of a delay or the end of a run, a specialized manifold backlash parameter, and the option to print a program's contents in the short or long format.

Alerts

To view or edit the current system alerts, start at the Main Menu and select **UTIL**, then **SETUP.** The EDIT SETUP FOR screen appears:

```
EDIT SETUP FOR:
ALERTS PRINT  TIPS
```

- Select **ALERTS.** The USE DELAY ALERTS? screen appears first:

```
USE DELAY ALERTS?    YES
 YES     NO
```

  - ➢ Select **YES** to enable an audible alert at the start of a delay. YES is the default selection.
  - ➢ Select **NO** to disable the audible alert.

❖ **Note:** The keypad display always provides a *visual* alert, regardless of the selection made here.

- The END-OF-RUN ALERT? screen appears next:

```
END-OF-RUN-ALERT?    YES
 YES     NO
```

  - ➢ Select **YES** to enable an audible alert at the end of a program run. YES is the default selection.
  - ➢ Select **NO** to disable the audible alert.

❖ **Note:** The keypad display always provides a *visual* alert, regardless of the selection made here.

Manifold Backlash (BKLSH)

Manifold Backlash is a configurable adjustment for the manifold syringe pump that has a direct effect on dispensing precision. The initial setting is determined by the factory specifically for each instrument and it should not require adjustment. The backlash parameter is, however, made accessible through the software in the unlikely event that an adjustment is required. *Do not change this setting unless instructed to by Bio-Tek Instruments.*

To view or edit the manifold backlash setting, start at the Main Menu and select **UTIL**, **SETUP**, then **––>.** The EDIT SETUP FOR screen appears:

```
EDIT SETUP FOR:
ALERTS PRINT  TIPS -->
```

```
EDIT SETUP FOR:
BKLASH 8/12        -->
```

- Select **BKLASH.** The MANIFOLD BACKLASH screen appears:

```
MANIFOLD BACKLASH:     7
(0..200)       FULL STEPS
```

➢ The valid range is from 0 to 200 full steps.

8- or 12-Channel Mode

Only the Precision Universal model may be run as an 8- or 12-channel instrument. The Universal model has two platforms: a 6-station platform for 8-channel operation, and a 4-station platform for 12-channel operations. The Universal also has an 8-channel manifold and 12-channel manifold.

To run the instrument in these two modes, you must first install the proper platform and manifold for either 8- or 12-channel operation, then follow the procedure below to switch between 8- and 12-channel software.

- Start at the Main Menu and select **UTIL**, **SETUP**, then **––>**. The EDIT SETUP FOR screen will appear:

```
EDIT SETUP FOR:
ALERTS PRINT  TIPS -->
```

- Select **-->**. The BKLASH 8 / 12 screen appears:

```
EDIT SETUP FOR:
BKLASH 8/12          -->
```

- Select **8 / 12**. The NUMBER OF CHANNELS screen appears:

```
NUMBER OF CHANNELS:     8
  8      12          -->
```

- Select **8 or 12** to set the mode in which the dispenser will run; for example, 8:
  - At the NUMBER OF CHANNELS screen, selecting 8 or 12 will bring you back to the BKLASH 8 / 12 screen. Press the Main Menu key to return to the Main Menu.

```
EDIT SETUP FOR:
BKLASH 8/12          -->
```

PRINT Format for Programs

The contents of any file can be printed via DEFINE, PRINT (see ***File Activities*** in ***Chapter 5***). The contents of program files can be printed in a short or a long format. To change the format, start at the Main Menu and select **UTIL**, then **SETUP.** The EDIT SETUP FOR screen appears:

```
EDIT SETUP FOR:
ALERTS BKLSH PRINT
```

- Select **PRINT.** The PGRM IN LONG FORMAT? screen appears:

```
PGRM IN LONG FORMAT? YES
 YES  NO
```

  - Select **YES** to print the program file report in the long format.
  - Select **NO** to print the program file report in the short format.
  - See the sample reports on the next page.

Sample program file report in the SHORT format:

```
File Type: PROGRAM      File Name: SMPL96_96_100UL

01 MAP: A 1-12 T RAININ_250NB 1 1
02 MAP: B 1-12 V NF_8X12STRPS 1 1
03 MAP: C 1-12 V NF_8X12STRPS 1 1
04 MAX: 12 # OF LOOPS
05  ON: START OF LOOP
06 TIP: A 1 1 TRR
07 ASP: 110 B 1 1 A000N440
08 DSP: 100 C 1 1 DP0484040
09 OFF: END OF LOOP
10 END:
```

Sample program file report in the LONG format:

```
File Type: PROGRAM      File Name: SMPL96_96_100UL

01 MAP: A 1-12 T RAININ_250NB 1 1
   MAP INFO FOR STATION:  A           A     B     C
   LOAD WITH:           TIPS         TIPS  VESSELS
   TIP SPECS FILE:        01         NAME:   RAININ_250NB
   FIRST COLUMN TO LOAD:  1          (1..12)
   LAST COLUMN TO LOAD:  12          (1..12)
   RELOAD AFTER RUN:      1          (1..99)
   RESET INDEX AFTER RUN: 1          (1..99)

02 MAP: B 1-12 V NF_8X12STRPS 1 1
   MAP INFO FOR STATION:  B           A     B     C
   LOAD WITH:        VESSELS         TIPS  VESSELS
   VESSEL SPECS FILE:    01          NAME:   NF_8X12STRPS
   FIRST COLUMN TO LOAD:  1          (1..12)
   LAST COLUMN TO LOAD:  12          (1..12)
   INITIAL VOLUME:      200          (0.. 350)
   RELOAD AFTER RUN:      1          (1..99)
   RESET INDEX AFTER RUN: 1          (1..99)
```

```
03 MAP: C 1-12 V NF_8X12STRPS 1 1
   MAP INFO FOR STATION:  C            A     B     C
   LOAD WITH:       VESSELS         TIPS  VESSELS
   VESSEL SPECS FILE:    01         NAME:   NF_8X12STRPS
   FIRST COLUMN TO LOAD:  1         (1..12)
   LAST COLUMN TO LOAD:  12         (1..12)
   INITIAL VOLUME:        0         (0.. 350)
   RELOAD AFTER RUN:      1         (1..99)
   RESET INDEX AFTER RUN: 1         (1..99)

04 MAX: 12 # OF LOOPS
   MAX NUMBER OF LOOPS:  12         (1..99)
   TEXT: # OF LOOPS

05  ON: START OF LOOP
```

LIST

To print a comprehensive list of the current program, detail, and specification files:

- Make sure a printer is connected to the instrument's parallel port, and the printer is online and contains paper.
- From the Main Menu, select **UTIL** then **LIST.** The list will print, and it will resemble the following:

```
File Type: PROGRAM

  01: REAG96_100UL
  02: REAG384_50UL
  03: SMPL96_96_100UL
  04: SMPL96_96DIL10_1
  05: SMPL384_384_20UL
  06: MAN96_100UL

File Type: QC

  01: SEALCHECK
  02: PIP96_100UL_X6
  03: PIP96_50UL_X3
  04: PIP96_38UL_X3
  05: PIP96_25UL_X3

File Type: TIP DETAIL

  01: TRR
  02: TDD

File Type: ASPIRATE DETAIL

  01: A000N140
  02: A000N440
  03: A000N445
  04: A050N345
  05: A0100N445
```

```
File Type: DISPENSE DETAIL

  01: DM1250044
  02: DM1250033
  03: DP0481040
  04: DP0485040
  05: DP0484145

File Type: TIP SPECIFICATION

  01: RAININ_250NB

File Type: VESSEL SPECIFICATION

  01: NF_8X12STRPS
  02: R_1X4
  03: CSTR_384
```

HOME

If for any reason one or more axes need to be returned to their home positions, you can either turn the instrument off/on, or run the Home utility.

To run the **Home** utility:

1. Make sure there are no obstructions in the way of any axis.
2. From the Main Menu, select **UTIL.**
3. From the SELECT UTILITY screen, select the arrow **(-->)** until the **HOME** option appears, then select it. The following screen will appear.

```
ABOUT TO HOME EACH AXIS,
PRESS <ENTER> TO START.
```

4. Press the **Enter key** to start the homing process.

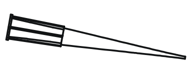
```
AXIS HOMING IN PROGRESS,
PLEASE WAIT...
```

5. When the homing is complete, the SELECT UTILITY screen reappears. Press the **Main Menu key** to return to the Main Menu.

Specification Utility (SPECS)

During program execution, the instrument needs to know some information about the supplies loaded on the different stations, in order to process them correctly. For example, if one of the stations is loaded with tips, the instrument needs to know how far the pipette shuttle must travel down to successfully engage the tips, and how far it must travel up with the tips engaged to "clear" the tops of the tips remaining in the tray.

The MAP commands in a program reference Tip and Vessel Specification Files that contain information on the physical characteristics of the tips and vessels. The instrument's on-board software is pre-programmed with specification files for Rainin and Labcon tips, Bio-Tek's reagent trough, and some commonly used microstrips/microplates. You may, however, want to create specification files for different tips and/or vessels.



Tip: To view the specification files that are installed on your instrument, start at the Main Menu and select **DEFINE**, **EDIT**, **SPECS**, then **TIPS** or **VESSELS.** Press the **Options key** to cycle through the available spec file names. Press the **Enter key** to view the contents of a particular file.

Do not edit the specification files that were shipped with your instrument!

When you create a new Tip or Vessel Specification File (via DEFINE ➔ CREATE ➔ SPECS), the software asks for the following information about the tip or vessel:

Tip Specs File parameters:	Vessel Specs File parameters:
Tip Max Volume	**Volume in Units of**
Distance to Tip Rim	*Distance to Vessel Bottom*
Distance to Engage Tip	**Vessel Maximum Volume**
Distance to Lift Tips	*Distance to Maximum Volume*
Distance to First Column	*Distance to Vessel Top*
Distance to Last Column	**Number of Rows**
Distance to First Row	**Number of Columns**
	Distance to First Column
	Distance to Last Column
	Distance to First Row
	Fill Column-Wise?

The parameters shown above in *italic* text tell the instrument exactly how to position the pipette, manifold, and supply station during program execution. *You MUST use the Specification Utility to determine the settings for these parameters.*

> **Important!** The accuracy of the settings of all of these parameters is critical to ensuring successful instrument performance. You can read more about Specification Files in ***Chapter 5***.

Measuring Specs

Before using a new type of tip or vessel in a fluid transfer program, you need to "take measurements", and then enter those measurements in a Tip or Vessel Specification File. The **Spec Utility** is your measuring tool. It helps you to precisely record the distance in steps from internally known positions to important reference positions. For example, when you're measuring for the *Distance to First Column* parameter for a vessel, you are measuring the number of steps the pipette shuttle must travel from the center of the station to the center of the first column of vessels.

The Spec Utility consists of a set of selectable commands (called Move Types) to move the pipette shuttle in different directions, and a mechanism for keeping track of the current positions of the pipette shuttle and supply platform as you step them along a particular axis.

- Your goal when measuring specs for **tips** is to ensure that when you run a program, the stainless steel pipette tips line up and mate correctly with the disposable pipette tips.
- Your goal when measuring specs for **vessels** is to ensure that when you run a program, the manifold tubes or disposable pipette tips access the vessels the way you want them to.

To access the Spec Utility:

1. From the Main Menu select **UTIL**, the **arrow**, and then **SPECS.** The MEASURE SPECS FOR screen appears:

```
MEASURE SPECS FOR:
TIPS  VESSELS
```

2. Select **TIPS** or **VESSELS.**

- When you select *TIPS*, the following screen appears:

```
SEE OPERATOR'S MANUAL TO
LOAD STATION A WITH TIPS
```

  - Load Station A with the required number of tips (tip requirements vary, see pages 172 through 180).
  - Press the **Enter key** to continue. The TYPE OF MOVE screen appears. See step 3.

- When you select *VESSELS*, the following screen appears:

```
TIP SPECS FILE        01
NAME: RAININ_250NB
```

  - Select the Tip Specs File for the tips that you will be using to measure vessel specs. The tips are used as "pointers" to help with your measurements. Press the **Enter key** to continue or press the **Options key** to select a different Tip Specs File.

    The first of two prompts appears:

```
LOAD TIPS INTO FIRST
COLUMN OF STATION A
```

    Load the first column of Station A with tips. Press the **Enter key** to continue. The second of two prompts appears:

```
LOAD VESSELS INTO ALL
COLUMNS OF STATION C
```

  - Load all columns of Station C with vessels. Press the **Enter key** to continue. The TYPE OF MOVE screen appears.

3. Select a **command** from the TYPE OF MOVE screen. See the table below for command descriptions.

   This is the screen that appears if TIPS was selected. Select the arrow to see additional options UP/DN, LFT/RT, and BCK/FWD.

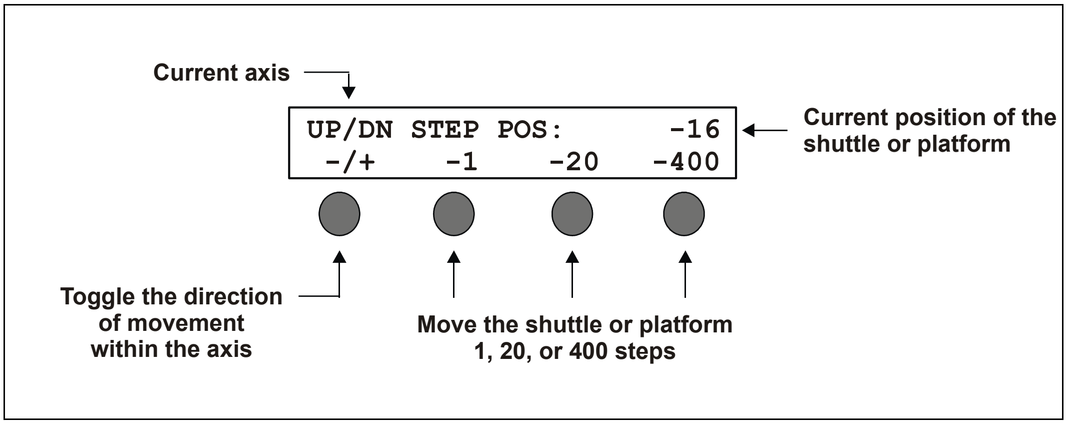
```
TYPE OF MOVE:
STA-A EJECT          -->
```

   This is the screen that appears if VESSELS was selected. Select the arrow to see additional options UP/DN, LFT/RT, and BCK/FWD.

```
TYPE OF MOVE:
T-GET STA-C T-PUT    -->
```

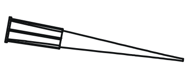
Move Type Command	**Available for**	**Description**
STA-A	Tips	Moves the pipette shuttle so that it is positioned over the center of Station A.
EJECT	Tips	Strips the tips off the pipette when you're done with them.
T-GET	Vessels	Picks up a column of pipette tips.
STA-C	Vessels	Moves the pipette shuttle so that it is positioned over the center of Station C.
T-PUT	Vessels	Moves the pipette shuttle so that it is positioned over Column 1 of Station A and then strips off the tips.
UP/DN	Tips & Vessels	Prepares the pipette shuttle to move in the z- axis (up/down).
LFT/RT	Tips & Vessels	Prepares the pipette shuttle to move in the x-axis (left/right).
BCK/FWD	Tips & Vessels	Prepares the supply platform to move in the y-axis (back/forward).

- When you select a move type command of UP/DN, LFT/RT, or BCK/FWD, the [AXIS] STEP POS screen appears:



➢ The **[AXIS] STEP POS** screen is the mechanism for stepping the pipette shuttle or supply platform within a particular axis while keeping track of its current position. You will use the options within this screen to move the shuttle or platform a number of steps in the currently selected direction.

4. When you have positioned the hardware appropriately for the particular parameter you are measuring, record the **Current Position** number for eventual use in the Tip or Vessel Specification File.
   - Worksheets for recording the Current Position numbers are provided on the next two pages. Make a copy for each spec file.
   - Information on measuring specific parameters (with diagrams) starts on page 172.



When measuring specs for tips:

- Select STA-A to position the pipette shuttle over the center of Station A.
- Select BCK/FWD and LFT/RT to center the stainless steel pipette tip(s) over the disposable tip(s).
- Select UP/DN to lift and lower the pipette shuttle when lifting or engaging tips.
- Select LFT/RT to move the shuttle with the engaged tips.
- Select EJECT to return the tips to the tray when you've finished taking measurements.

When measuring specs for vessels:

- Select T-GET to tell the instrument to pick up a column of tips.
- Select STA-C to position the shuttle over the center of Station C.
- Select LFT/RT and BCK/FWD to center the disposable tips over the vessel(s).
- Select UP/DN to move the tips into and out of the vessel(s).
- Select T-PUT to return the tips to the tray when you’ve finished taking measurements.

Spec Measurements for Tip

Tip Product Information: ______________________________

____

Tip Specification File Name: ______________________________

Notes: ______________________________

____

____

Parameter	Setting	Axis
Tip Max Volume	µl	N/A
Distance to Tip Rim	steps	UP/DN
Distance to Engage Tip	steps	UP/DN
Distance to Lift Tips	steps	UP/DN
Distance to First Column	steps	LFT/RT
Distance to Last Column	steps	LFT/RT
Distance to First Row	steps	BCK/FWD

Spec Measurements for Vessel

Vessel Product Information: ____

____

Vessel Specification File Name: ____

Notes: ____

____

____

Parameter	Setting	Axis
Volume in Units of		N/A
Distance to Vessel Bottom	steps	UP/DN
Vessel Maximum Volume		N/A
Distance to Maximum Volume	steps	UP/DN
Distance to Vessel Top	steps	UP/DN
Calculated Minimum Volume		N/A
Number of Rows		N/A
Number of Columns		N/A
Distance to First Column	steps	LFT/RT
Distance to Last Column	steps	LFT/RT
Distance to First Row	steps	BCK/FWD
Fill Column-Wise?		N/A

Distance to Tip Rim

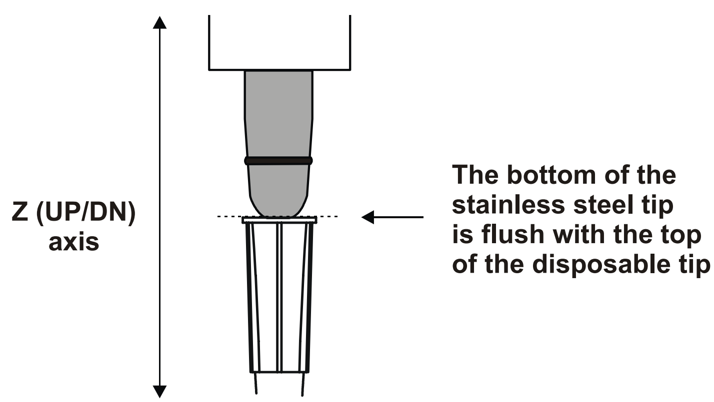
Used in: Tip Specs File

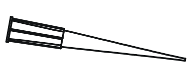
Axis: z (UP/DN)

Supplies: 2 tips in Row 1, Columns 1-2 at Station A

Instructions:

1. Move the pipette shuttle to Station A (STA-A).
2. Position the rearmost stainless steel pipette tip so it is precisely centered in the x- and y-axes over the top of the disposable pipette tip in Row 1. This requires using a combination of the LFT/RT and BCK/FWD commands.
3. When the tip is centered in the x- and y-axes, move the pipette head down in the z-axis until the bottom of the stainless steel pipette tip is flush with the top of the disposable tip, then record the current position.





To maximize efficiency and accuracy when measuring specs for tips, measure *Distance to Tip Rim*, *Distance to Engage Tip*, and *Distance to Lift Tips* in succession.

Distance to Engage Tip

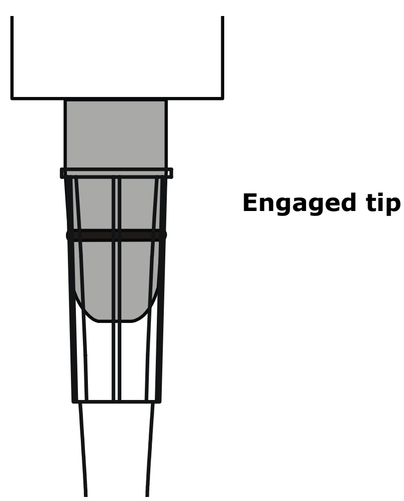
Used in: Tip Specs File

Axis: z (UP/DN)

Supplies: 2 tips in Row 1, Columns 1-2 at Station A

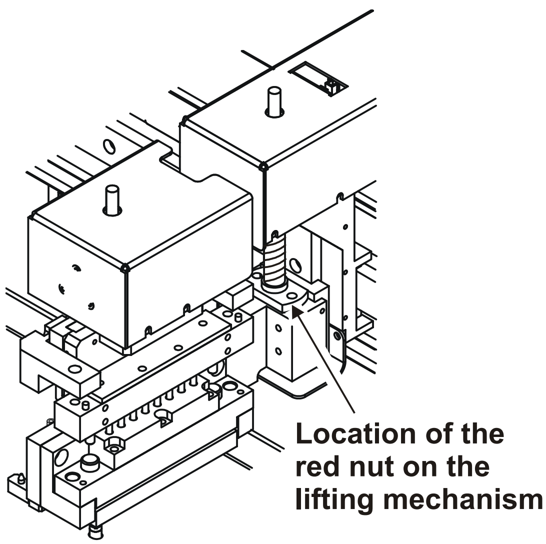
Instructions:

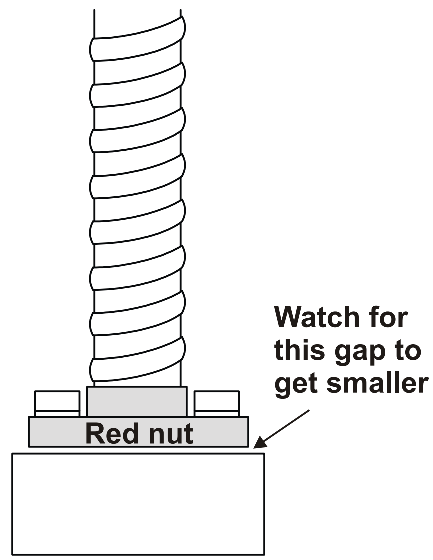
1. If you have not already done so, move the pipette shuttle to Station A (STA-A).
2. Position the rearmost stainless steel pipette tip so it is precisely centered in the x- and y-axes over the top of the disposable pipette tip in Row 1. This requires using a combination of the LFT/RT and BCK/FWD type commands (unless you are currently at the *Distance to Tip Rim* position, see previous page).
3. The pipette lifting mechanism is moved up and down with a nut and screw drive. The screw is rotated by a motor. The nut is attached to a cantilevered arm, but is allowed to free float so that it does not bind. The nut is red and the top of it is visible at the rear of the cantilevered arm of the lift mechanism. When viewed at rest, there is about **0.010”** of clearance between the nut and the bracket. This gap is what you need to be watching when determining engagement height.
4. Start moving the pipette head down in the z-axis (UP/DN) so that the stainless steel pipette tip engages the disposable pipette tip.



5 Observe the gap between the red nut and the arm of the lift mechanism (see drawing below). When the gap is seen to get smaller, stop. **This is the engagement position.** Do not move so far as to completely close the gap.

6 Move up and down to confirm the position where the change in the gap is observed. Record the current position.





Distance to Lift Tips

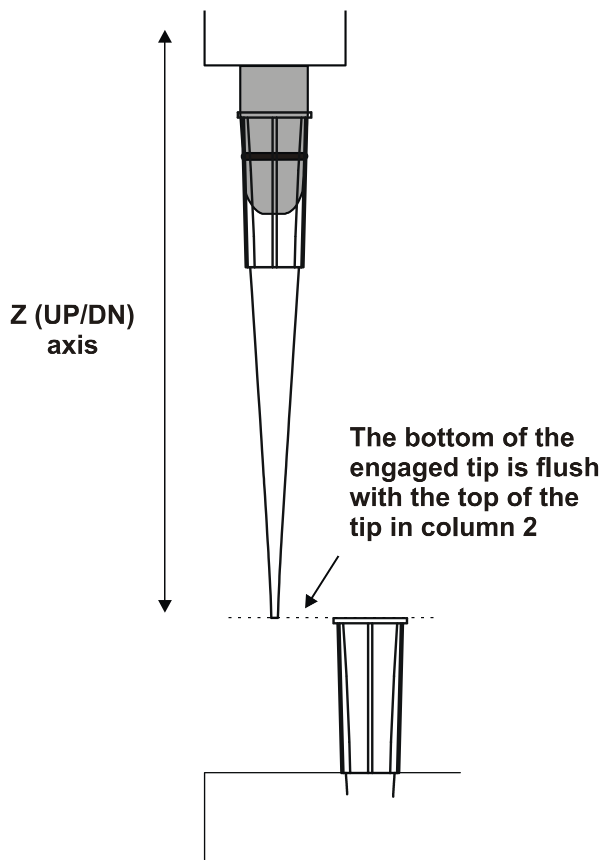
Used in: Tip Specs File

Axis: z (UP/DN)

Supplies: 2 tips in Row 1, Columns 1-2 at Station A
8 tips in Column 2 at Station A

Instructions:

1. If you have not already engaged the tip in Row 1 Column 1, follow the directions on the previous page to do so.
2. Move the pipette head up in the z-axis (UP/DN) until the bottom of the tip is flush with the top of the tip in Column 2. Record the current position.



Distance to First Column

Used in: Tip and Vessel Specs Files

Axis: x (LFT/RT)

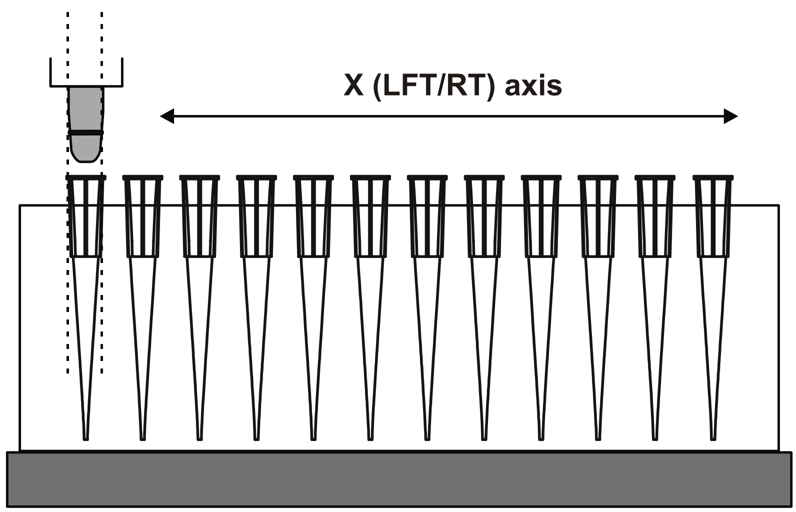
Supplies: 96 tips in Columns 1-12 at Station A

Enough vessels to fill all columns of Station C (if measuring for a Vessel Specs File)

Instructions:

Tips

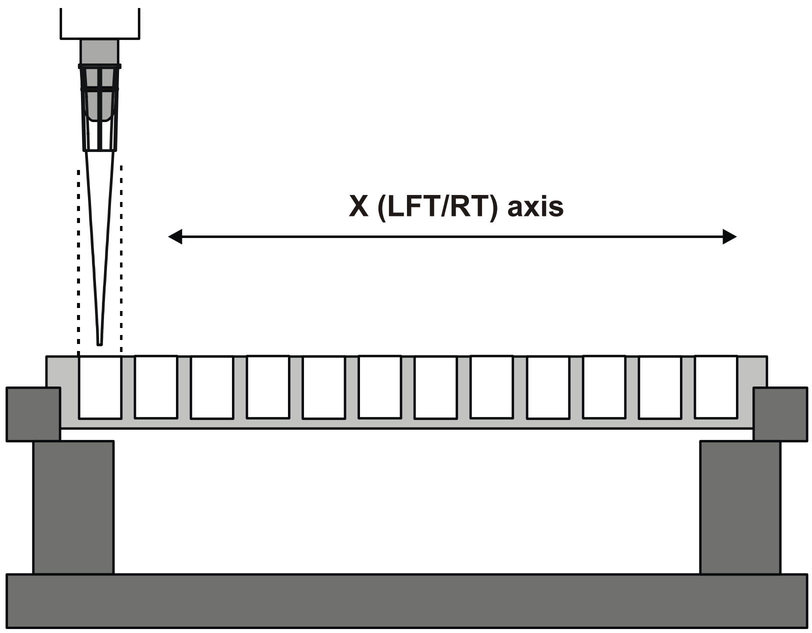
1. If you have not already done so, move the shuttle to Station A (STA-A).
2. Position the shuttle so that the stainless steel pipette tips are centered over the disposable tips in Column 1 in the x –axis (LFT/RT). Record the current position.



Vessels

1 Move the shuttle to Station A, pick up a column of tips, then go to Station C (STA-A, T-GET, STA-C).

2 Position the shuttle so the engaged tips are centered over the vessels in Column 1 in the x-axis (LFT/RT). Record the current position.



Distance to Last Column

Used in: Tip and Vessel Specs Files

Axis: x (LFT/RT)

Supplies: 96 tips in Columns 1-12 at Station A

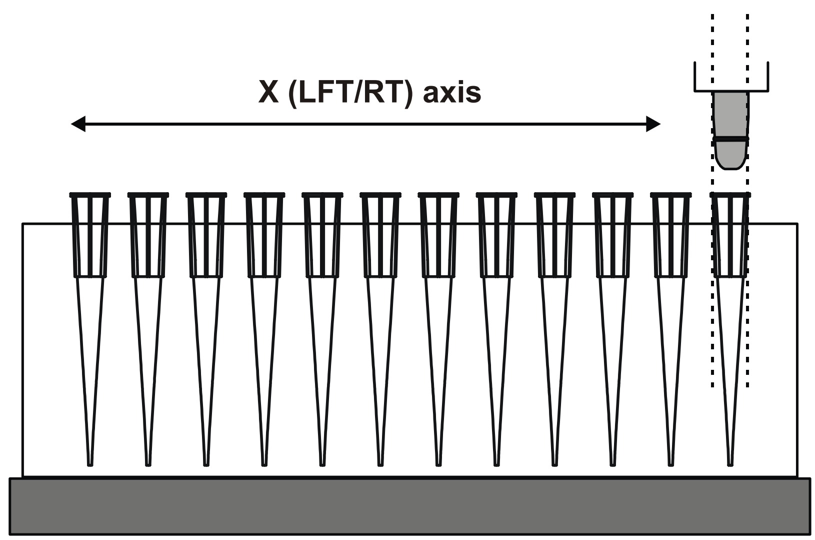
Enough vessels to fill all columns of Station C (if measuring for a Vessel Specs File)

Instructions:

Tips

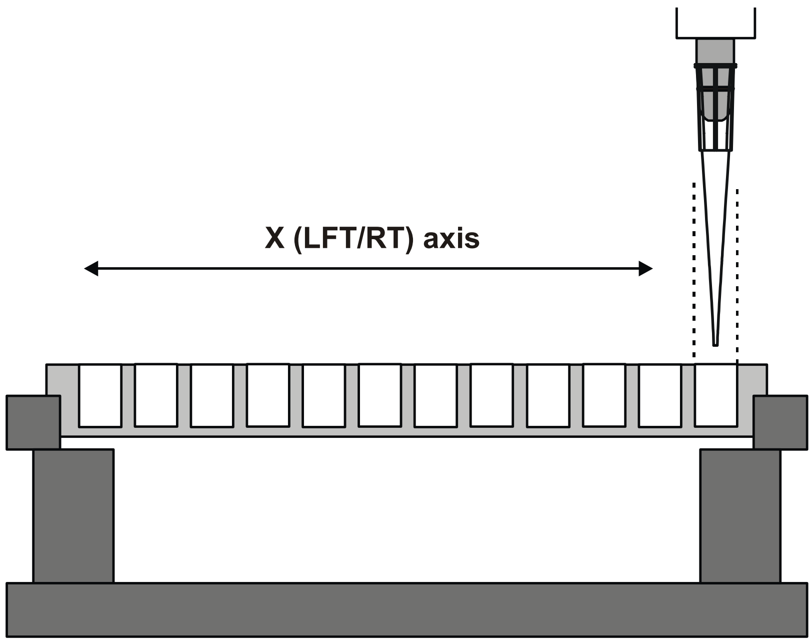
1 If you have not already done so, move the shuttle to Station A (STA-A).

2 Position the shuttle so the stainless steel pipette tips are centered over the disposable tips in Column 12 in the x-axis (LFT/RT). Record the current position.



Vessels

1. If you have not already done so, move the shuttle to Station A, pick up a column of tips, then go to Station C (STA-A, T-GET, STA-C).
2. Position the shuttle so the engaged tips are centered over the vessels in the last (rightmost) column in the x-axis (LFT/RT). Record the current position.



Distance to First Row

Used in: Tip and Vessel Specs Files

Axis: y (BCK/FWD)

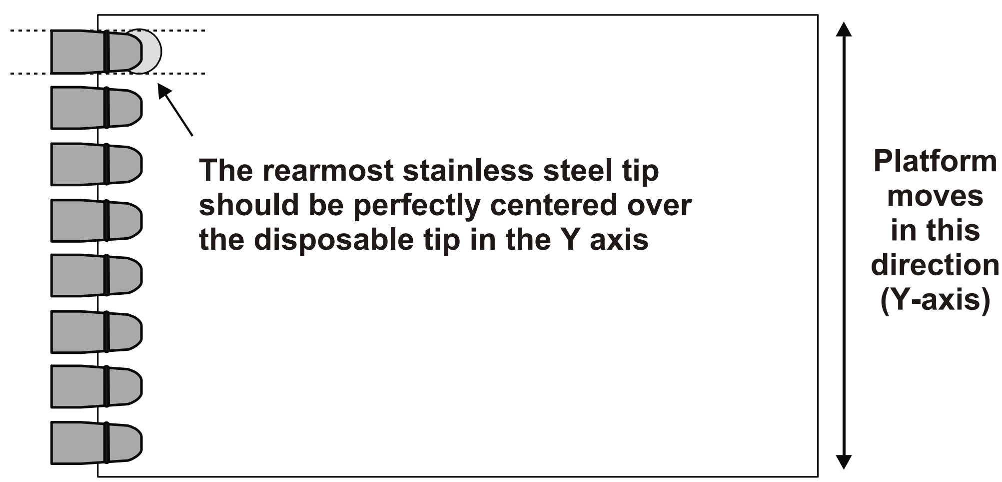
Supplies: 1 tip in Row 1 of Column 1 at Station A

Enough vessels to fill Column 1 at Station C (if measuring for a Vessel Specs File)

Instructions:

Tips

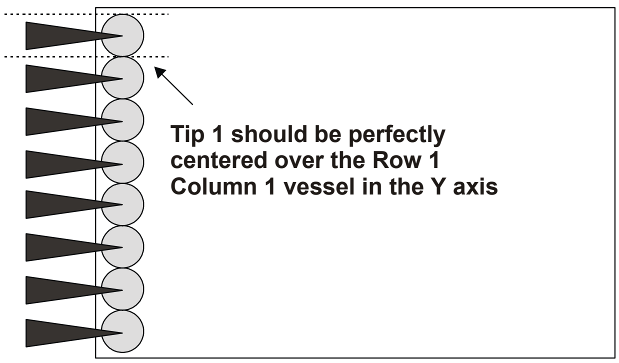
1. If you have not already done so, move the shuttle to Station A (STA-A).
2. Position the shuttle so the rearmost stainless steel pipette tip is centered over the disposable tip in the x-axis (LFT/RT). Move the supply platform in the y-axis (BCK/FWD) until the stainless steel pipette tip is perfectly centered over the disposable tip. Record the current position.

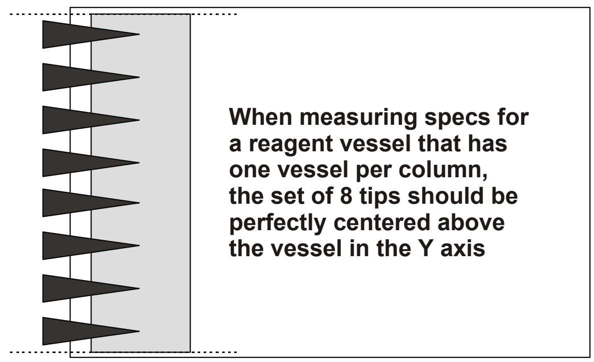


Vessels

1 If you have not already done so, move the shuttle to Station A, pick up a column of tips, then go to Station C (STA-A, T-GET, STA-C).

2 Position the shuttle so the engaged tip is centered over the vessel in Row 1 of Column 1 in the x-axis (LFT/RT). Move the supply platform in the y-axis (BCK/FWD) until the tip is perfectly centered over the vessel in Row 1 Column 1. Record the current position.





Distance to Vessel Bottom

Used in: Vessel Specs Files

Axis: z (UP/DN)

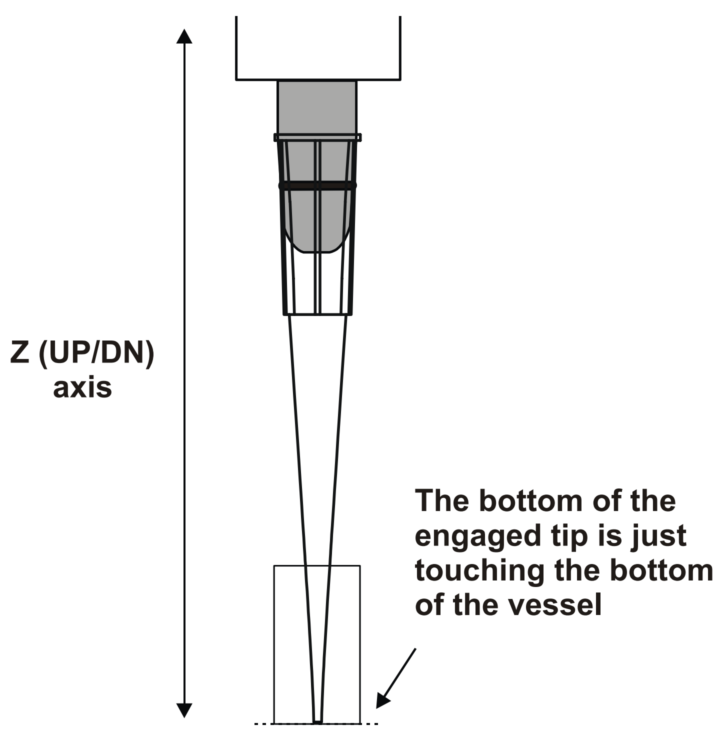
Supplies: 8 tips in Column 1 at Station A
Enough vessels to fill all Columns at Station C

Instructions:

1 If you have not already done so, move the shuttle to Station A, pick up the tips, then go to Station C (STA-A, T-GET, STA-C).

2 Position the tips so they are centered over the vessel(s) for which you are measuring specs. This requires using a combination of the LFT/RT and BCK/FWD commands.

3 When the tips are in place, step the pipette head down until the bottoms of the tips are just touching the bottoms of the vessels. Test for contact by attempting to lift the vessel when you have observed that the tip is near the vessel bottom. The gap between the tip and vessel should close. Record the current position.



Distance to Maximum Volume

Used in: Vessel Specs Files

Axis: z (UP/DN)

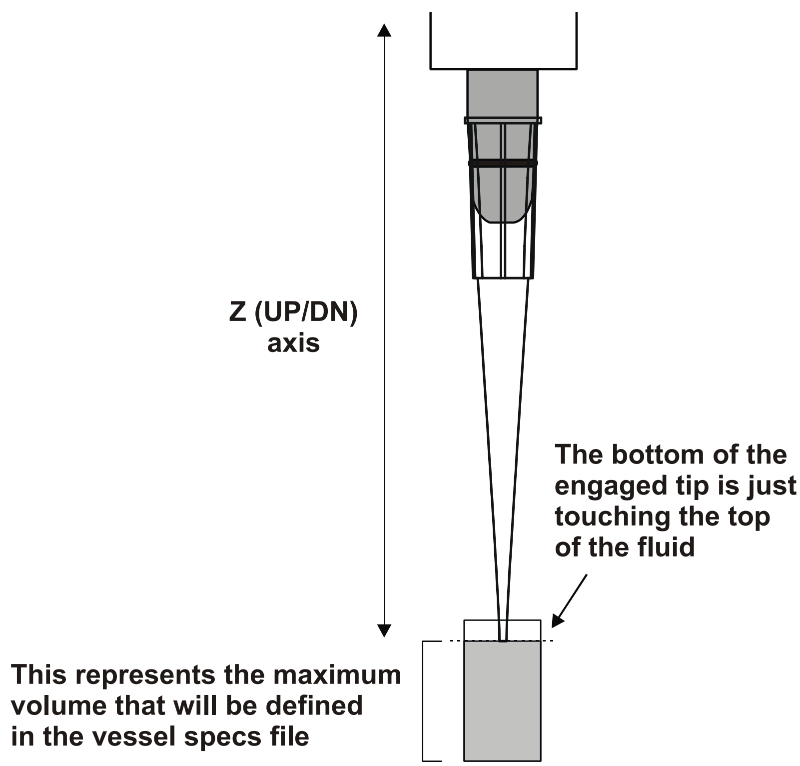
Supplies: 8 tips in Column 1 at Station A

Enough vessels to fill all Columns at Station C

Vessels should be filled with the Maximum Volume amount of a fluid characteristic of those to be used in your fluid handling programs

Instructions:

1. If you have not already done so, move the shuttle to Station A, pick up the tips, then go to Station C (STA-A, T-GET, STA-C).
2. Position the tips so they are centered over the vessel(s) for which you are measuring specs. This requires using a combination of the LFT/RT and BCK/FWD commands.
3. When the tips are in place, step the pipette head down until the bottoms of the tips are just touching the top of the fluid. Record the current position.



Distance to Vessel Top

Used in: Vessel Specs Files

Axis: z (UP/DN)

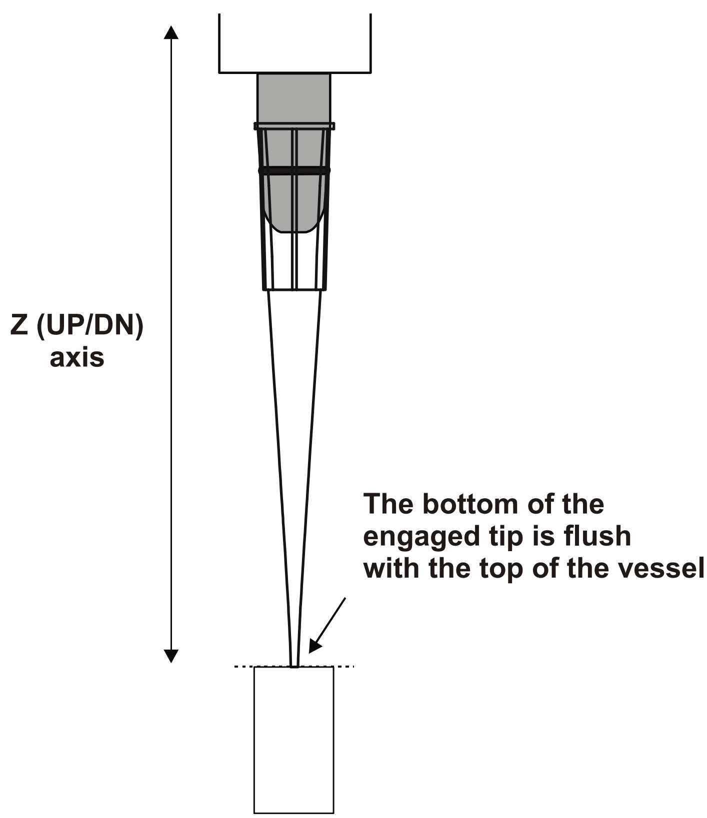
Supplies: 8 tips in Column 1 at Station A
Enough vessels to fill all Columns at Station C

Instructions:

1 If you have not already done so, move the shuttle to Station A, pick up the tips, then go to Station C (STA-A, T-GET, STA-C).

2 Position the tips so they are centered over the vessel(s) for which you are measuring specs. This requires using a combination of the LFT/RT and BCK/FWD commands.

3 When the tips are in place, step the pipette head down until the bottoms of the tips are flush with the tops of the vessels. Record the current position.



PRIME

❖ **Note:** The PRIME utility is only available with the manifold-equipped models.

The **Prime** utility should be run:

- After the external supply bottle and/or tubing has been replaced, to clear any air from the lines. A minimum priming volume of 20 ml is recommended if using the 2-liter supply bottle with a tube from the cap to the bottom of the bottle. If a beaker or other supply container is used and the manifold syringe inlet tube is put directly into the beaker or container, then a smaller prime volume of 16 ml may be adequate.
- Periodically throughout the day if the dispensing fluid does not contain surfactant, or once a day if the fluid does contain surfactant (see ***Daily Maintenance*** in ***Chapter 8***).
- Before running a program *if* the program does not specify a pre-prime, or if the pre-prime volume is not sufficient to clear the lines and prime the manifold tubes. If the program does not specify a pre-prime volume and there is no air in the lines, a 1 ml prime should be sufficient.

To run the Prime utility:

1. Make sure the external supply bottle contains a sufficient amount of the appropriate fluid, and that it is properly connected to the manifold syringe pump (see ***Installing the Components*** in ***Chapter 3***).
2. Make sure the manifold priming trough is empty. To remove the trough for emptying, simply lift it up and off the two shoulder screws.

❖ **Note:** The priming trough holds just about 100 ml of fluid. If you are going to prime with a high volume (80 ml or greater), consider removing the priming trough and placing the (larger) waste collection bin underneath the manifold.

3. From the Main Menu, select **UTIL.**
4. From the SELECT UTILITY screen, select the arrow **(-->)** until the **PRIME** option appears, then select it. The MANIFOLD PRIME VOL entry screen will appear.

```
MANIFOLD PRIME VOL:   20
(1..100)        ML TOTAL
```

5. Enter the total volume of fluid (in milliliters) to be used for the prime. The default setting is 20.
6. Press the **Enter key.** The following screen will appear:

```
CONNECT FLUID BOTTLE AND
PRESS <ENTER> TO START.
```

7. Press the **Enter key** to start the prime.

```
PRIMING IN PROGRESS,
PLEASE WAIT...
```

8. When the prime is complete, the SELECT UTILITY screen reappears. Press the **Main Menu key** to return to the Main Menu.

Chapter 7

Performance Verification/ Qualification Tests

This chapter recommends procedures for obtaining, recording, and interpreting the test results required to verify the Precision's performance is consistently compliant with specifications.

Instrument verification for the Precision involves three activities: qualification of installation and setup, qualification of routine capability, and qualification of long-term stability. This manual refers to these activities as Installation Qualification (IQ), Operational Qualification (OQ), and Performance Qualification (PQ), respectively.

Qualification Schedule

The following schedule defines the factory-recommended frequency of qualification tests for a Precision that is used from two to five days a week. The schedule assumes the instrument is properly maintained as outlined in ***Chapter 8***, ***Maintenance***.

Important! The risk factors associated with your fluid handling procedures may require the Operational and Performance Qualification procedures to be performed more frequently than shown below.

Recommended Instrument Qualification Schedule for the Precision

Tests	Installation Qualification	Performance Qualification		Operational Qualification
		Daily	Monthly	Initially/ Annually
System and Checksum Tests	✓	✓	✓	✓
Seal Check	✓		✓	✓
Dispense Accuracy & Precision Test for Pipette			✓	✓
Dispense Accuracy & Precision Test for Manifold*			✓	✓

* This test only applies to the Precision 8-Channel Plus, 12-Channel Plus, and Universal models, with the dispensing manifold.

- The **Self Test** is performed automatically at start-up and may be performed at other times per the directions on page 191. This test verifies the movement of the pipette shuttle, syringes, and supply platform.
- The **Checksum Test** displays part number and version information for the software currently loaded on the instrument. It may be performed per the directions on page 191. This information is helpful when contacting Bio-Tek for technical assistance and ensures that the software has not been corrupted.

- The **Seal Check** is performed by running an on-board QC program and observing the pipette tips to confirm they are not dripping. This verifies the integrity of the energized seals on the pistons of the pipette head and of the o-rings on the tip holders.
- The **Dispense Accuracy & Precision Test** is performed by running an on-board QC program to dispense a certain volume of blue dye solution into a microplate. The strips are weighed to verify accuracy, and then read on an absorbance reader to verify precision.

Installation Qualification (IQ)

The recommended Installation Qualification tests include the System and Checksum Tests, and the Seal Check.

- These tests should be performed after the instrument is installed and set up as described in ***Chapter 3***, ***Installation and Setup***, and before the instrument is used in a laboratory environment.
- The successful completion of the IQ tests verifies that the instrument is installed and set up correctly.

Operational Qualification (OQ)

The recommended Operational Qualification tests include the System and Checksum Tests, the Seal Check, and the Dispense Accuracy Test(s).

- These tests should be performed routinely; the recommended interval is *initially* and *annually*.
- Results should be compared with results from the initial Operational Qualification (baseline) tests, previous annual Operational Qualification tests, and previous Performance Qualification tests (if applicable).
- The successful completion of the OQ tests, in combination with previously comparable OQ, and PQ test results verifies the instrument meets factory specifications.

Performance Qualification (PQ)

The recommended Performance Qualification tests include the System and Checksum Tests, the Seal Check, and the Dispense Accuracy Test(s). Your facility's operating policies may also require you to perform an actual assay prior to accepting the Precision for routine use. Never use the data obtained from the first assay run on the instrument until you have confirmed that the package insert criteria have been met. Subsequent monthly PQ testing may rely upon review of the last assay conducted during normal use.

- These tests should be performed routinely; the recommended interval is *monthly*. This frequency may be adjusted depending on the trends observed in the testing.
- The successful completion of the PQ tests verifies that the instrument is performing consistently under normal operating conditions.

System and Checksum Tests

The Self Test and the Checksum Test are performed automatically whenever the instrument is turned on. They can also be performed manually through the Main Menu.

- The **Self Test** checks the movement of the pipette shuttle, syringes, and supply platform.
- The **Checksum Test** displays part number and version information for the software currently loaded on the instrument. This information is useful when contacting Bio-Tek for technical assistance.

To run the system tests:

1. At the Main Menu, select **UTIL.** The SELECT UTILITY screen appears.

```
SELECT UTILITY:
TESTS SETUP  SPECS  -->
```

2. At the Select Utility screen, select **TESTS.** The SELECT A SYSTEM TEST screen appears.

```
SELECT A SYSTEM TEST:
SLFCHK CHKSUM
```

3. Select **SLFCHK** to run the Self Test, or **CHKSUM** to run the Checksum Test.
   - When the Self Test is run and no errors are detected, the software briefly displays “SYSTEM TEST PASS,” and then returns to the Main Menu. If an error is detected, the instrument “beeps” and displays an error code. See ***Chapter 9, Error Codes*** for more information.
   - When the Checksum Test is run, the following information displays:

```
7110200    VERSION 1.00
CODE CHECKSUM:    (085D)
```

- The **on-board (basecode) software** part number, version number, and checksum display first. After five seconds, a second screen appears:

```
7110203-FW V1.00.00
```

- The second screen shows the **configuration software** part number and version number.

4. Record the actual information that appears on both screens for troubleshooting purposes.
   - After a few moments, the software returns to the Main Menu.

Seal Check

> ❖ **Note:** The following procedure contains instructions for performing the Seal Check using the external keypad, when the Precision is in standalone mode, and using Precision Power, during PC control of the Precision.

The **Seal Check** verifies the integrity of the energized seals on the pistons of the pipette head and the o-rings on the tip holders. The test should be performed routinely as an Instrument Qualification task. It should also be performed if dripping from the disposable pipette tips is observed during a fluid transfer; the o-rings may have to be replaced (see ***Periodic Maintenance*** in ***Chapter 8***).

To perform a seal check:

1. Load Station A, column 1, with Labcon® 200 µl tips.
2. Load Station B, column 4, with one of Bio-Tek's reagent vessels. Fill the vessel with 14 ml of deionized water. For 12-Channel and Universal models, load column 3.
3. **Using the external keypad**, at the Main Menu, select **QC.** Press the **Options key** until `SEALCHECK` appears, or `12_SEALCHECK` for 12-Channel or Universal models, then press the **Enter key** to select it.

   Using Precision Power, go to **File|Run On-Board Program**, select **QC**, and click **Get Program Lists**. Then, from the drop-down menu of **Programs**, select `SEALCHECK`, or `12_SEALCHECK` for 12-Channel or Universal models. Click **Prepare First Run**.

4. Select **START** to begin.

   The pipette picks up the tips and aspirates 115 µl of deionized water and 5 µl of air, then pauses for one minute. During this time, some droplets may appear at the ends of the pipette tips; this is *not* a problem. After one minute, the pipette dispenses the water and aspirates another 120 µl, then pauses for another minute.

5. While the keypad display and the Precision Power screen shows `CHECK FOR DRIPS`, watch the end of the pipette tips. Droplets should **NOT** form on the tips for the entire minute. (Precision Power counts down the time in the **Delay Time** field.)

   - *Rapid* loss of fluid is an indication of a failed piston seal. Contact Bio-Tek Instruments (see ***Chapter 1*** for contact information).

   - *Gradual* loss of fluid is an indication of either a weak piston seal or a defective o-ring. Replace the o-rings (see ***Chapter 8***, ***Maintenance)***, and then run this test again. If there is still a gradual loss of fluid, contact Bio-Tek Instruments.

6. After one minute, the pipette dispenses the fluid and returns the tips to Station A. Select **MENU** to return to the Main Menu.

Dispense Accuracy & Precision Tests

Accuracy is the ratio of the difference between actual and theoretical weight to the theoretical weight expressed as percentage. **Precision** is the ratio of the standard deviation of the optical densities across the plate to the mean value of optical density of the plate expressed as a percentage.

The dispense accuracy is determined gravimetrically. The weight of the dispense fluid is measured on a precision balance and is compared to the theoretical value. The dispense precision is determined by dispensing a blue dye solution into a 96-well flat bottom microplate and then measuring the optical density for each well. The optical density of each well is proportional to the volume in each well.

Important! The pass/fail specifications for the following tests were determined by the factory, using the test solutions described below. You may use your own buffer solution in place of Solution #1. If any tests fail using your solution, however, retry the tests using the suggested solutions. Using pure deionized water in place of Solution #1 is *not* recommended and may result in the failure of the instrument to meet specifications.

Materials

- 12 Nunc Flat microstrips and accompanying frame (2 sets: one for testing the *pipette* another for testing the *manifold)*
- Labcon 200 µl tips (1 box)
- Balance with 0.001 gram resolution
- Orbital shaker
- 2 1000-ml flasks or glass bottles
- Pipettes and graduated beakers
- Absorbance reader set up to perform a dual-wavelength read at 630/450 nm
- Prepare three test solutions:

  Solution #1: ~0.1% Tween® 20 in deionized water

  ➢ Add 1 ml Tween® 20 into 1 liter (1000 ml) of deionized water and mix well

  or

  ➢ Add 10 ml of Bio-Tek Wetting Agent (PN 7773002) (100X concentration) into 1 liter (1000 ml) of deionized water and mix well.

<u>Solution #2: Blue Dye Concentrate</u>

- Add 0.250 grams of FD&C #1 blue dye into 500 ml of Solution #1

  or

- Add 50 ml of Bio-Tek Blue Test Dye Solution (PN 7773001) (10X concentration) to 450 ml of Solution #1. Mix well.

<u>Alternate Solution #2: Yellow Dye Concentrate</u>

- Add 13 ml of FD&C #5 Yellow Dye (Durkee® yellow food coloring or equivalent) into 500 ml of Solution #1. Mix well.

<u>Solution #3: Precision & Accuracy Solution</u>

Add 25 ml of Solution #2 into 475 ml of Solution #1. This is a 1:20 dilution. Mix well.

Dispense Accuracy & Precision Test for the Pipette

> ❖ **Note:** The following procedure contains instructions for performing the Accuracy and Precision Test using the external keypad, when the Precision is in standalone mode, and using Precision Power, during PC control of the Precision.

To perform the test for the pipette:

1. Load <u>Station A, columns 1-12,</u> with Labcon 200 µl tips.
2. Load <u>Station B, column 4,</u> with one of Bio-Tek's reagent vessels.
3. Fill the reagent vessel with 20 ml of the Precision & Accuracy solution (Solution #3).
4. Load <u>Station C, columns 1-12</u>, with the 12 Nunc Flat microstrips in a frame.
5. **Using the external keypad:** At the Main Menu, select **QC,** then press the **Options key** until `PIP96_100UL_X6` appears, or `12_PIP96_100UL` for 12-Channel and Universal models, then press the **Enter key** to select it.

   Using Precision Power: Go to **File|Run On-Board Program**, select **QC** (not Assay), and click **Get Program Lists**, then from the drop-down menu select `PIP96_100UL_X6`, or `12_PIP96_100UL` for 12-Channel and Universal models.

6. Select **START** to begin. Both the keypad display and Precision Power show:

```
PAUSE:TARED PLATE IN C
ABORT RESUME STEP
```

7. Tare the balance with the strips in a frame. Put the frame back on Station C and then select **RESUME.**

   The pipette picks up tips, aspirates 110 µl of solution, and then dispenses 100 µl into the first column. This is repeated until all the strips are dispensed.

8. Weigh the strips and frame and record the **Total Dispense Weight** in the worksheet on page 199.
9. Place the strips and frame in an orbital shaker and shake for 10 seconds.
10. Place the strips and frame in an absorbance reader and perform a dual-wavelength read at 630/450 nm for blue dye or 450/630 nm for yellow dye. Print out the results, then record the value for each well into the worksheet on page 199.

❖ **Note:** If you are using one of Bio-Tek's keypad-based readers, such as the ELx800™ or ELx808™, make sure the reader is **not** running in Rapid mode. To check this, select **UTIL → READ** and cycle through the prompts until you see **READ IN RAPID MODE?** Choose **NO** for an accurate result.

11. Perform data reduction as follows (use the worksheet on page 199 to record results):

    a. Calculate the **Accuracy % Error:**

       - % Error = ((Total Dispense Weight – 9.6)/9.6) * 100
       - The % Error must be less than or equal to 2.0% to pass.
       - If the % Error is greater than 2.0%, run the Seal Check QC program to test for leaking seals (see page 193), then re-run this test. If it fails again, contact Bio-Tek TAC.

    b. Calculate the **Mean Absorbance** for the 96 wells (after dual-wavelength subtraction).

    c. Calculate the **%CV** (Coefficient of Variation) for the 96 wells:

       - %CV = (Standard Deviation / Mean OD) * 100
       - If you have a spreadsheet program, enter all 96 values into a spreadsheet and use the program's standard deviation function (such as Microsoft Excel's STDEV function).

- The %CV must be less than or equal to 2.0% to pass.
- If the %CV is greater than 2.0%, run the Seal Check QC program to test for leaking seals (see page 193), then re-run this test. If it fails again, contact Bio-Tek TAC.

Pipette Dispense Precision & Accuracy Worksheet

Instrument Serial Number: ____________ Date of Test: ______________

Tested By: ____

Accuracy Test

Total Dispense Weight ____________ grams

Accuracy % Error ____________ % ❑ Pass ❑ Fail
((Total Dispense Weight – 9.6)/9.6) * 100
% Error must be <= 2.0% to pass

Precision Test

For each well, record the absorbance value after dual wavelength subtraction (630/450 nm blue dye, or 450/630 yellow dye):

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												
E												
F												
G												
H												

Mean Absorbance of the 96 wells: ______________

Standard Deviation: ______________
(Calculate using a spreadsheet program)

% Coefficient of Variation: ______________ % ❑ Pass ❑ Fail
= *Standard Deviation / Mean Absorbance) * 100*
% CV must be <= 2.0% to pass

Dispense Accuracy & Precision Test for the Manifold

❖ **Note:** The following procedure contains instructions for performing the Accuracy and Precision Test using the external keypad, when the Precision is in standalone mode, and using Precision Power, during PC control of the Precision.

To perform the test for the manifold:

1. Fill the supply bottle with 80 ml of the Dispense Precision & Accuracy solution (Solution #3).
2. Load Station C, columns 1-12, with the Nunc Flat strips in a frame.
3. Make sure the priming trough is installed.
4. **Using the external keypad:** At the Main Menu, select **UTIL**, then the **arrow**, then **PRIME.** Enter a prime volume of **20 ml** and press the **Enter key.**

   Using Precision Power, go to **Instrument|Configuration**, and select **Utilities**. Under **Manifold Priming**, enter **20 ml** for **Volume** and click **Start Priming**.

5. Observe the fluid as the manifold dispenses; it should be flowing from all dispense tubes.

❖ If the fluid is not flowing from all tubes, or if it is flowing inconsistently from one or more tubes, the manifold must be removed and thoroughly cleaned before you can perform this test. See ***Chapter 8***, ***Maintenance*** for instructions.

6. When the priming has successfully completed, exit the Utility program.
7. **Using the keypad**, select **QC** from the Main Menu, and press the **Options key** until `MAN96_100UL_X12` appears, or `12_MAN_96_100UL` for 12-Channel and Universal versions. Press the **Enter key** to select it.

   Using Precision Power, go to **File|Run On-Board Program**, select **QC** (not **Assay**), and click **Get Program Lists**. Then, from the drop-down menu of **Program**(**s**), select `MAN96_100UL_X12`, or `12_MAN_96_100UL` for 12-Channel and Universal versions.

8. Select **START** to begin. Both the keypad display and Precision Power show:

```
PAUSE:TARED PLATE IN C
ABORT RESUME STEP
```

9. Tare the balance with the strips and frame. Put the frame back on Station C and then select **RESUME.** The manifold dispenses 100 µl into each well.

10. Weigh the strips and frame, and record the **Total Dispense Weight** in the worksheet on page 202.
11. Place the strips and frame in an orbital shaker and shake for 10 seconds.
12. Place the strips and frame in an absorbance reader and perform a dual-wavelength read at 630/450 nm for blue dye or 450/630 nm for yellow dye. Print out the results.

❖ **Note:** If you are using one of Bio-Tek's keypad-based readers, such as the ELx800™ or ELx808™, make sure the reader is **not** running in Rapid mode. To check this, select **UTIL → READ** and cycle through the prompts until you see **READ IN RAPID MODE?** Choose **NO** for an accurate result.

13. Perform data reduction as follows (use the worksheet on page 202 to record results):

    a. Calculate the **Accuracy % Error:**

    - % Error = (Total Dispense Weight - 9.6)/9.6) * 100
    - The % Error must be less than or equal to 2.0% to pass.
    - If the % Error is greater than 2.0%, reprime the instrument and verify that all air has been purged from the tubing, then re-run this test. If it fails again, contact Bio-Tek TAC.

    b. Calculate the **Mean Absorbance** for the 96 wells (after dual-wavelength subtraction).

    c. Calculate the **%CV** (Coefficient of Variation) for the 96 wells:

    - %CV = (Standard Deviation / Mean OD) * 100
    - If you have a spreadsheet program, enter all 96 values into a spreadsheet and use the program's standard deviation function (such as Microsoft Excel's STDEV function).
    - The %CV must be less than or equal to 3.0% to pass.
    - If the %CV is greater than 3.0%, reprime the instrument and verify that all air has been purged from the tubing, then re-run this test. If it fails again, contact Bio-Tek TAC.

Manifold Dispense Accuracy & Precision Worksheet

Instrument Serial Number: ____________ Date of Test: ______________

Tested By: ____

Accuracy Test

Total Dispense Weight ____________ grams

Accuracy % Error ____________ % ❑ Pass ❑ Fail

((Total Dispense Weight - 9.6)/9.6) * 100

% Error must be <= 2.0% to pass

Precision Test

For each well, record the absorbance value after dual wavelength subtraction (630/450 nm blue dye, or 450/630 yellow dye):

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												
E												
F												
G												
H												

Mean Absorbance of the 96 wells _____________

Standard Deviation _____________

(Calculate using a spreadsheet program)

% Coefficient of Variation _____________ % ❑ Pass ❑ Fail

= *Standard Deviation / Mean Absorbance) * 100*

% CV must be <= 3.0% to pass

Chapter 8

Maintenance

Preventative Maintenance (PM) is a set of procedures performed regularly to maintain the Precision in top condition. During normal operation, residue can crystallize in the manifold dispense tubes and reduce output. Adherence to the recommended maintenance schedule reduces this problem, maximizes running time, and extends the life of the instrument.

Recommended Maintenance Schedule

The following chart lists Bio-Tek's recommends preventative maintenance tasks. Daily and weekly routines and minimal guidelines for maintenance are listed (≤ means 'at least every').

Maintenance Task	Purpose / Frequency				
	Daily	**Overnight**	**Multi-Day**	**Periodically/ As Needed**	**Before Storage or Shipment**
Rinse the manifold and prime the tubing*, p. 205	✓	✓	✓		✓
Replace the pipette tip o-rings (PN 19458), p. 208				✓ ≤ 6 months	
Clean the supply platform and fixtures, p. 209				✓ ≤ 1 month	✓
Clean the stainless steel pipette tips, p. 210				✓	✓
Clean the supply bottle*, p. 210				✓	✓
Clean the manifold*, p. 210				✓	✓
Decontaminate the instrument, p. 213				✓	✓
Clean and lubricate the linear ways and motor screws, p. 216				✓ ≤ 6 months	
* These tasks only apply to models with the dispensing manifold: the Precision 8-Channel Plus, 12-Channel Plus, and Universal models.					

It is important to note that the risk and performance factors of your assays may require that some or all of the procedures be performed more frequently than presented in the chart.

Develop a schedule for your lab based on the characteristics of the fluids used and the instrument's activity level. See the **Frequency** recommendations for each daily, overnight/multi-day or periodic maintenance tasks listed on the following pages.

Daily Maintenance

Purpose

For Precision 8-Channel Plus, 12-Channel Plus, and Universal models: Daily maintenance involves rinsing the manifold with an appropriate reagent or deionized water throughout the day. Routinely rinsing the manifold helps prevent the dispense tubes from clogging between dispensing programs.

Frequency

The rinsing frequency depends on two factors: how frequently the manifold is used throughout the day, and the dispensing solutions currently in use. Here are some guidelines to help establish an appropriate routine for your laboratory:

- If a solution containing surfactant is used throughout the day, the rinsing procedure should be performed at the end of the day.
- If a solution that does not contain surfactant is used throughout the day, the rinsing procedure should be performed if the instrument is idle for more than 4 hours.

Procedure

Rinse the Manifold

To clear the existing fluid from the manifold tubing:

1. Disconnect the tubing from the supply bottle fitting.
2. Run the **Prime** Utility with a manifold prime volume of 20 to 40 ml. See ***Chapter 6*** for instructions on using the Prime Utility.

Prime the Tubing

To prime the tubing using 40 to 60 ml of the desired rinse fluid:

1. Fill the supply bottle with a sufficient amount of the desired rinse fluid.
2. Reconnect the tubing to the supply bottle fitting.
3. Run the Prime Utility with a manifold prime volume of 40 to 60 ml. See ***Chapter 6*** for instructions on using the Prime Utility.
4. Empty the priming trough.

Overnight/Multi-Day Maintenance

Purpose

For Precision 8-Channel Plus, 12-Channel Plus and Universal models: Overnight/ multi-day maintenance involves flushing all dispensing solution from the instrument, soaking the manifold and tubing, and keeping them moist, until regular use is resumed.

Frequency

If the instrument will be left idle for a period of time (such as overnight or over the course of a weekend), the tubes should be left filled with deionized water.

Procedure

To perform overnight/multi-day maintenance:

1. Run the *Daily Maintenance* procedure at the end of the day (see previous page).
2. When the Prime is complete, turn the instrument off. Take the manifold out of its holder and set it over the priming trough so the tubes are soaking in the fluid. Leave the instrument like this overnight or for multiple days.
3. Before you turn the instrument back on, reseat the manifold in its holder and empty the priming trough. When you turn the instrument back on, run the Prime utility again to flush the manifold tubes.

Periodic Maintenance

Purpose

Periodic maintenance involves replacing the pipette tip o-rings, cleaning the instrument's fluid-handling components and work surfaces, and cleaning and lubricating the linear ways and motor screws.

Frequency

The pipette tip o-rings should be replaced at least every six months. Fluid-handling components and work surfaces should be cleaned at least monthly, and the linear ways and motor screws should be cleaned and lubricated at least every six months.

Warning! Internal Voltage. Always turn off and disconnect the instrument from the power supply for all cleaning operations.

Important! Do not immerse the instrument, spray it with liquid, or use a "wet" cloth. Do not allow cleaning solution to run into the interior of the instrument. If this happens, contact the Bio-Tek Service Department.

Do not soak the external keypad – this will cause damage. Moisten a clean cloth with deionized or distilled water and wipe the keypad. Dry immediately with a clean, dry cloth.

Important! The use of any lubricant on the fluid-handling components will interfere with the dispensing performance, and may cause irreparable damage to them. Specifically, **do not apply lubricants** to manifold channel-end seals, bottle-cover seals, any tubing connections, or any surface that is a part of the fluid path.

In addition, **do not apply lubricants** to the stainless steel pipette tips or to the o-rings that come into contact with the disposable tips. Any lubricant present on these components may interfere with the reliable retention of the disposable tips.

Tools and Supplies

- Spare pipette tip o-rings (8 or 12), supplied with all models (PN 19458)
- One fine point plastic pipette tip (if replacing o-rings)
- Stylus, supplied with Precision 8-Channel Plus, 12-Channel Plus and Universal models (PN 2872304)
- Deionized or distilled water
- Lint-free disposable towels
- Soft lens cleaning tissue
- 70% isopropyl alcohol
- Dish soap or other mild cleanser
- Soft-bristled brush

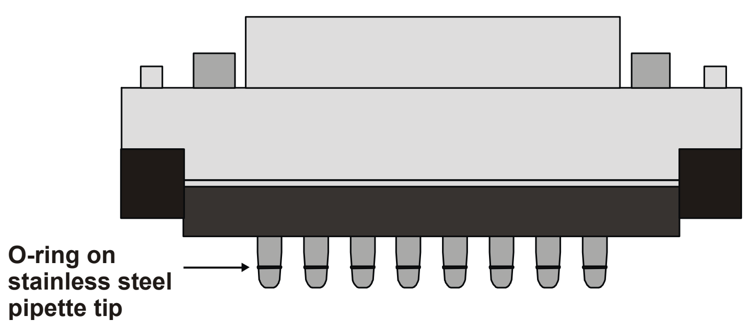
Procedures

Replace the Pipette Tip O-Rings

The pipette tip o-rings should be replaced *at least every six months*.

They should also be replaced if damage such as tears or cuts are observed, or if dripping from the pipette tips is observed during a fluid transfer.

❖ **Note:** If such observations are made, run the Seal Check described under ***Operational Qualification*** in ***Chapter 7***. If the test fails, replace the o-rings and re-run the test.



> **Important!** Do not use a hard, sharp tool of any kind to remove the o-rings. Use a fine point plastic pipette tip. Using a hard, sharp tool will permanently damage the stainless steel pipette tips.

Remove the existing o-rings:

1. Turn the instrument off. Push the supply platform all the way back, and slide the pipette mechanism all the way to the right. Remove any supply platform components from Stations C and F. Position yourself in front of the instrument so you are about eye-level with the stainless steel pipette tips.
2. Get a fine point plastic pipette tip and set it aside.
3. With clean, dry hands, grasp a steel pipette tip between your thumb and index finger so you can squeeze the o-ring.
4. Squeeze the o-ring and push it forward to stretch it. A loop of the stretched o-ring will come out of the o-ring groove.
5. Insert the plastic pipette tip into this loop, and with a downward motion pull the o-ring out of the groove and off the steel tip.
6. Remove all of the o-rings before installing the new ones.

Install replacement o-rings:

1. Place an o-ring near the tip of your index finger.
2. Touch the bottom of the steel pipette tip so it is centered inside the ring.
3. Use both index fingers to slide the ring up onto the tip, until it is seated firmly in the o-ring groove.

Clean the Supply Platform and Fixtures

If liquid has overflowed onto the supply platform and/or fixtures, some buildup may occur. This can prevent the fixtures from seating correctly on the platform, and supplies from seating correctly in the fixtures.

To clean the supply platform and fixtures:

1. Turn the instrument off and unplug it.
2. Remove all supplies and fixtures, and then remove the supply platform (lift it up and off its two holding pins).
3. Clean the supply platform using soap and hot water or 70% isopropyl alcohol.

4 Clean the fixtures using soap and hot water or 70% isopropyl alcohol.

5 Replace the supply platform. Orient the platform so that the label **FRONT** is visible when standing in the front of the instrument

6 Replace the fixtures.

Clean the Stainless Steel Pipette Tips

General guidelines:

- No maintenance is needed under normal operating conditions. If required, however, the stainless steel tips and o-rings can be gently wiped with soft lens cleaning tissue moistened with 70% isopropyl alcohol.

Clean the Supply Bottle (Precision 8-Channel Plus, 12-Channel Plus, and Universal)

General guidelines:

- Thoroughly rinse the supply bottle with deionized water before the first use, before each refill, and periodically, as necessary, to prevent bacteria growth.

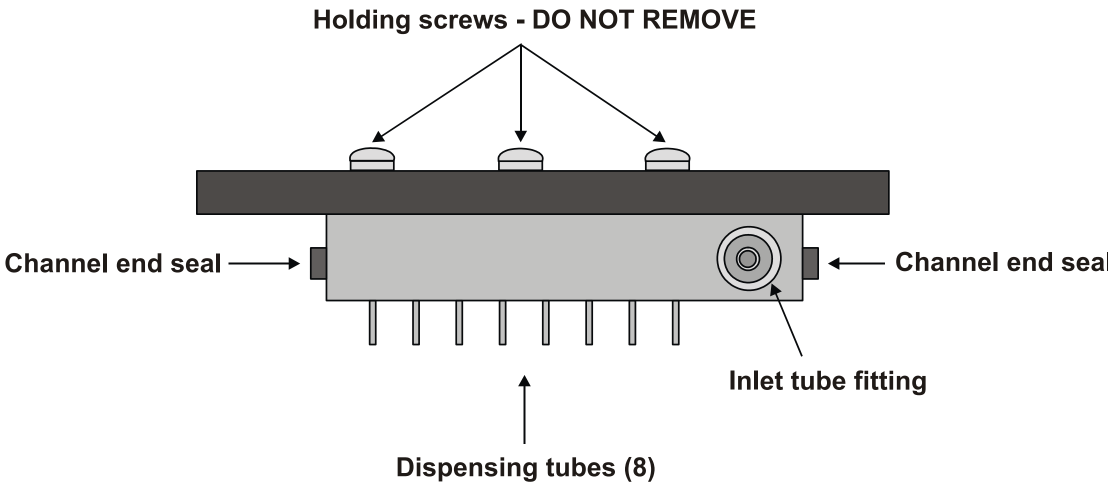
- Rinse the supply bottle cover every time the bottle is filled.

- Accumulated algae, fungi, or mold on the supply bottle and/or cover may require disinfecting. See ***Decontamination*** at the end of this chapter for instructions.

Clean the Manifold (Precision 8-Channel Plus, 12-Channel Plus, and Universal)

As described in ***Daily Maintenance***, regular rinsing keeps the manifold clean, the dispense tubing clear, and increases the life of the tubing. Periodically running the ***Decontamination*** procedure disinfects the manifold and tubing. If you are performing these recommended procedures, and are still experiencing manifold dispensing problems, clean the dispense tubes and channel.

> **Important!** Do **NOT** remove the three screws that hold the manifold together. Removing these screws will have an adverse effect on the manifold's alignment.



To clean the manifold tubes and channels:

1. Turn the instrument off and unplug it.
2. Lift the manifold off its holder.
3. Disconnect the inlet tubing from the clear plastic fitting.
4. Remove the two black channel-end seals.
5. Using a soft bristled brush, thoroughly clean the outside of the manifold. Insert the stylus into each tube to break up any buildup. Flush deionized or distilled water through the end channels to remove debris.
6. Reinsert the channel-end seal furthest away from the clear plastic fitting. While holding one finger over the fitting, orient the manifold under a stream of hot water so that it flows into the open channel and flows out through the dispense tubes. Adjust the water flow and the angle of the manifold until the water streams out of the tubes.
7. If any buildup remains, soak the manifold in hot soapy water for about 30 minutes, then repeat steps 5 and 6.
8. When you’re satisfied that the manifold is clean, re-insert both channel-end seals, reconnect the inlet tubing, and reseat the manifold on its holder.
9. Turn the instrument on and run the Prime utility using 80 ml of deionized or distilled water.

Preparation for Storage or Shipment

Purpose

Before storing or shipping any instrument model, it should be decontaminated (see the next section). Before shipping the Precision 8-Channel Plus, 12-Channel Plus, or Universal, the manifold and tubing should be rinsed and soaked with disinfectant, then purged of all fluid.

Frequency

Perform these steps when leaving the instrument unused for a long period of time.

Procedure

1. Decontaminate the instrument (see the next section).
2. For the Precision 8-Channel Plus, 12-Channel Plus, and Universal models:
   - Run the ***Daily Maintenance*** procedure at the end of the day, substituting the rinse fluid with a disinfectant appropriate for your lab.
   - When the Prime is complete, turn the instrument off.
   - Take the manifold off its holder and set it on the priming trough so the tubes are soaking in the fluid. Leave the instrument like this for 30 minutes.
   - Before you turn the instrument back on, reseat the manifold in its holder and empty the priming trough. Turn the instrument on.
   - Disconnect the tubing from the fitting on the supply bottle. Run the Prime Utility with a prime volume of 20 to 40 ml. Repeat if any fluid remains in the tubing.

Storing the Precision

1. Turn off and disconnect the Precision from its power supply.
2. Store the instrument on a flat surface that is relatively free of vibration, in a dust- and particle-free environment.
3. Protect the instrument from temperature extremes that can cause condensation within the unit and from corrosive fumes and vapors.
4. Store the Precision under the following environmental conditions:
   - **Temperature:** -25° to 50° C < 24 hours; 10° to 40° C > 24 hours
   - **Relative humidity:** 10% to 80% (non-condensing)

Decontamination

Purpose

Any laboratory instrument that has been used for research or clinical analysis is considered a biohazard and requires decontamination prior to handling.

Decontamination minimizes the risk to all who come into contact with the instrument during shipping, handling, and servicing. Decontamination is required by the U.S. Department of Transportation regulations.

Persons performing the decontamination process must be familiar with the basic setup and operation of the instrument.

Important! Bio-Tek Instruments, Inc. recommends the use of the following decontamination solutions and methods based on our knowledge of the instrument and recommendations of the Centers for Disease Control and Prevention (CDC). Neither Bio-Tek nor the CDC assumes any liability for the adequacy of these solutions and methods. Each laboratory must ensure that decontamination procedures are adequate for the Biohazard(s) they handle.

Wear prophylactic gloves when handling contaminated instruments. Gloved hands should be considered contaminated at all times; keep gloved hands away from eyes, mouth, nose, and ears. Eating and drinking while decontaminating instruments is not advised.

Mucous membranes are considered prime entry routes for infectious agents. Wear eye protection and a surgical mask when there is a possibility of aerosol contamination. Intact skin is generally considered an effective barrier against infectious organisms; however, small abrasions and cuts may not always be visible. Wear protective gloves when performing the decontamination procedure.

Tools and Supplies

- Sodium hypochlorite (NaClO, or bleach)
- 70% isopropyl alcohol (as an alternative to bleach)
- Deionized or distilled water
- Safety glasses
- Surgical mask
- Protective gloves
- Lab coat
- Biohazard trash bags
- 125 ml beakers
- Clean cotton cloths

Decon Procedure for External Surfaces of the Instrument

Warning! Internal Voltage. Always turn off and unplug the instrument for all decontamination and cleaning operations.

The bleach solution is caustic; wear gloves and eye protection when handling this solution.

Do not immerse the instrument, spray it with liquid, or use a "wet" cloth. Do not allow the cleaning solution to run into the interior of the instrument. If this happens, contact the Bio-Tek Service Department.

Do not soak the keypad. This will cause damage. Wipe the keypad with a damp cloth.

1. Turn off and unplug the instrument.
2. Prepare an aqueous solution of 0.5% sodium hypochlorite (bleach). As an alternative, 70% isopropyl alcohol may be used if the effects of bleach are a concern.

- Be sure to check the % NaClO of the bleach you are using; this information is printed on the side of the bottle. Commercial bleach is typically 10% NaClO; if this is the case, use a 1:20 dilution. Household bleach is typically 5% NaClO; if this is the case use a 1:10 dilution.

3. Moisten a cloth with the bleach solution or alcohol. Do not soak the cloth.
   - Wipe the keypad (do not soak). Wipe again with a clean cloth moistened with deionized or distilled water. Dry immediately with a clean, dry cloth.
   - If the protective aerosol cabinet is installed, remove it by lifting it up and away from the base instrument. Wipe the supply platform, supply fixtures, and all exposed surfaces, including the aerosol cabinet.
4. Wait 20 minutes. Moisten a cloth with DI or distilled water and wipe all surfaces of the instrument that have been cleaned with the bleach solution or alcohol.
5. Use a clean, dry cloth to dry all wet surfaces.
6. Reassemble the instrument as necessary.
7. Discard the used gloves and cloths using a Biohazard trash bag and an approved Biohazard container.

Decon Procedure for Tubing and Manifold

1. Turn off and unplug the instrument.
2. Remove the tubing and manifold.
3. Prepare an aqueous solution of 0.5% sodium hypochlorite (bleach). As an alternative, 70% isopropyl alcohol may be used if the effects of bleach are a concern.
   - Be sure to check the % NaClO of the bleach you are using; this information is printed on the side of the bottle. Commercial bleach is typically 10% NaClO; if this is the case, use a 1:20 dilution. Household bleach is typically 5% NaClO; if this is the case use a 1:10 dilution.
4. Soak the tubing and manifold in the bleach or alcohol solution.
5. Wait 20 minutes. Rinse the tubing and manifold in DI water.
6. Use a clean, dry cloth to dry all wet surfaces of the tubes and manifold.
7. Reassemble the instrument as necessary.
8. Discard the used gloves and cloths using a Biohazard trash bag and an approved Biohazard container.

Cleaning and Lubrication of the Linear Ways and Motor Screws

Purpose

Periodic cleaning and lubrication of the four linear ways and two motor screws on the Precision is necessary to ensure optimum performance of these components. Bio-Tek recommends cleaning and lubricating the linear ways and motor screws every six months using the grease kit (PN 7110017) included in the package contents of the Precision.

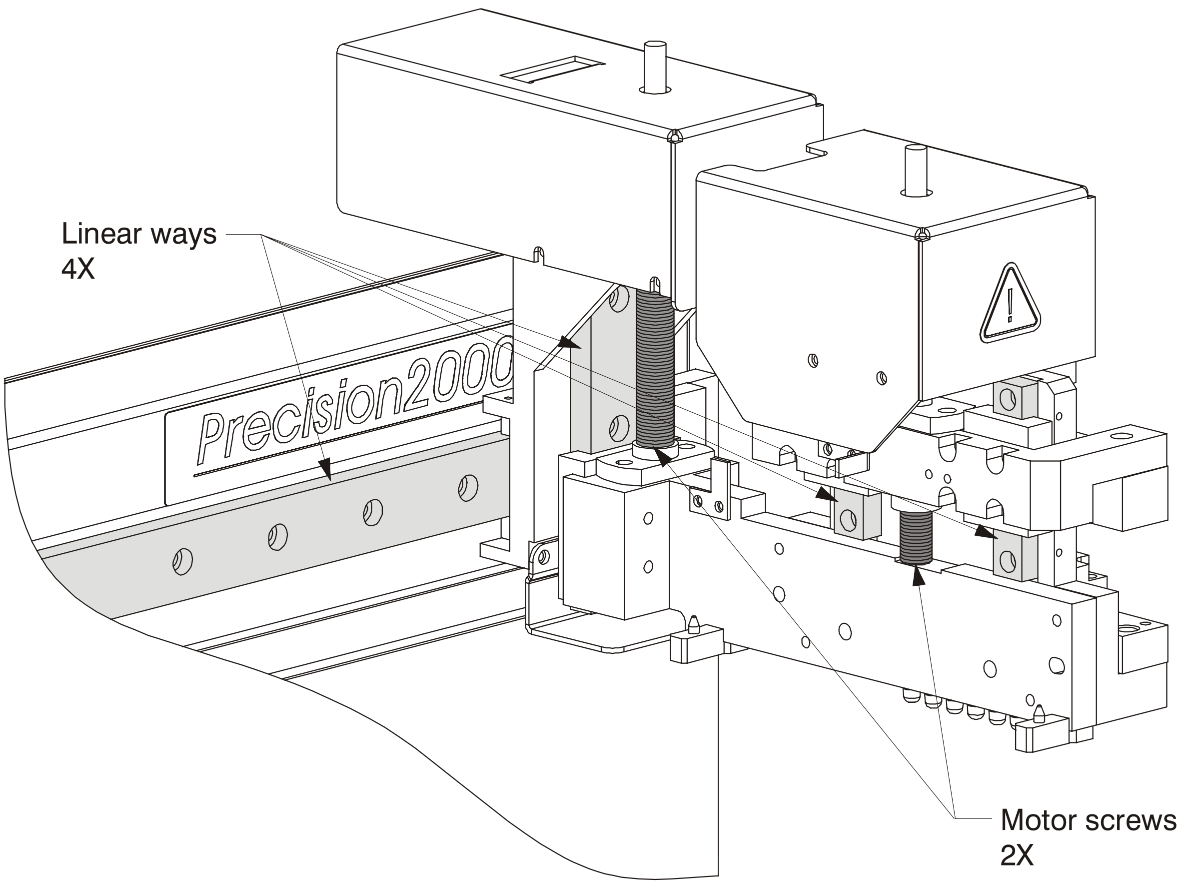
Tools and Supplies

- Clean lint-free towels
- Rubber gloves
- Soft-bristled toothbrush
- Cotton swabs
- Paper towels
- Bio-Tek grease kit (PN 7110017)

Procedure

1. Power down and unplug the Precision.
2. Refer to the drawing (PN 7110017-AW) included in the kit and shown in the illustration on the following page.
3. Using the cotton swabs or paper towels moistened with alcohol to assist the process, remove old contaminated grease from the four linear ways and two motor screws.
4. Allow these parts to dry completely.
5. Apply a small amount of new lubricant to all surfaces of the linear ways and screws, spreading thin layers and working the grease into the surfaces with a soft-bristled toothbrush.
6. Ensure that you lubricate the sides of the linear ways, since ball bearings travel on these surfaces.

Important! DO NOT apply lubricant to any of the fluid-handling components, stainless steel pipette tips, or o-rings that come into contact with the disposable tips! Lubricant on any of these parts could damage the instrument.



Chapter 9

Error Codes

This chapter lists and describes the possible functional and validation error codes that may appear on the Precision's external keypad display. Bio-Stack error codes are also included for customers who have purchased the Stacker for operation with the Precision.

Error Codes

Functional Error Codes: General and Fatal Errors

A **functional error** code is generated by a hardware failure, and appears on the Precision's external keypad display as a four-digit identifier. The first digit will be **0**, **1**, **2**, **3**, or **A**.

- **0**, **1**, **2**, or **3** indicates a non-critical error ("General"), which means that the instrument will still respond to keypad input. See ***General Errors***, page 221.
- **A** indicates a more serious error ("Fatal"), which requires that the Precision be turned off and then powered up. Upon restarting the instrument, you should be able to enter commands into the keypad. See ***Fatal Errors***, page 223.

Program Validation Error Codes

A **program validation error** occurs when a fluid-transfer program fails to meet internally programmed validation criteria. A four-digit code appears on the Precision's external keypad display with some additional information, such as program name, and command, loop and run numbers. See ***Program Validation Errors*** page 224.

Bio-Stack Error Codes

Bio-Stack error codes are displayed in **Precision Power™ Software** (on the controlling PC) during operation of the Precision with the **Bio-Stack™ Microplate Stacker**. Errors may occur during communication between the two instruments or during Bio-Stack plate transfer operations. See ***Bio-Stack Errors***, page 238.

General Errors

General Errors indicate non-fatal conditions that require attention.

For the codes that represent motor errors, the fourth digit of the code represents the affected motor. For example, error code **0200** means that the platform motor (left) could not find its optical sensor.

0 = platform motor (left)

1 = lift motor

2 = shuttle motor

3 = platform motor (right)

4 = manifold syringe motor

5 = pipette syringe motor

6 = both (left and right) platform motors: instruments with basecode **PN 7110200-FW**

A = both (left and right) platform motors: instruments with basecode **PN 7110208-FW**

Code	Description
0100	Error aborting function.
020n	<Motor> did not find opto-sensor transition. This error indicates that a motor was not able to move to its "home" position as registered by feedback from an optical sensor. • Pipette arm movement may be limited so that the optical sensor cannot be interrupted. Check the pathway for obstructions.
030n	<Motor> could not find edge of hole in jig. This error is usually only seen during the AutoCal sequence (an auto-alignment procedure performed by Service personnel).
040n	<Motor> failed positional verify. This error indicates that an axis failed its positional verify test. After moving a predefined number of steps from a home position, the motor should return to the home position in the proper amount of time and steps. If the axis moves back to its home position in the wrong amount of time or too few or too many steps, the test fails. • A belt may be slipping due to incorrect tension, a loose motor pulley, or a loose belt clamp. This can also be caused by a defective motor drive circuit. • The linear ways or motor lead screws need to be lubricated.

General Errors, Cont'd

Code	Description
0500	Undefined program type specified.
060n	Invalid <file number>.
0700	Invalid write attempt.
0800	Invalid delete attempt.
0900	Manifold syringe volume too large.
0A0n	Checksum failure <file number>.
0B00	Dipswitch incompatibility error.
1000	Necessary configuration data is missing.
1100	Failed configuration checksum test.
1200	Self Test not complete.
130n	<Motor> not homed successfully.
1400	AutoCal aborted.
1900	Error trying to allocate memory.
1C00	Manifold syringe FMEA error.
1E00	Failed AutoCal checksum test.
2110	Not enough fluid detected for aspirate.
2120	Not enough fluid detected for dispense.
2300	Requested pickup volume is too small for the aspirate rate.
2400	Pipette syringe is too full for aspiration.
2500	Shuttle home and away sensors are either too close to or too far away from each other.
2600	Volume to be dispensed by manifold syringe is too large.
2700	Printer timed out.
2800	Printer not connected.
3500	Lift travel limit exceeded (35,000 ¼ steps maximum)
3600	Invalid manifold for calibration.

❖ **Note:** Calibration errors (1400, AutoCal aborted; 1E00, Failed AutoCal checksum test; 3600, Invalid manifold for calibration) will normally be displayed only during calibration or repair of the instrument by Bio-Tek TAC.

Fatal Errors

Fatal Errors indicate conditions that require immediate attention. If a fatal error is displayed, contact Bio-Tek's Technical Assistance Center for further instructions.

For the codes that represent device errors, the fourth digit of the code represents the affected device. For example, error **A302** means that for some reason the shuttle mechanism is inaccessible.

0 = platform (left)
1 = lift
2 = shuttle
3 = platform (right)
4 = manifold syringe
5 = pipette syringe
6 = timer
7 = display
8 = printer
9 = quick flash

Code	Description
A100	Task control block not available.
A200	Dispenser function already in use.
A30n	<Device> not available.
A400	Failed code checksum test on power up.
A500	Power dropped below safe level.
A600	Quick flash configuration timed out.
A700	Quick flash read did not match write.
A800	RAM error.
A900	Memory allocation heap corrupted.

Program Validation Errors

The Precision provides a utility to ensure the validity of programs before they are actually run. You can execute this utility manually by selecting `DEFINE` and then `VALIDATE`. It also executes automatically when you choose to run a program. *A program must be error-free before you can run it.*

During validation, the software runs the program in a simulation mode, checking to see if:

- The syntax of the program is correct.
- Supplies are mapped legally for a station.
- All indices are calculated within the "mapped" range.
- All volumes are within a "valid" range.

When validation is complete, either `PROGRAM IS VALID` is displayed, or an error code is displayed. Error codes are displayed with some additional information, to help you find and fix the problem(s). For example:

```
PGRM: 96 2 96
 ERR:4019 C:08 L:07 R:01
```

- **PGRM** is the name of the program that was just validated.
- **ERR** contains the actual **error code.** Use the tables on the following pages to look up error codes, and read about their probable causes.
- **C** represents the **command number** in the program where the error was encountered.
- **L** represents the **Loop** number in which the error was detected. Remember that the software runs the program in a simulation mode, so it is actually going through the loop(s) L-MAX times. `L:00` means the command was not inside of a loop.
- **R** represents the **Run** number in which the error was detected. The program runs in simulation mode for as many runs as is specified by the MAP command with the largest *Reload after Run* value.

Here is the program that generated the **4019** error, “No supply exists at the calculated column index”:

```
01 MAP: A 1-12 T RAIN     1 1
02 MAP: B 1-12 V NF8x12 200 1 1
03 MAP: C 1-12 V NF8x12   0 1 1
04 MAX: 12 # OF LOOPS:
05 ON:  START OF LOOP
06 TIP:       A 1 1 TDETAIL1
07 ASPIR: 100 B 1 1 ADETAIL1
08 DISP:  50  C 1 2 DDETAIL1
09 OFF: END OF LOOP
10 END:
```

The error appears in command #08 (DISP), during loop #07 of run #01.

Notice that the Increment Column By for the DISP command is set to **2**, while it is set to 1 for the TIP and ASPIR commands. **Note:** All stations are arranged in an 8 x 12 format.

In loop #07, tips are picked up from column 7 of Station A and fluid is aspirated from column 7 of Station B. But because Station C’s columns have been processed in the order 1, 3, 5, 7, 9, 11, and there is no column 13, the 4019 error is detected.

Code	Description and Possible Causes
4001	**This command cannot be used when looping is on.** Probable causes: • A MAP command is defined between a set of L-ON and L-OFF commands. Each MAP command should *precede* the loop in which it is referenced. • There is an extra L-ON command inside the loop. Every loop requires one L-ON and one L-OFF command. • The program has "nested" loops. A program can have more than one loop, but one loop must end before another can begin.
4002	**This command cannot be used when looping is off**. Probable cause: • There is an extra L-OFF command outside the loop. Every loop requires one L-ON and one L-OFF command.
4003	**Invalid command type.** Probable cause: • The basecode and/or configuration software may need to be re-downloaded. Contact Bio-Tek TAC.
4004	**The program has more than one L-MAX command.** Probable cause: • A program can have only one L-MAX command, and it must precede the *first* L-ON command. If a program has multiple loops, all loops use the same L-MAX.
4005	**Flash memory reports problems.** Probable cause: • The basecode and/or configuration software may need to be re-downloaded. Contact Bio-Tek TAC.

Code	Description and Possible Causes
4006	**Referenced a column beyond the tip specification limit.** Probable cause: • The referenced specification file was designed for a format other than the one specified by the program. For example, the referenced specification file may have been designed for a 12-channel instrument but the program's format is set to 8-channel. • A Tip Specification File that is referenced by a command in a previously valid program may have been edited to decrease the number of columns.
4007	**Referenced a column beyond vessel limit.** Probable cause: • A Vessel Specs file that is referenced by a MAP command in a previously valid program may have been edited to decrease the number of columns. For example, the MAP command may define a Last Column to Load of 12 but the Vessel Specs file may define Number of Columns as 10.
4008	**Volume exceeds capacity.** Probable cause: • A Vessel Specs file that is referenced by a MAP command in a previously valid program may have been edited to decrease the Maximum Volume, and now the Initial Volume in the MAP command is greater than the capacity of the vessel.
4009	**File type conflict.** Probable cause: • The basecode and/or configuration software may need to be re-downloaded. Contact Bio-Tek TAC.
4010	**The Reset Index value is greater than Reload After Run value.** Probable cause: • Within any MAP command, the Reset Index After Run value cannot be greater than the Reload After Run value.

Code	Description and Possible Causes
4011	**Vessel(s) and tips are mapped to the same station.** Probable cause: • Any station can be loaded with tips or vessels, but not with both at the same time. Check the Station and Load With parameters for every MAP command to ensure every station is mapped with tips *or* vessels.
4012	**Illegal range, first value is greater than last value.** Probable cause: • A MAP command may specify a First Column to Load value that is greater than the Last Column to Load value. For example, if First Column to Load is 12 and Last Column to Load is 1, this is an "illegal range."
4013	**The program contains one or more ASPIRate commands but there is no TIPS command.** Probable cause: • The program does not have a TIPS command. A TIPS command must precede one (or a set of) ASPIRate commands.
4014	**The program contains an aspirate command and the manifold is on.** Probable cause: • The program does not have a TIPS command. A TIPS command must precede one (or a set of) ASPIRate commands.

Code	Description and Possible Causes
4015	**Cannot aspirate this much fluid with this tip.** *Per tip: Initial Volume + Pre-Air Volume + Post Air Volume + Aspirate Volume must be less than 120 µl OR the Tip Max Volume in the Tip Specs file, whichever is smaller.* Probable causes: • The volume in the ASPIR command is greater than the tip max volume defined in the Tip Specs File. Check the settings of the Tip Specs File referenced in the MAP command for the station where the ASPIR is taking place. **Note:** The pre- and post-air volumes add to the tip's volume. • The aspirate volume in the ASPIR command is greater than the initial volume defined in the MAP command. In the example below, the aspirate volume of 100 is greater than the vessel volume of 50. `02 MAP: B 1-12 V NF96` **50** `05 ASP:` **100** `B 1 1` • The ASPIR command is not referencing an Aspirate Detail file. **Note:** This unlikely scenario can only occur if there are NO existing Aspirate Detail files.
4016	**Cannot aspirate this much fluid from this vessel.** Probable cause: • Aspirating the volume defined in the ASPIRate command would cause the fluid level in the vessel to drop below the Vessel Minimum Volume that is defined in the Vessel Spec File. Consider decreasing the aspirate volume in the ASPIR command, or reference a different Vessel Spec File in the MAP command.

Code	Description and Possible Causes

4017	**Cannot dispense this much fluid with the current volume in the tips.**
	
	Probable causes:
	
	• The dispense volume in a DISP command is greater than the aspirate volume in the corresponding ASP command. In the example below, the dispense volume of 100 µl/tip is greater than the aspirate volume of 80 µl/tip:
	
	`06 ASP: 80 B 1 1 ASP01`
	`07 DSP: 100 C 1 1 DSP01`
	
	• The DISP command is not referencing a Dispense Detail file. **Note:** This unlikely scenario can only occur if there are NO existing Dispense Detail files.

4018	**A Loop Max command is required before the loop.** Probable cause: • A loop is defined by L-ON and L-OFF, but there is no L-MAX command. An L-MAX command must be defined before the *first* L-ON command (a program can have only one L-MAX command; if a program has multiple loops, all loops use the same L-MAX).
4019	**No supply exists at the calculated column index.** Probable causes: • Compare the ranges in the MAP commands with the specific columns that are going to be processed by the action commands (TIPS, ASPIR, and DISP). For example, error 4019 will appear if the Starting At Column for an action command is 5, but the corresponding MAP command's Last Column to Load is 4. • An action command is referencing a station for which no MAP command has been defined. • A set of tips was picked up at this column but was discarded, so it cannot be picked up again. The setting of the Put Used Tips Into parameter of the Tip Detail file determines whether or not a set of tips will be made available for re-use.

Code	Description and Possible Causes
4020	**Two MAP commands reference the same station and column.** Probable causes: • The MAP commands accidentally reference the same station, although the intent was to reference two different stations. • The MAP commands appropriately reference the same station but the column ranges overlap. It is acceptable to assign multiple MAP commands to the same station, but their First Column to Load / Last Column to Load ranges cannot overlap.
4021	**An L-MAX command is defined, but the program contains no loop.** Probable causes: • An intended loop is missing. Add L-ON and L-OFF to define the loop. • The program should not contain a loop. Remove the L-MAX command.
4022	**Cannot dispense this much fluid into the vessel.** *Per vessel: Initial Volume* + *Dispense Volume* + <*any volume previously dispensed*> *must be less than or equal to the Vessel Max Volume in the Vessel Specs file.* Probable causes: • A DISP command is trying to dispense more fluid to a vessel than it is specified to hold. Check the Vessel Specs file referenced by the MAP command for the station where the dispense is taking place. Its Max Volume is probably less than the Dispense Volume. • A DISP command is trying to dispense a volume of fluid that, when added to the volume of fluid already in the vessel, will exceed the Max Volume in the Vessel Specs file. Check the Initial Volume defined in the MAP command, and also check any previous DISP commands applied to this vessel.
4023	**Detail file being referenced is invalid** Probable causes: • The command references a detail file that has been deleted or renamed. • The instrument's flash memory is defective. Contact Bio-Tek TAC.

<table>
<tr><th>Code</th><th>Description and Possible Causes</th></tr>
<tr><td>4024</td><td>Spec or detail file not assigned.

Probable causes:

• A MAP command is missing the required reference to a Tip or Vessel Specs file. Make sure that the necessary spec file exists, then make sure the MAP command references it.

• The TIPS, ASPIR, or DISP command has no detail file associated with it. Ensure that the necessary detail files exist, and that the TIPS, ASPIR, or DISP command references them.</td></tr>
<tr><td>4025</td><td>The map has the wrong supply for the command.

Probable causes:

• A TIPS command references a station that does not contain tips. Ensure that the station referenced in the TIPS command has a MAP command defined for it, and that the MAP command references a Tip Specs file.

• An ASPIR or a DISP command references a station that does not contain a vessel(s). Make sure that the station referenced in the ASPIR or DISP command has a MAP command defined for it, and that the MAP command references a Vessel Specs file.</td></tr>
<tr><td>4026</td><td>Minimum volume not met for the defined aspiration rate.

Probable cause:

• Within an ASPIR command, the Aspirate Volume is too small for the Aspiration Rate defined in the Aspirate Detail file. Increase the volume or decrease the rate.</td></tr>
<tr><td>4027</td><td>Minimum volume not met for the defined dispense rate.

Probable cause:

• Within a DISP command, the Dispense Volume is too small for the Aspiration Rate defined in the Dispense Detail file. Increase the volume or decrease the rate.</td></tr>
</table>

Code	Description and Possible Causes
4028	**Minimum volume not met for the defined mixing rate.** Probable causes: • Within an ASPIR command, the Aspirate Volume is too small for the Mix Dispense Rate defined in the Aspirate Detail file. Increase the volume or decrease the rate. • Within a DISP command, the Dispense Volume is too small for the Mix Dispense Rate defined in the Dispense Detail File. Increase the volume or decrease the rate.
4029	**Minimum volume not met for the defined priming rate.** Probable cause: • Within the Dispense Detail file referenced in a DISP command, the Manifold Prime Volume is too small for the defined Manifold Aspir Rate. Increase the volume or decrease the rate.
4030	**Mix volume is more than the tip can hold.** Probable causes: • For an ASPIR command, in the referenced Aspirate Detail File, the defined Mix Volume is greater than the Tip Max Volume defined in the Tip Specs file. • For a DISP command, in the referenced Dispense Detail File, the defined Mix Volume is greater than the Tip Max Volume defined in the Tip Specs file.
4031	**Mix volume exceeds what is accessible in the vessel.** Probable cause: • The current volume in the vessel is smaller than the defined Mix Volume in the Aspirate or Dispense Detail file (if this is the run 01, the Initial Volume in the MAP command may be smaller than the Mix Volume). Increase the vessel volume or decrease the Mix Volume.

Code	Description and Possible Causes
4032	**This model is not equipped with a manifold.** Probable cause: • A DISP command in the program references a Dispense Detail File that is designed for the manifold, and the instrument is not equipped with a manifold.
4033	**Too many aspirate air-fluid layers.** Probable cause: • There are too many air/fluid “layers” in the tip. Reduce the number of times air was used as a separator between fluid aspirations.
4034	**Cannot replenish a non-existing column.** Probable cause: • The SUPPLY command specifies replenishing a supply at a column location that does not exist for the current supply mapping. It is possible that the Station Supply List was modified after the SUPPLY command was created. You must be sure that the SUPPLY command replenishes supplies that are correctly specified in the Station Supply.
4035	**No map was found for replenishing.** Probable cause: • The SUPPLY command specifies replenishing a supply at a station that does not have a supply mapped at that column location. It is possible that the Station Supply List was modified after the SUPPLY command was created. You must be sure that the SUPPLY command replenishes supplies that are correctly specified in the Station Supply List.
4036	**The fill volume is too small.** Probable cause: • The SUPPLY command specifies replenishing a vessel with a volume that is smaller than the minimal accessible volume for that vessel. It is possible that the SUPPLY command has an incorrect value for the volume to replenish. You must be sure that the SUPPLY command replenishes volumes that are correct for the specified supplies.

Code	Description and Possible Causes
4037	**The fill volume is too large.** Probable cause: • The SUPPLY command specifies replenishing a vessel with a volume that exceeds the maximum capacity for that vessel. It is possible that the SUPPLY command has an incorrect value for the volume to replenish. You must be sure that the SUPPLY command replenishes volumes that are correct for the specified supplies.
4038	**A map command refresh value prohibits a mid-run replenishing.** Probable cause: • For the supply specified at this station, the Reload Supply value under the Advanced Options was set to a number greater than one. It is a contradiction to specify that a supply can be used for more than one run and then request to replenish it during a run. You must either set the Reload Supply value of the Advanced Options to 1 or remove this SUPPLY command.
4039	**A program's mode, 8- or 12-channel, conflicts with the specs file used.** Probable cause: • The program was created with a format setting that conflicts with the format of the selected specification file(s). If you are writing a program for the 8-channel version of the instrument, be sure that you select specification files representing the 8-channel configuration. If you are writing a program for the 12-channel version of the instrument, be sure that you select specification files representing the 12-channel configuration.
4040	**A program's mode, 8- or 12-channel, conflicts with the hardware setting.** Probable cause: • The program was created with a format setting that conflicts with the current setting of the instrument. Unique programs must be written for each format of the instrument (e.g., 8-channel or 12-channel format). Because a program references specification files that are unique to a particular format, a program cannot run in a format other than what it was designed for.

Code	Description and Possible Causes
4053	**Resupplying a tip rack requires the SUPPLY command to use the Unload setting.** Probable cause: • Invalid SUPPLY command; edit the SUPPLY command to change its In-Process Shuttle Action to Unload.
4054	**Invalid pre-air or post-air volume.** Probable cause: • The volume selected is either too small for the single-channel syringe to aspirate using the current Aspirate Rate, or too large for the multi-channel pipette to aspirate using the current Aspirate Rate. Check the pre- and post-air volumes defined in the Detail file selected for the command. Ensure the total allowable volume for the instrument is not exceeded.
4420	**Volume per stroke not within acceptable range.** Probable cause: • Configuration data is corrupt or was never downloaded.
4430	**Too many syringe strokes required.** Probable cause: • Volume chosen for activity is too large.
4440	**Syringe micro-liters per step error.** Probable cause: • Configuration data is corrupt or was never downloaded.
4450	**Volume aspirated will exceed pipette capacity.** Probable cause: • The Aspirate Volume or the Mixing Volume of the ASPIRATE command will exceed the capacity of the pipette syringe if the volume is actually aspirated. Reduce the volume and ensure that the amount in the syringe prior to aspirating is correct.

Code	Description and Possible Causes
4460	**Invalid aspirate rate.** Probable cause: • The Aspirate Detail File referenced in the ASPIRATE command is not compatible with the pipette to perform the command. Modify the command to reference a detail file with an aspirate rate that matches the pipette.
4470	**Invalid dispense rate.** Probable cause: • The Dispense Detail File referenced in the DISPENSE command is not compatible with the pipette or dispenser set to perform the command. Modify the command to reference a detail file with an aspirate rate that matches the pipette.
4480	**Invalid mix rate.** Probable cause: • The Aspirate Detail File referenced in the ASPIRATE command or the Dispense Detail File referenced in the DISPENSE command is not compatible with the pipette set to perform the command. Modify the command to reference a detail file with an aspirate rate that matches the pipette.
4490	**Invalid prime aspirate rate.** Probable cause: • This is no longer used. If you receive this error code, please contact Bio-Tek's Technical Assistance Center.
44A0	**Invalid prime dispense rate.** Probable cause: • The Dispense Detail File referenced in the DISPENSE command uses a rate number for the Dispenser Prime Rate that is out of range. Edit the file using a rate within the specified range.

Bio-Stack Errors

Precision Power Software controls all functionality of the Precision and uses the **ActiveX** component of the **Bio-Stack PC Control Software** to control the Bio-Stack. All errors are displayed in Precision Power on the controlling PC.

There are two basic types of errors that can occur during operation of the Precision with the Bio-Stack: communication errors and operational or plate transfer errors.

Communication Errors

If there are problems with communication between the Precision and the Bio-Stack, error messages are **generated by the ActiveX component** and are displayed on the host PC as text messages (in English).

Occasionally, an error code may appear without the text; these codes are always in a negative value format, for example: **-3**, **-401**.

See ***Communication Errors During Operation of the Precision With the Bio-Stack*** on page 239, for a list of these errors' text messages and codes and their probable causes.

Operational (Plate Transfer) Errors

Errors **generated by the Bio-Stack** during plate transfer operations are displayed on the host PC as text messages (in English).

Occasionally, an error code may appear without the text; these codes will be displayed in four-digit format, for example: **1000**. The first digit will be **0**, **1**, **2**, **3**, or **A**.

- **0**, **1**, **2**, or **3** indicates a non-critical error ("General"), which means that the Bio-Stack will still respond to input on the controlling PC.
- **A** indicates a more serious error ("Fatal"), which requires that the Bio-Stack be turned off and then powered up. Upon restarting the instrument, you should be able to enter commands in Precision Power.

See ***Plate Transfer Errors During Operation of the Precision With the Bio-Stack*** on page 241 for a list of these errors' text messages and codes; refer to the Bio-Stack Operator's Manual for their probable causes.

❖ **Note:** Plate transfer error codes are occasionally preceded by an **0x**; for example, code **1000** may appear as: **0x1000**.

Communication Errors During Operation of the Precision With the Bio-Stack

Error Code	or Text Message Displayed	Probable Cause
-3	**Operation cancelled by user.**	There is a problem with the driver software or with the communications. • Try closing Precision Power and restarting, or maybe even re-booting.
-4	**Unable to start system timer.**	There is a possibility that too many applications are using timers on the PC (there are only 8 timers available), or the delay timer is already set. • Close Precision Power and try again. • Close one or more other applications that may be using timers.
-5	**Invalid request.**	The Bio-Stack is not in correct mode for handling this request. • Try restarting the Bio-Stack.
-6	**Unable to process request.**	The Bio-Stack is not in correct mode for handling this request. • Try restarting the Bio-Stack.
-401	**Required object does not exist.**	The driver software has somehow lost information on the instrument it is trying to communicate with. • Re-start the application.
-504	**Serial port error.**	Either another application is using one of the serial ports, or a port was opened by another application or by Precision Power but was not closed properly. • Close the other application. • If that doesn't work, close Precision Power and re-start it. • Lastly, re-boot the PC.
-505	**Serial write error.**	This indicates a problem trying to write all of the serial data. • Try re-starting Precision Power.

Error Code	or Text Message Displayed	Probable Cause
-506	**Time-out or other read error.**	There has been a timeout while reading in serial data, or an incorrect number of serial characters were read in. • Check the serial cable connections to ensure they are not loose. • Check to see if any other application is very CPU intensive. • Try re-starting Precision Power.
-507	**Checksum error.**	This indicates a checksum error with the serial data read in. • Attempt the operation again. • Try re-starting Precision Power.
-508	**NAK: Invalid or out-of-context request.**	When attempting to talk to the Bio-Stack, the Bio-Stack basecode software returned a NAK, indicating it did not recognize the request. • Attempt the operation again. • Try re-starting the instrument. • Try re-starting Precision Power.
-509	**Excess data received.**	Precision Power received back more data than it was expecting. Unlikely to be seen. It is expected that a –506 would be sent instead. • Try re-starting Precision Power.
-510	**Unknown message object.**	Precision Power doesn't recognize the message sent. This is unlikely to be seen, but could possibly happen if the software got out-of-sync in the characters sent back and forth. • Try re-starting Precision Power.
-511	**Invalid message body size.**	This error indicates that Precision Power received an invalid count of expected characters for a specific message. This is unlikely to be seen, but could possibly happen if the software got out-of-sync in the characters sent back and forth. • Try re-starting Precision Power.

Plate Transfer Errors During Operation of the Precision With the Bio-Stack

Error Code	or Text Message Displayed
General Errors: Errors **0100 through 3200** are General Errors. General Errors indicate non-fatal conditions that require attention. Refer to the Bio-Stack Operator's Manual for **Probable Causes** and for a complete list of **sensor**, **motor**, and **instrument numbers** referenced in these errors.	
0100	**Error trying to abort the run.**
020# (# is the sensor number)	**Could not find sensor: #**
0300	**Could not find autocal jig.**
040# (# is the motor number)	**Failed verification of motor: #**
0500	**Program checksum error.**
0600	**Configuration data error.**
0700	**Configuration cheksum error.**
080# (# is the motor number)	**Failed homing of motor: #**
0900	**Failed allocating memory.**
1000	**Autocal checksum error.**
1300	**Serial timeout error.**
1500	**Power-up check error.**
1600	**No plate on carrier.**
1601	**No plate on carrier (1).**
1602	**No plate on carrier (2).**
1700	**No plate in gripper.**
1701	**No plate in gripper (1).**
180# (# is the motor number)	**Undefined motor: #**
Note: Autocalibration errors (**1000, Autocal checksum error**) will normally be displayed only during calibration or repair of the instrument by Bio-Tek TAC.	

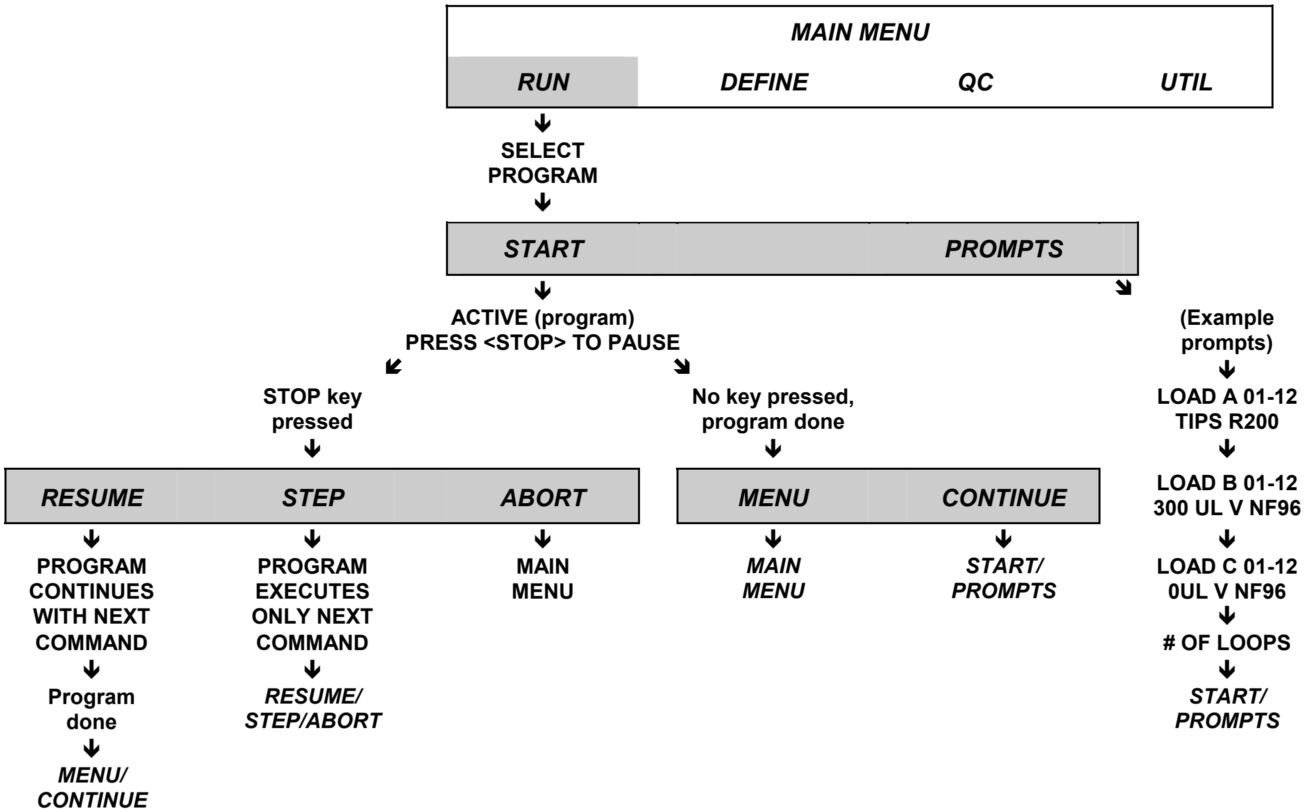
Error Code	**or Text Message Displayed**
2000	**Plate on carrier.**
2001	**Plate on carrier (1).**
1900	**Plate in gripper.**
1901	**Plate in gripper (1).**
2002	**Plate on carrier (2).**
2003	**Plate on carrier (3).**
210# (# is the motor axis number)	**Invalid motor axis: #**
220# (# is the instrument number)	**Invalid instrument: #**
2300	**Gripper width invalid.**
240# (# is the motor position number)	**Undefined position of motor: #**
3200	**Serial port error.**
Fatal Errors: Errors **A100 through A900** are Fatal Errors. Fatal Errors indicate conditions that require immediate attention. Refer to the Bio-Stack Operator's Manual for **Probable Causes** and for a complete list of the **Device** numbers referenced in these errors.	
A100	**A task control block (TCB) was not available.**
A20# (# is the device number)	**The requested device was not available: #**
A30# (# is the device number)	**The requested device was not available: #**
A400	**Checksum error.**
A500	**Power supply error.**
A600	**Timeout error writing to Quick Flash memory.**
A700	**Quick Flash memory error.**
A800	**RAM error.**
A900	**Heap space corrupted.**

Appendix A

Software Menu Maps

This chapter contains software menu "maps", showing the different function paths that an operator can travel down. Follow the shaded options to see the general flow of control.

RUN Function Path



DEFINE Function Path: Create/Edit Detail & Spec Files

MAIN MENU

RUN	*DEFINE*	*QC*	*UTIL*

↓

SELECT FILE ACTIVITY

↓

CREATE	*EDIT*	*COPY* →

CREATE ↓ SELECT FILE TYPE ↓

EDIT ↓ SELECT FILE TYPE ↓

PGRM	*DETAIL*	*SPECS*

DETAIL ↓ DETAIL INFO FOR ↓

TIPS	*ASPIR(ATE)*	*DISP(ENSE)*

SPECS ↓ SPECIFICATIONS FOR ↓

TIPS	*VESSELS*

DETAIL – TIPS

↓ DETAIL FILE NAME ↓ PUT USED TIPS INTO ↓ DISP RESIDUAL INTO ↓ OK TO SAVE FILE?

DETAIL – ASPIR(ATE)

↓ DETAIL FILE NAME ↓ HORIZONTAL ASP POS ↓ PRE-AIR VOLUME ↓ NUMBER OF MIX CYCLES ↓ VOLUME PER CYCLE ↓ MIX DISPENSE RATE ↓ PICK FROM BOTTOM? ↓ ASPIRATE RATE ↓ FLUID EXIT RATE ↓ POST-AIR VOLUME ↓ OK TO SAVE FILE?

DETAIL – DISP(ENSE)

↓ DETAIL FILE NAME ↓ DISP DEVICE IS ↓

PIPETTOR	*MANIFLD*

PIPETTOR: ↓ HORIZONTAL DSP POS ↓ DISPENSE HEIGHT ↓ DISPENSE RATE ↓ NUMBER OF MIX CYCLES ↓ VOLUME PER CYCLE ↓ MIX ASPIRATE RATE ↓ FLUID EXIT RATE ↓ POST-AIR VOLUME ↓ OK TO SAVE FILE?

MANIFLD: ↓ MANIFOLD PRIME VOL ↓ MANIFOLD ASPIR RATE ↓ HORIZONTAL DSP POS ↓ DISPENSE HEIGHT ↓ DISPENSE RATE ↓ OK TO SAVE FILE?

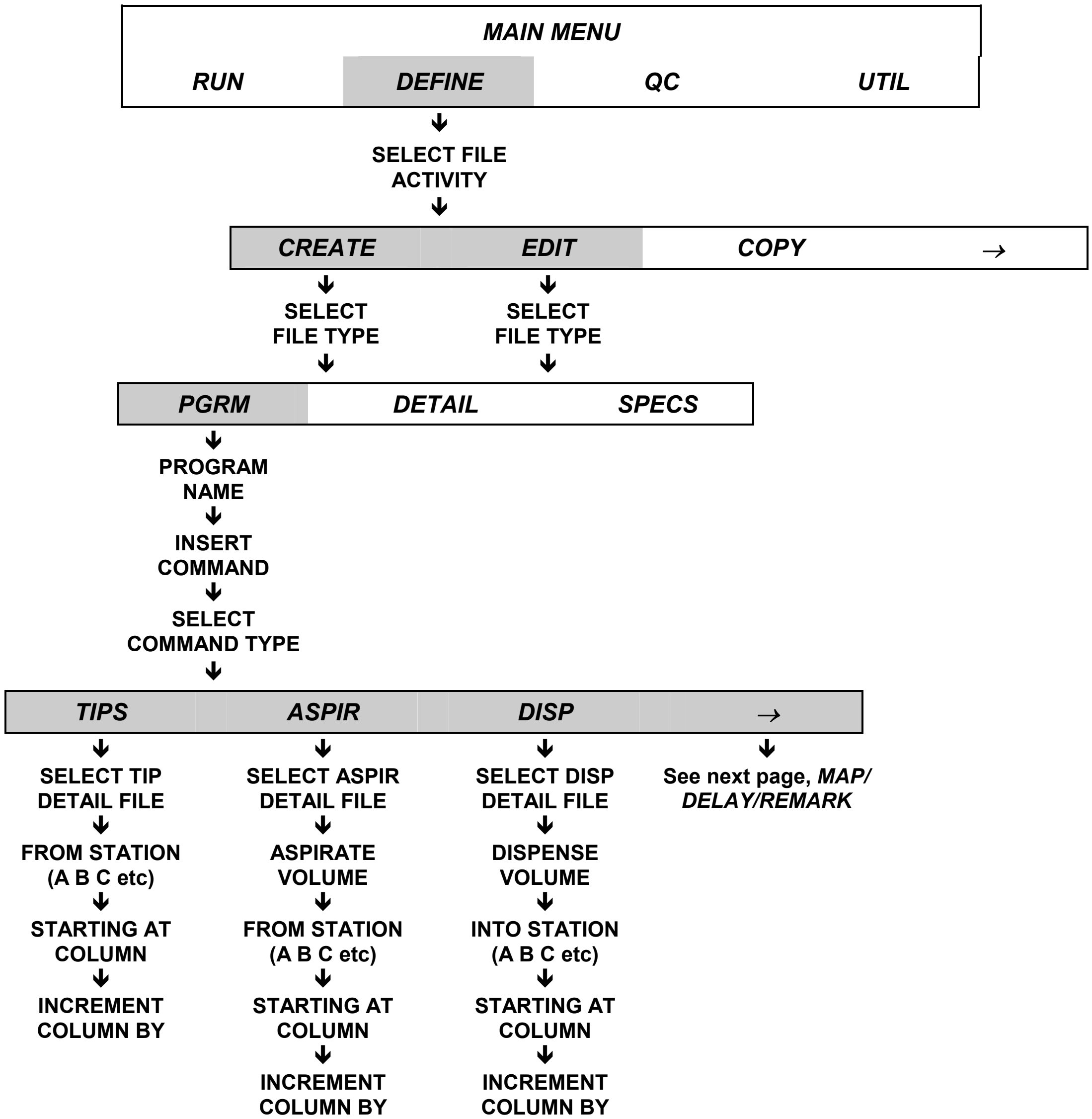
SPECS – TIPS

↓ SPEC FILE NAME ↓ TIP MAX VOLUME ↓ DIST TO TIP RIM ↓ DIST TO ENGAGE TIP ↓ DIST TO LIFT TIPS ↓ DIST TO FIRST COL ↓ DIST TO LAST COL ↓ DIST TO FIRST ROW ↓ OK TO SAVE FILE?

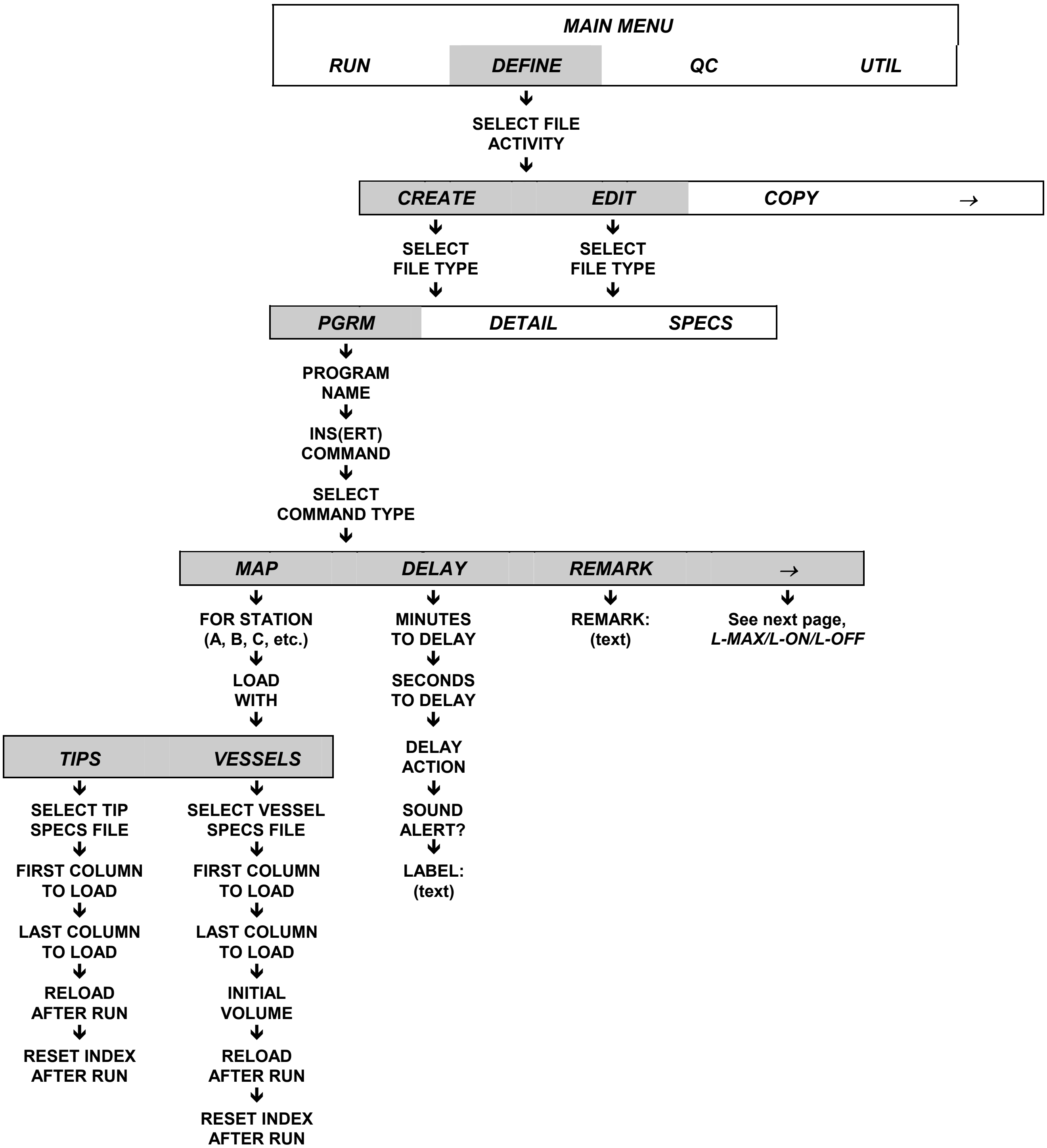
SPECS – VESSELS

↓ SPEC FILE NAME ↓ VOLUME IN UNITS OF ↓ DIST TO VSL BOTTOM ↓ VESSEL MAXIMUM VOL ↓ DIST TO MAX VOL ↓ DIST TO VESSEL TOP ↓ CALCULATED MIN VOL ↓ NUMBER OF ROWS ↓ NUMBER OF COLUMNS ↓ DIST TO FIRST COL ↓ DIST TO LAST COL ↓ DIST TO FIRST ROW ↓ FILL COLUMN-WISE? ↓ OK TO SAVE FILE?

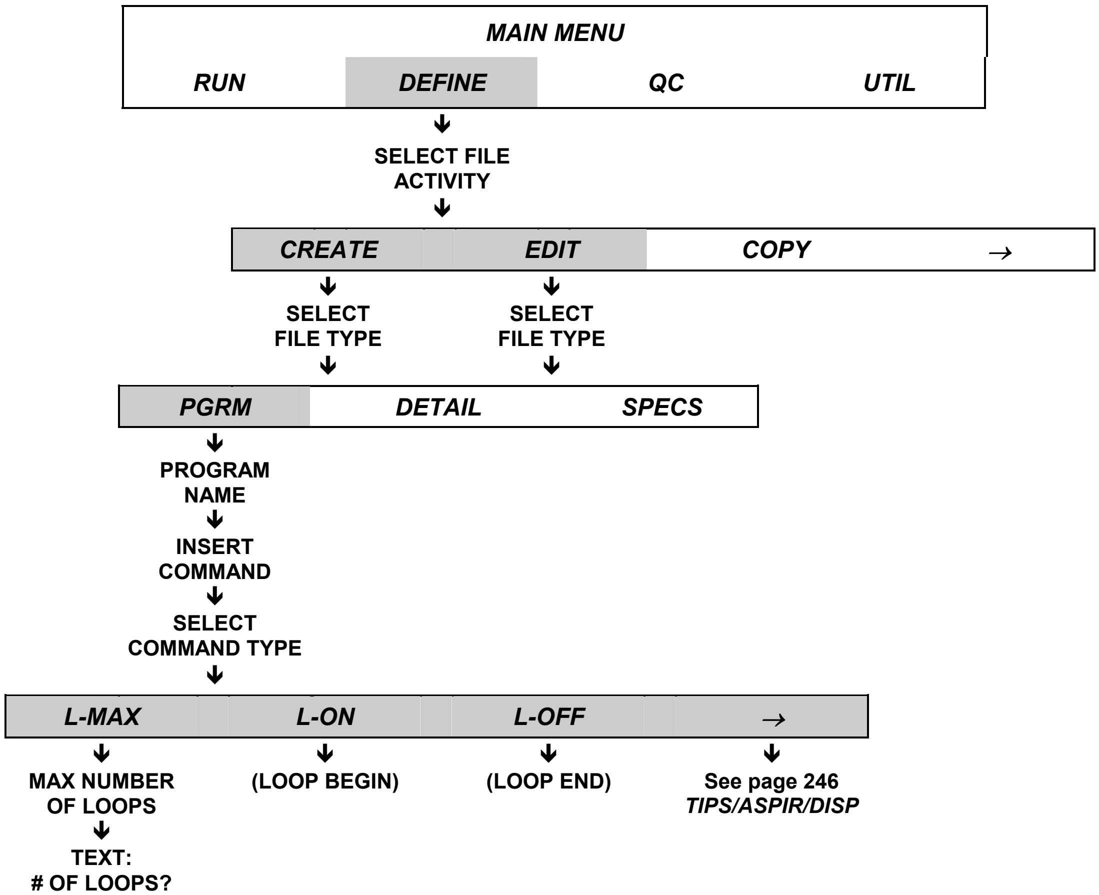
DEFINE Function Path: Create/Edit Program Files



DEFINE Function Path: Create/Edit Program Files, Cont’d



DEFINE Function Path: Create/Edit Program Files, Cont'd



DEFINE Function Path: Copy/Delete/Print/Rename/ Lock/Validate Files

MAIN MENU			
RUN	*DEFINE*	*QC*	*UTIL*

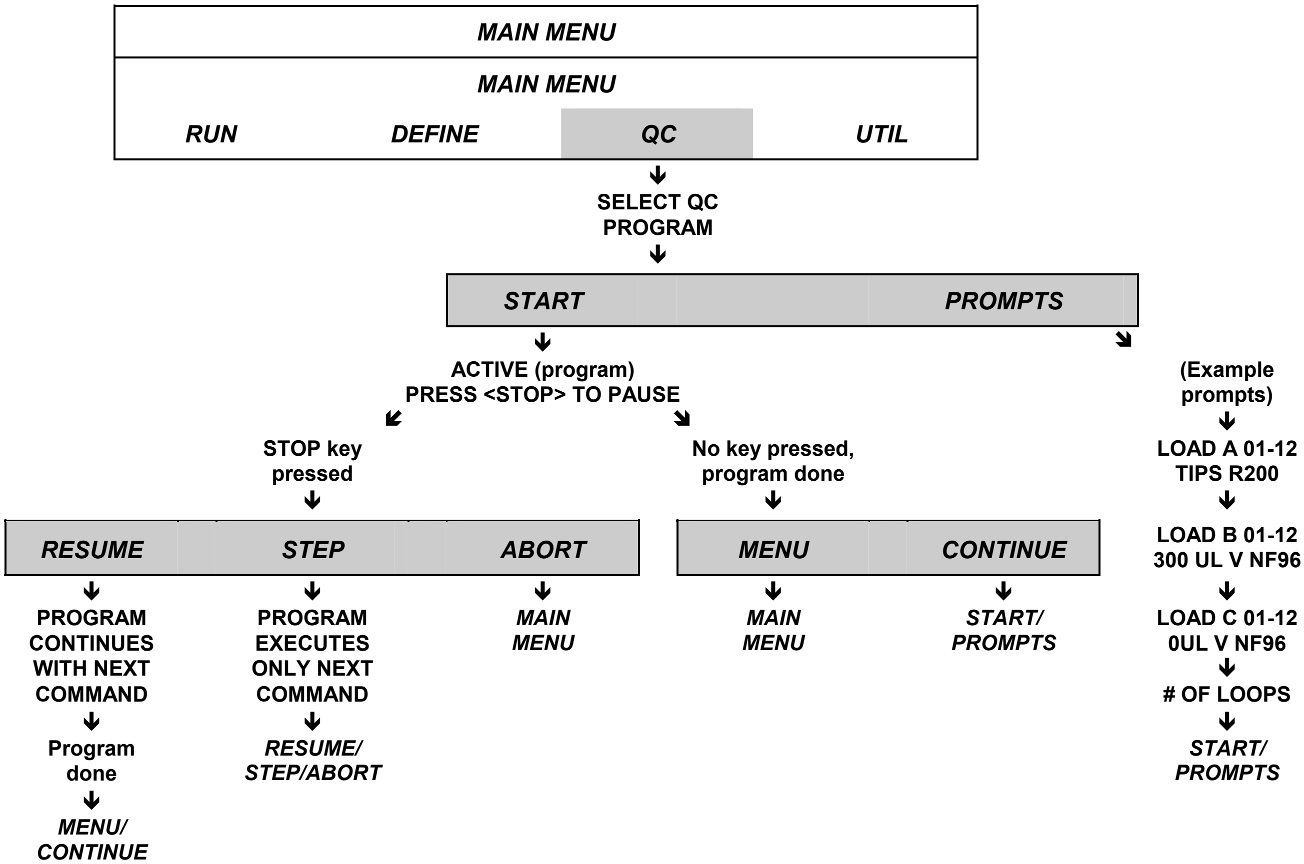
↓
SELECT FILE ACTIVITY
↓

CREATE	*EDIT*	*COPY*	→
		↓ SELECT FILE TYPE ↓ SELECT FILE ↓ ENTER NEW FILE NAME ↓ OK TO COPY?	See *DELETE/ PRINT/RENAME* below

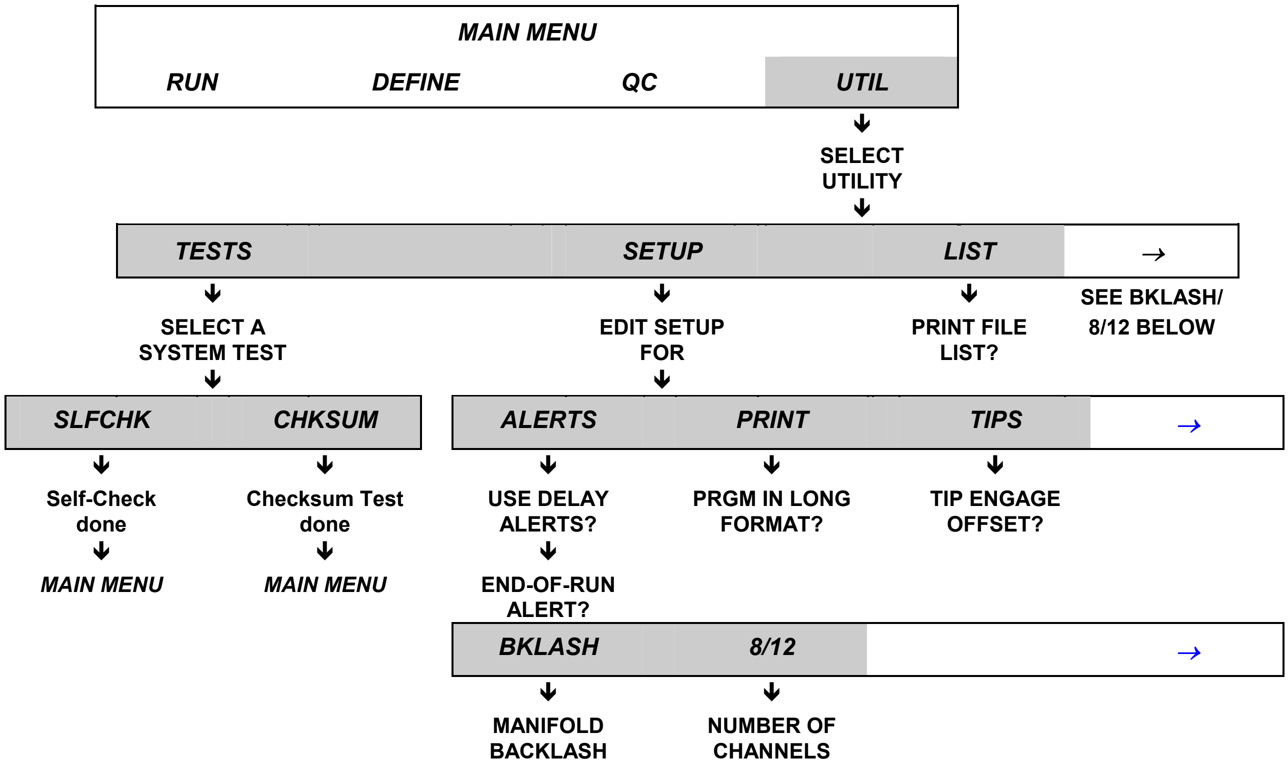
DELETE	*PRINT*	*RENAME*	→
↓ SELECT FILE TYPE ↓ SELECT FILE ↓ OK TO DELETE?	↓ SELECT FILE TYPE ↓ SELECT FILE	↓ SELECT FILE TYPE ↓ SELECT FILE ↓ CHANGE FILE NAME ↓ OK TO RENAME?	See *LOCK/ VALIDATE* below

LOCK	*VALIDATE*		→
↓ SELECT FILE TYPE ↓ SELECT FILE ↓ SET FILE PROTECTION	↓ SELECT PROGRAM		See *CREATE/ EDIT/COPY* above

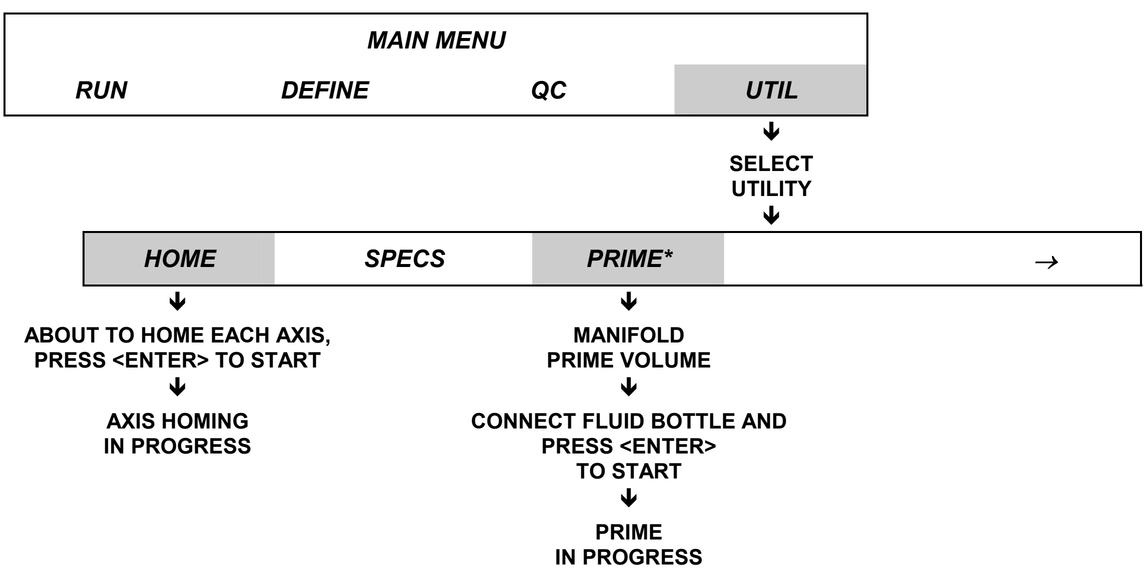
QC Function Path



UTIL Function Path: Tests, Setup, and List Utilities

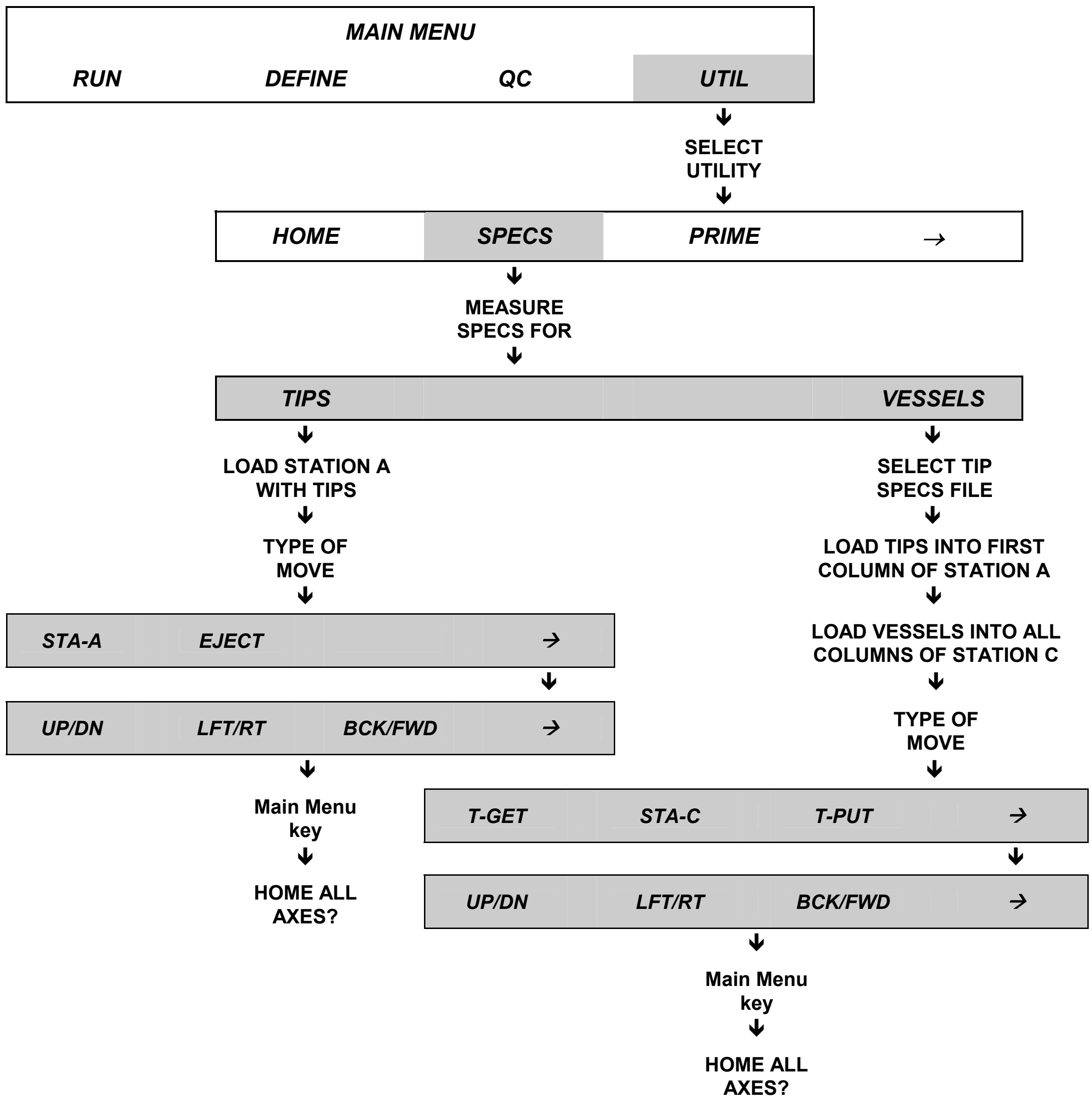


HOME and PRIME Utilities



* *The PRIME utility is only available with the Precision 8-Channel and 12-Channel Plus, and Universal models.*

UTIL Function Path: Measure Specs for Tips & Vessels



Appendix B

Installed Files

This appendix lists the Program, Detail and Specification files initially installed on the instrument. The files can be modified, renamed, and deleted as necessary.

Introduction

This appendix contains just a summary of each program file. Each program file in turn references multiple detail and specification files.

To view a program's contents (including the names of these referenced files), start at the Main Menu and select **DEFINE**, then **EDIT**, then choose the desired program.

To print the entire contents of a program, detail or specification file:

1. Make sure a printer is attached to the instrument, and that it is on and contains paper.
2. Start at the Main Menu and select **DEFINE.**
3. From the SELECT FILE ACTIVITY screen, select the arrow (-->) until the **PRINT** option appears, then select it.
4. From the SELECT FILE TYPE screen, select **PGRM**, **DETAIL**, or **SPECS.**
5. From the subsequent screen, press the **Options key** until the desired file name appears, then press the **Enter key.** The report will print.

Installed Program Files

Program File Name:	**REAG96_100UL**
Supplies Required:	Station A, 8 Labcon 200 µl pipette tips in Column 1 Station B, 1 Bio-Tek reagent vessel in Column 4, containing 14 ml reagent Station C, 12 Nunc Flat 1 x 8 microstrips, containing no fluid
File Description:	Transfers reagent from the vessel in Column 4 at Station B to all vessels at Station C (100 µl/vessel). Tips are returned to the rack.
Program File Name:	**REAG_384_50UL**
Supplies Required:	Station A, 8 Labcon 200 µl pipette tips in Column 1 Station B, 1 Bio-Tek reagent vessel in Column 4, containing 24 ml reagent Station C, 1 Costar 384-well plate
File Description:	Transfers reagent from the vessel in Column 4 at Station B to all vessels at Station C (50 µl/vessel). Tips are returned to the rack.
Program File Name:	**SMPL96_96_100UL**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips Station B, 12 Nunc Flat 1 x 8 microstrips, containing 100 µl sample/well Station C, 12 Nunc Flat 1 x 8 microstrips, containing no fluid
File Description:	Transfers 100 µl of sample from each vessel at Station B to each vessel at Station C. Tips are disposed of in the waste collection bin.
Program File Name:	**SMPL96_96DIL10_1**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips Station B, 1 Bio-Tek reagent vessel in column 4, containing 44 ml reagent Station C, 12 Nunc Flat 1 x 8 microstrips, containing 100 µl sample/well Station F, 12 Nunc Flat 1 x 8 microstrips, containing no fluid
File Description:	Transfers 90 µl of reagent from the vessel at Station B and 10 µl of sample from each vessel at Station C, to each vessel at Station F. The reagents at Station B and the samples at Station C can be used for four full runs. Tips are disposed of in the waste collection bin.

Installed Program Files, Cont'd

Program File Name:	**SMPL384_384_20ul**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips
	Station B, 96 Labcon 200 µl pipette tips
	Station C, 1 Costar 384-well microplate, containing 100 µl sample/well
	Station D, 96 Labcon 200 µl pipette tips
	Station E, 96 Labcon 200 µl pipette tips
	Station F, 1 Costar 384-well microplate, containing no fluid
File Description:	Transfers 20 µl of sample from each vessel at Station C into each vessel at Station F.
Program File Name:	**SMPL96_384_4REPS**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips
	Station B, 12 Nunc Flat microstrips, containing 300 µl sample/well
	Station C, 1 Costar 384-well microplate, containing no fluid
File Description:	Transfers 200 µl of sample from each vessel at Station B into 4 vessels at Station C (50 µl/vessel).
Program File Name:	**MAN96_100UL**
Supplies Required:	Station C, 12 Nunc Flat 1 x 8 microstrips, containing no fluid
	External supply bottle containing reagent
File Description:	Manifold dispenses 100 µl reagent to each vessel at Station C
Program File Name:	**MAN96_100UL_X6**
Supplies Required:	Station A, 12 Nunc Flat 1 x 8 microstrips, containing no fluid
	Station B, 12 Nunc Flat 1 x 8 microstrips, containing no fluid
	Station C, 12 Nunc Flat 1 x 8 microstrips, containing no fluid
	Station D, 12 Nunc Flat 1 x 8 microstrips, containing no fluid
	Station E, 12 Nunc Flat 1 x 8 microstrips, containing no fluid
	Station F, 12 Nunc Flat 1 x 8 microstrips, containing no fluid
	External supply bottle containing reagent
File Description:	Manifold dispenses 100 µl reagent to each vessel at Stations A, B, C, D, E, and F

Installed Program Files, Cont'd

Program File Name:	**MAN384_50UL**
Supplies Required:	Station C, 1 Costar 384-well microplate, containing no fluid External supply bottle containing reagent
File Description:	Manifold dispenses 50 µl reagent to each vessel at Station C
Program File Name:	**MAN384_50UL_X6**
Supplies Required:	Station A, 1 Costar 384-well microplate, containing no fluid Station B, 1 Costar 384-well microplate, containing no fluid Station C, 1 Costar 384-well microplate, containing no fluid Station D, 1 Costar 384-well microplate, containing no fluid Station E, 1 Costar 384-well microplate, containing no fluid Station F, 1 Costar 384-well microplate, containing no fluid External supply bottle containing reagent
File Description:	Manifold dispenses 50 µl reagent to each vessel at Stations A, B, C, D, E, and F
Program File Name:	**96_SERIAL_DIL**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips Station C, Column 1 Nunc Flat microstrip, containing 100 µl sample/well Station C, Column 2-12 Nunc flat microstrips containing no fluid
File Description:	Dispenses with the manifold 50 µl per well to Nunc strips in Columns 2-11. Aspirates 50 µl from Column 1 of Station C and dispenses it to Column 2 of Station C with three mixing aspirates and dispenses. Repeats aspirating and dispensing starting in Column 2. Continues across the plate until a ½ dilution gradient has been created from Column 1 to Column 12.

Installed Program Files, Cont'd

Program File Name:	**384_SERIAL_DIL**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips Station C, Column 1-2 Costar 384-well microplate, containing 40 µl sample/well Station C, Column 3-48 Costar 384-well microplate containing no fluid
File Description:	Dispenses with the manifold 40 µl per well to Columns 3-48. Aspirates 40 µl from Column 1 of Station C and dispenses it to Column 3 of Station C with three mixing aspirates and dispenses. Repeats aspirating and dispensing starting in Column 3. Continues across the plate until a ½ dilution gradient has been created in all the odd columns of the plate. Starts in Column 2 and creates the same dilution gradient in all the even columns of the plate.
Program File Name:	**96_S_DIL_1_3_RG**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips Station B, Bio-Tek reagent vessel in Column 4 containing 4 ml of reagent Station C, Nunc flat strips, empty
File Description:	Dispenses with the manifold 100 µl per well to Nunc strips in Columns 1-12. Aspirates 50 µl of reagent from Station B and dispense into Column 1 of Station C with three mixing aspirates and dispenses. Aspirates 50 µl from Column 1 of Station C and dispenses it into Column 2 of C with three mixing cycles. Continues in this way across the plate until a 1/3 dilution gradient has been created across all columns of Station C.
Program File Name:	**12_96_SERIAL_DIL**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips Station C, Column 1 Nunc Flat microstrip, containing 100 µl sample/well Station C, Column 2-8 Nunc flat microstrips containing no fluid
File Description:	Dispenses with the manifold 50 µl per well to Nunc strips in Columns 2-8. Aspirates 50 µl from Column 1 of Station C and dispenses it to Column 2 of Station C with three mixing aspirates and dispenses. Repeats aspirating and dispensing starting in Column 2. Continues across the plate until a ½ dilution gradient has been created from Column 1 to Column 8.

Installed Program Files, Cont'd

Program File Name:	**12_384_SERIAL_DIL**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips Station C, Column 1-2 Costar 384-well microplate, containing 40 µl sample/well Station C, Column 3-32 Costar 384-well microplate containing no fluid
File Description:	Dispenses with the manifold 40 µl per well to wells in Columns 3-32. Aspirates 40 µl from Column 1 of Station C and dispenses it to Column 3 of Station C with three mixing aspirates and dispenses. Repeats aspirating and dispensing starting in Column 3. Continues across the plate until a ½ dilution gradient has been created in all the odd columns of the plate. Starts in Column 2 and creates the same dilution gradient in all the even columns of the plate.
Program File Name:	**12_96X4_TO_384**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips Station B, Nunc Flat strips containing 100 µl of sample per well Station C, Costar 384-well microplate, empty
File Description:	Transfers 50 µl from the wells of sample in Station B to the first 8 columns of the plate in Station C. Pauses for the user to place another plate of samples in Station B and clean tips in Station A. Transfers the second plate of samples to Columns 9-16. Repeats until 384 samples have been transferred to the Costar plate in Station C.
Program File Name:	**96X4_TO_384**
Supplies Required:	Station A, 96 Labcon 200 µl pipette tips Station B, Nunc Flat strips containing 100 µl of sample per well Station C, Costar 384-well microplate, empty Station D, 96 Labcon 200 µl pipette tips Station E, Nunc Flat strips containing 100 µl of sample per well
File Description:	Transfers 50 µl from the wells of sample in Station B to the first 12 columns of the plate in Station C. Transfers 50 µl from the wells of sample in Station E to Columns 13-24 of the plate in Station C. Pauses for the user to place two other plates of sample in Stations B and E and clean tips in Stations A and D. Repeats until 384 samples have been transferred to the Costar plate in Station C.

Installed Detail Files

Tip Detail Files

Name	Deposit Residual	Discard Tip
EXAMPLE TIP DTL	Rack	Rack
TRR	Rack	Rack
TDD	Dump	Dump
TDR	Dump	Rack

Pipette Aspirate Detail Files

Name	Horiz Position	Pre Air Vol	Mix Cycles	Mix Vol	Mix Rate	Bottom Pickup	Aspirate Rate	Exit Rate	Post Air
A000N140	0	0	0	50	3	N	1	4	0
A000N240	0	0	0	50	3	N	2	4	0
A000N340	0	0	0	50	3	N	3	4	0
A000N440	0	0	0	50	3	N	4	4	0
A000N540	0	0	0	50	3	N	5	4	0
A000N450	0	0	0	50	3	N	4	5	0
A000N550	0	0	0	50	3	N	5	5	0
A003N340	0	0	3	100	4	N	3	4	0
A000N445	0	0	0	50	3	N	4	4	5
A000N4410	0	0	0	50	3	N	4	4	10
A050N440	0	5	0	50	3	N	4	4	0
A050N345	0	5	0	50	3	N	3	4	5
A0100N440	0	10	0	50	3	N	4	4	0
A0100N445	0	10	0	50	3	N	4	4	5
EXAMPLE ASP DTL	0	0	0	50	3	N	3	4	0

Pipette Dispense Detail Files

Name	Disp Device	Horiz Position	Disp Height	Disp Rate	Mix Cycles	Mix Volume	Mix Rate	Exit Rate	Post Air
DP0481040	Pipette	0	48	1	0	50	3	4	0
DP0482040	Pipette	0	48	2	0	50	3	4	0
DP0483040	Pipette	0	48	3	0	50	3	4	0
DP0484040	Pipette	0	48	4	0	50	3	4	0
DP0485040	Pipette	0	48	5	0	50	3	4	0
DP0485050	Pipette	0	48	5	0	50	3	5	0
DP0484050	Pipette	0	48	4	0	50	3	5	0
DP0483045	Pipette	0	48	3	0	50	3	4	5
DP0485045	Pipette	0	48	5	0	50	3	4	5
DP0484145	Pipette	0	48	4	1	50	3	4	5
DP0485320550	Pipette	0	48	5	3	20	5	5	0
DP0485350550	Pipette	0	48	5	3	50	5	5	0
DP04853100550	Pipette	0	48	5	3	100	5	5	0
EXAMPLE DSP DTL	Pipette	0	48	3	0	0	3	4	0

Manifold Dispense Detail Files

Name	Dispense Device	Pre-Prime Volume	Horizontal Position	Dispense Height	Aspirate Rate	Dispense Rate
DM125044	Manifold	125	0	0	4	4
DM125034	Manifold	125	0	0	3	4
DM125033	Manifold	125	0	0	3	3

Installed Specification Files

Tip Specification Files

Name	Tip Vol	Dist Rack	Dist Engage	Dist Clearance	Dist First Column	Dist Last Column	Dist Row A
RAININ_250NB	250	120	1320	-5220	-1083	1083	0
LABCON_200NB	50	-40	1030	-5510	-1087	1087	0
LABCON_50NB	50	550	1860	-3250	-1087	1087	0
LABCON200ROBOTIC	200	-172	970	-5700	-1087	1087	10
LABCON200_REFILL	200	-172	970	-5700	-1087	1087	10
LABCON50_ROBOTIC	50	508	1730	-3342	-1087	1087	10
LABCON50_REFILL	50	508	1730	-3342	-1087	1087	10
12_LABCON200_ROB	200	-172	970	-5700	-689	689	0
12_LABCON200_FLL	200	-172	970	-5700	-689	689	0
12_LABCON_200NB	50	-40	1030	-5510	-689	689	0
12_LABCON_50NB	50	550	1860	-3250	-689	689	0
12_LABCON50_ROB	50	508	1730	-3342	-689	689	0
12_LABCON50_FLL	50	508	1730	-3342	-689	689	0
Fisher50	50	-24	1240	-3940	-1083	1083	10
Fisher100	50	-24	1240	-5650	-1083	1083	10
Fisher200	50	-24	1240	-5650	-1083	1083	10
12_Fisher50	50	-24	1240	-3940	-689	689	0
12_Fisher100	50	-24	1240	-5650	-689	689	0
12_Fisher200	50	-24	1240	-5650	-689	689	0
12_RAININ_250NB	250	120	1320	-5220	-689	689	0

Vessel Specification Files

Name	Vol Units	Dist Bottom	Max Vol	Dist Max Vol	Dist Top	# Rows	# Col	Dist First	Dist Last	Dist Row A	Fill By Col
R_1X4	ml	5820	50	2320	1300	1	4	-984	984	0	T
NF_8X12STRPS	µl	1740	350	540	380	8	12	-1083	1083	0	T
NR_8X12STRPS	µl	1686	250	626	380	8	12	-1083	1083	0	T
CSTR_384	µl	1786	100	466	346	16	24	-1132	1132	49	T
REAG_RES_UNIV	ml	4820	50	1780	1340	1	4	-1074	1074	0	T
12_REAG_RES_UNIV	ml	5330	65	2100	1340	1	3	-640	640	0	T
12_NF_8X12STRPS	µl	1740	350	540	380	12	8	-689	689	0	T
12_NR_8X12STRPS	µl	1686	250	626	380	12	8	-689	689	0	T
12_CSTR_384	µl	1786	100	466	346	24	16	-738	738	49	T

Appendix C

Templates for Program, Specification, and Detail Files

This appendix contains templates you can photocopy to help organize and develop the contents of your program, specification, and detail files.

Templates

The following templates are provided:

- Program Files – MAP Steps
- Program Files – Processing Steps
- Tip Specification File
- Vessel Specification File
- Tip Detail File
- Aspirate Detail File
- Dispense Detail File

Program File: ____________________________ **MAP Steps**

Command	Station	Load With	Spec File	First Column to Load	Last Column to Load	Initial Volume	Reload Supplies After Run	Reset Index After Run

Program File: ________________________ Processing Steps

Command	Detail File	Volume	Station	Starting At Column	Increment Column By

Tip Specification File: ______________________________

Tip Max Volume	
Distance to Tip Rim	
Distance to Engage Tip	
Distance to Lift Tips	
Distance to First Column	
Distance to Last Column	
Distance to First Row	

Vessel Specification File: ____________________________

Volume in Units of	
Distance to Vessel Bottom	
Vessel Maximum Volume	
Distance to Maximum Volume	
Distance to Vessel Top	
Calculated Minimum Volume	
Number of Rows	
Number of Columns	
Distance to First Column	
Distance to Last Column	
Distance to First Row	
Fill Column-Wise?	

Tip Detail File: ______________________________

Place Used Tips Into	
Dispense Residual Into	

Aspirate Detail File: ______________________________

Horizontal Aspirate Position	
Pre-Air Volume	
# of Mix Cycles	
Volume Per Cycle	
Mix Dispense Rate	
Pick From Bottom?	
Aspirate Rate	
Fluid Exit Rate	
Post-Air Volume	

Dispense Detail File: ______________________________

Dispensing Device Is	
Manifold Prime Volume	
Manifold Aspirate Rate	
Horizontal Dispense Position	
Dispense Height	
Dispense Rate	
# of Mix Cycles	
Volume Per Cycle	
Mix Aspirate Rate	
Fluid Exit Rate	
Post-Air Volume	

Appendix D

Flow Rates & Volumes Compatibility Tables

This appendix features tables containing aspirate and dispense flow rates and the volume ranges that are compatible with the specified models.

Manifold Aspirate and Dispense Profiles

8-Channel Plus Models

Rate Number	Rate in µl Per Tube Per Sec.	Volume Range in µl/Tube	Where Used
1	75	10-9999	aspirate
2	100	10-9999	aspirate
3	150	10-9999	aspirate
4	230	30-9999	aspirate
5	310	40-9999	aspirate
1	90	20-9999	dispense
2	120	20-9999	dispense
3	150	10-9999	dispense
4	275	25-9999	dispense
5	400	35-9999	dispense

12-Channel Plus and Universal Models

Rate Number	Rate in µl Per Tube Per Sec.	Volume Range in µl/Tube	Where Used
1	75	10-9999	aspirate
2	150	21-9999	aspirate
3	250	31-9999	aspirate
4	350	46-9999	aspirate
5	450	67-9999	aspirate
1	150	15-9999	dispense
2	190	15-9999	dispense
3	225	15-9999	dispense
4	260	10-9999	dispense
5	300	10-9999	dispense

Pipette Syringe Aspirate and Dispense Profiles

8- and 12-Channel Plus or Universal Models

Rate Number	Rate in µl Per Tube Per Sec.	Volume Range in µl/Tube	Where Used
1/1	75	1-120	asp/disp
2/2	150	8-120	asp/disp
3/3	200	10-120	asp/disp
4/4	250	12-120	asp/disp
5/5	300	14-120	asp/disp

Appendix E

Chemical Compatibility

This appendix contains a name and materials listing of each Precision component that will come into contact with chemicals dispensed during operation or maintenance. If there are questions about compatibility of chemicals with the Precision, contact Bio-Tek. Refer also to the Tech Notes in the Precision section of the Bio-Tek website: www.biotek.com.

Components and Materials Composition

Continuous contact with harsh chemicals is not recommended. Always rinse the fluid path with deionized water after contact with any strong acid, base, or solvent.

Components	Material Composition
Precision manifold	CPVC (chlorinated polyvinyl chloride)
Pipette piston block locating pins	304 Stainless Steel
Dispense tubes, syringe piston, and check valve spring	316 Stainless Steel
Pipette tip stripper and pipette piston retaining plate	Aluminum
Assay plates	Polystyrene
Check valves, fittings in bottles, inline fittings, and reagent reservoirs	Polypropylene
Tubing in supply bottle, inlet and outlet to syringe pump	Silicone
Inlet and outlet tubing	Tygon
Bumpers in manifold	Neoprene
Manifold seal o-ring	EP (ethylene propylene)
Check valve o-rings	Viton
Syringe seal and buffer bottle	Polyethylene
Pipette piston block and tip holder block	Ertalyte (polyethylene terephthalate)
Pipette seals	Graphite filled PTFE (polytetrafluoroethylene)
Syringe cylinder and standard labware holders	Noryl (polyphenylene ether + polystyrene)

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