

ELx405TM

Microplate Washer

Operator's Guide



For all models:

ELx405

ELx405 Select

ELx405 Magna

ELx405 HT

ELx405 Select CW



ELx405™
Microplate Washer
Operator's Guide

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Revision I
Bio-Tek® Instruments, Inc.

Notices

Bio-Tek® Instruments, Inc.

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Table of Contents

Notices	iii
Table of Contents	v
List of Figures	xii
Contact Information	xiii
Customer Service and Sales.....	xiii
Service/TAC.....	xiii
European Coordination Center.....	xiii
Document Conventions	xiv
Revision History	xv
Intended Use Statement	xviii
Quality Control	xviii
Repackaging and Shipping	xviii
Warnings	xix
Hazards and Precautions	xix
Hazards	xix
Precautions.....	xx
Directive 89/336/EEC: Electromagnetic Compatibility.....	xxii
Directive 73/23/EEC: Low Voltage (Safety).....	xxii
Directive 2002/96/EC: Waste Electrical and Electronic Equipment.....	xxii
Directive 98/79/EC: <i>In Vitro</i> Diagnostics (some models).....	xxiii
Electromagnetic Interference and Susceptibility	xxiv
USA FCC CLASS A.....	xxiv
Canadian Department of Communications Class A.....	xxiv
User Safety	xxiv
Safety Symbols	xxv

Warranty	xxvii
Bio-Tek Instruments Warranty Policy	xxvii
Hardware Warranty	xxvii
Registration Card	xxviii
Registration Online	xxviii
Chapter 1: Introduction	1
Introducing the ELx405.....	2
ELx405 Washer Variations.....	3
Compatibility With the Bio-Stack System	4
Hardware Features	6
Software Features.....	7
Package Contents.....	8
Optional Accessories	9
Specifications	10
Performance Specifications.....	11
Technical Support	12
Phone Support	13
Electronic Communication.....	13
Facsimile Support.....	13
Written Communication.....	13
Shipping Address.....	13
Applications Support	14
Phone Support	14
Electronic Communication.....	14
Chapter 2: Installation	15
Unpacking and Inspecting the Instrument	16
To unpack the washer and its accessories.....	16
Unpacking the Valve Module.....	19
Removing the Manifold Shipping Bracket.....	21
Setting Up the Washer.....	22
Operating Environment.....	22

Installing the Microplate Carrier	22
Connecting the Tubes and Bottles	26
Attaching the Mist Shield	33
Connecting the Power Cord	34
Serial Port for Communication With Other Devices	34
Verifying Performance	35
Installation of the Washer for Operation With the Bio-Stack	36
Repackaging and Shipping	37
Before Repackaging the Instrument	38
Repackaging the ELx405 and Its Accessories	39
Repackaging the External Valve Module (if equipped)	39
Chapter 3: Operation	41
ELx405 Front Panel	42
Keypad Description	43
Entering Program Names	44
System Startup	45
Main Menu	46
Programs	47
Operation With the Bio-Stack	48
General Usage Guidelines	49
Before Running Any Program	49
Maintenance	50
Programming Considerations	51
Wash	52
Run Wash Program	52
Define Wash Program	53
Edit Wash Program	71
Copy Wash Program	71
Delete Wash Program	72
Prime	73
Run Prime Program	73
Define Prime Program	74

Recommended Prime and Low Flow Prime Volumes	76
Edit Prime Program	76
Copy Prime Program	77
Delete Prime Program.....	77
Default Prime Program: Prime_200	78
Default Prime Program: Prime_CW	78
Dispense	79
Run Dispense Program.....	79
Define Dispense Program	80
Edit Dispense Program.....	81
Copy Dispense Program.....	81
Delete Dispense Program.....	82
Aspiration	83
Run Aspiration Program	83
Define Aspiration Program.....	84
Edit Aspiration Program	84
Copy Aspiration Program.....	85
Delete Aspiration Program	85
Soak.....	86
Define Soak Program	86
Edit Soak Program.....	86
Copy Soak Program	87
Delete Soak Program.....	87
Linking Programs	88
Run Link Program.....	88
Define Link Program.....	89
Delete Link Program.....	90
Setup Utilities	91
RS-232 Settings (RS232)	91
Sensor System (SENSOR).....	91
Adjust Utility (ADJUST).....	92
Park Utility (PARK).....	93
Bio-Stack Utilities (BIOSTACK)	93

Delay After Dispense (DISP).....	94
Plate Clearance Height (PLATE).....	94
Vacuum Dissipation Delay (VACUUM).....	94
Manifold Selection (MANIFOLD).....	95
ELx405 Washer Menu Maps.....	96
Main Menu (DEFINE function path for Create and Edit)	97
Main Menu (DEFINE function path for Copy and Delete)	98
Main Menu (RUN function path).....	99
Main Menu (MAINT, UTIL function path)	100
Chapter 4: Preventive Maintenance.....	101
Overview.....	102
Schedule.....	102
Recommended Maintenance Schedule.....	103
Required Materials.....	104
Warnings & Precautions	105
Maintenance Programs	106
Prime Programs.....	107
Rinse/Soak the Fluid Path.....	109
Daily Maintenance	109
Overnight/Multi-Day Maintenance	111
Clean Components.....	114
Periodic Maintenance	114
Decontaminate the Washer.....	128
Decon Procedure for External Surfaces of the Instrument	129
Decon Procedure for Tubing and Manifold.....	130
Alternate Decontamination Procedure for Tubing and Manifold.....	132
Prepare for Storage or Shipment.....	134
Long_Shutdown	134
Storing the Washer	135
Replace Components.....	136
Replacing the O-Rings and Channel-End Seals	136

Chapter 5: Performance Verification/Qualification Tests139

Overview 140

Verification Schedule..... 141

Installation Qualification (IQ) 142

Operational Qualification (OQ) 142

Performance Qualification (PQ)..... 143

System and Checksum Tests 144

 System Self Test 144

 Checksum Test..... 145

Liquid Tests 146

 Evacuation Efficiency Test (Overview) 146

 Dispense Precision Test (Overview) 146

 Valve Module Test (Overview) 147

 Which Tests to Perform?..... 147

 Materials 148

 Evacuation Efficiency Test (96)..... 150

 Dispense Precision Test (96)..... 153

 Evacuation Efficiency Test (192)..... 157

 Dispense Precision Test (192)..... 160

 Worksheets 164

Appendix A: Troubleshooting171

Overview 172

 Troubleshooting Checklist 172

Troubleshooting Charts 173

 Washer Start-Up 173

 Fluid Aspiration..... 175

 Fluid Delivery 178

 Fluid Leakage..... 181

 Microplate Carrier Movement..... 182

 Washer Manifold Movement..... 182

 Microplate Scratches 183

Appendix B: Error Codes	185
Error Codes.....	186
Bio-Stack Errors (Overview).....	186
General Errors.....	187
Fatal Errors.....	200
Bio-Stack Errors.....	203
Appendix C: Chemical Compatibility	205
Components and Materials Composition.....	206
Appendix D: Default Programs	207
Default Programs.....	208
Appendix E: Changing the Manifolds	209
Changing Manifolds in HT Models With the 96-Tube Manifold.....	210
Index	213

List of Figures

Figure 1: The ELx405™ Microplate Washer With the Bio-Stack	5
Figure 2: Removing the Inner Shipping Box	17
Figure 3: Removing the Carrier and Other Accessories	17
Figure 4: Removing the End Caps	18
Figure 5: Manifold Shipping Bracket	18
Figure 6: Removing the Valve Module From the Shipping Container.....	20
Figure 7: Removing the Wire Holders, Supply Bottles, and Other Accessories	20
Figure 8: Removing and Storing the Manifold Shipping Bracket	21
Figure 9: Installing the Microplate Carrier for the ELx405 Model	23
Figure 10: Installing the Microplate Carrier for the Select, Select CW, and all HT Models	24
Figure 11: Installing the Microplate and Magnet Plate Carriers for the Magna Model.....	25
Figure 12: Rear Panel	27
Figure 13: Washer With Vacuum Pump and Waste Tubing Connections.....	29
Figure 14: Washer With Supply Tubing Connections (Without External Valve Module)	31
Figure 15: Washer With External Valve Module	32
Figure 16: Attaching the Mist Shield	33
Figure 17: ELx405 Front Panel With LCD and Keypad	42
Figure 18: Dispense and Aspirate Heights for the ELx405 and Magna Models	68
Figure 19: Dispense and Aspirate Heights for the Select, Select CW, and HT2/HTV2 Models With Dual/96 Manifold	69
Figure 20: Dispense and Aspirate Heights for the HT Model	70
Figure 21: Using the Adjust Utility	93
Figure 22: Position of the Transport Arm on the Plate Carrier.....	116
Figure 23: Removing the Screws and Washers From the Transport Arm	117
Figure 24: The Transport Arm Removed From the Carrier	117
Figure 25: Carrier and Manifold Placement in the ELx405 Model.....	120
Figure 26: Carrier and Manifold Placement in the Select, Select CW, and HT Models	121
Figure 27: Carrier and Manifold Placement in the Magna Model	122
Figure 28: Cleaning the Fluid Inlet Filter	127
Figure 29: Replacing the Channel-End Seals.....	137
Figure 30: Storing the 96- or 192-Tube Dual Manifold in the Shipping Case.....	212

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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.
Note:	Bold text is primarily used for emphasis.
	This icon calls attention to important information.

Revision History

Rev	Date	Changes
A	12/98	<ul style="list-style-type: none"> Release to Production.
B	3/99	<ul style="list-style-type: none"> Replaced graphic of the Magna carrier placement to clarify position. Added defaults and ranges for Method, Dispense, Aspirate, Prime and Soak parameters.
C	02/00	<ul style="list-style-type: none"> Updated contact information under Notices. Added "patented" to all references to the "dual-manifold design." Enhanced the Maintenance and Instrument Verification chapters.
D	6/00	<ul style="list-style-type: none"> Corrected default prime dispense volume. Added new error code A900. Added info on pump for testing 384-well plates.
E	3/03	<ul style="list-style-type: none"> Updated contact information, standards, and safety symbols in Preface. Added Cautions to Precautions section: Chemical Compatibility, Bovine Serum Albumin, Shipping Bracket, Waste Monitor Sensor Connector. Revised hardware/software features, package contents, optional accessories, and specifications in Ch. 1. Moved Technical Support section from App. A to Ch. 1, and updated TAC addresses, phone numbers, etc. Included information about compatibility of ELx405™ Auto Plate and Select models with Bio-Stack™ Microplate Stacking System in Ch. 1. Added brief paragraphs in Ch. 2 & 3, App. A & B regarding installation, operation, troubleshooting, error codes when operating with Bio-Stack; referenced Bio-Stack Operator's Manual. Updated Ch. 3 screens, descriptions of program options, and menu maps to reflect New/Repeat options at program completion and additional 4 aspirate rates (for Aspiration and Wash programs); added new sections to Setup Utilities about the Bio-Stack, delay after dispense, plate clearance height, and vacuum dissipation delay options. Updated maintenance and IQ-PQ-OQ chapters.

Revision History, Cont'd

Rev	Date	Changes
F	10/03	<ul style="list-style-type: none"> • Added information about new ELx405™ HT model throughout manual. • Updated TAC information in Preface and Ch. 1, and Customer Service contact information, Hazards, Safety Symbols, Intended Use Statement, and Warranty in Preface. • Updated Introduction, Variations, Hardware and Software Features, Package Contents, Optional Accessories, and Specifications in Ch. 1. • Enhanced Unpacking/Repackaging and Installation sections in Ch. 2; added new sections on unpacking/repackaging the optional valve module, and new Fig. 2-2A, Removing the valve module from the shipping container, and Figure 2-2B, Removing the wire holders, buffer bottles and other accessories from the shipping container. • Corrected menu screens, program options, and menu maps in Operation, Ch. 3. Included new ELx405 HT version and additional Bio-Stack information; added new Fig. 3-2C: Dispense and aspirate heights for the ELx405 HT (384-well) washer. • Updated Ch. 4 and Ch. 5. Added information from revised ELx405 IQ-OQ-PQ Manual (PN 7100567) to liquid testing section of Ch. 5, including new section on liquid testing for ELx405 HT model. • Updated App. A, Troubleshooting, and App. B, Error Codes; added several Bio-Stack error codes that appear on the ELx405. • Added new Appendix C, Chemical Compatibility. • Replaced previous artwork of microplate carriers with revised artwork of the latest, robotic compatible and Bio-Stack compatible carriers in figures throughout manual.
G	5/04	<ul style="list-style-type: none"> • Re-formatted manual in new template and according to format designated in latest Revision D of TP01, Structure for Operator Manuals/User Guides. • Added information on new cell washer model ELx405™ Select CW throughout manual, including the Low Flow Prime Volume, Dispense Flow Rates 10 and 11, Vacuum on Volume, prime program Prime_CW, and cell washer defaults in Maintenance and AutoPrime prime programs. • Revised Technical Support section and added new sections on Depot Service Contracts and Applications Support in Ch. 1. • Enhanced installation instructions in Ch. 2, and General Usage Guidelines in Ch. 3. • Updated Liquid Testing sections and added Valve Module Dispense Precision Test in Ch. 4. • Enhanced cleaning, decon, and long-term storage sections of Ch. 5. • Revised Troubleshooting and Error Codes sections. • Added new Appendix D, Default Programs.

Revision History, Cont'd

Rev	Date	Changes
H	7/04	<ul style="list-style-type: none"> • Edited Chemical Compatibility caution in Preface and Components and Materials Composition table in Appendix C concerning use of acetic acid. • Replaced section in Chapter 1 on Depot Service Contracts with reference to the Bio-Tek website, where this information may be found. • Revised Maintenance chapter with updated cleaning procedure for removal of Bovine Serum Albumin (BSA) residue from washer. • Updated ELx405 product name to reflect latest product name configuration.
I	1/05	<ul style="list-style-type: none"> • Added text throughout manual about new models: <ul style="list-style-type: none"> – HT2/HTV2 (HT models with the accessory 96-tube dual manifold) – Ultrasonic Advantage™ (ELx405, Select, Select CW, or HT models equipped with the ultrasonic cleaner) • Updated accessories and specs in Chapter 1, Introduction. • Revised artwork in Chapter 2, Installation, Chapter 3, Operation, and Chapter 4, Preventive Maintenance. • Revised instructions in Chapter 3 for the following: <ul style="list-style-type: none"> – Clarified use of the Select CW Dispense Flow Rates 10 and 11 (not recommended for 384-well plates). – Revised description of rapid Aspirate Rates 7 to 10. – Added more information about Magna soak/shake options. – Recommended a range of 12-175 (current range is 12-180) in Dispense Height, Bottom Dispense Height, Aspirate Height, Crosswise Aspirate Height, Plate Clearance Height sections. – Revised sections on recommended Prime and Low Flow Prime Volumes for the Select CW models. • Updated Chapter 4, and Chapter 5, Performance Verification/Qualification Tests with revisions from latest ELx405 IQ-OQ-PQ procedures. • Enhanced Appendix B, Error Codes with descriptions of the codes and new AUTOCLEAN codes. • Added new Appendix E, Changing the Manifolds (for HT2/HTV2 models).

Intended Use Statement

- The ELx405™ Microplate Washer provides microplate priming, washing, dispensing, and aspiration for ELISA™, fluorescence and chemiluminescence immunoassays, cellular and agglutination assays.
- The washer can operate as a stand-alone instrument or with standard robotic systems, such as Bio-Tek's Bio-Stack Microplate Stacker.
- The intended use of this instrument is dependent on the instrument's rear panel label. If there is an IVD label, then the instrument may be used for clinical, research and development, or other non-clinical purposes. If there is no such label, then the instrument may **only** be used for research and development, or for other non-clinical purposes.

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



Important! 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 document, there are no known hazards associated with the ELx405™. 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 ELx405's power cord must be connected to a power receptacle that provides voltage and current within the specified rating for the system. Use of an incompatible power receptacle may produce electrical shock and fire hazards.

Warning! Electrical Grounding. Never use a two-prong plug adapter to connect primary power to the ELx405. 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.

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

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 and apron.

Warning! Ultrasonic Energy. Ultrasonic energy is present in the ultrasonic cleaner reservoir when AUTOCLEAN programs are running (Ultrasonic Advantage™ models only). Avoid putting your fingers in the bath. Ultrasonic energy can be destructive to human tissue.

Hazards, Cont'd

Warning! Liquids. Avoid spilling liquids on the washer; fluid seepage into internal components creates a potential for shock hazard. Wipe up all spills immediately. Do not operate the instrument if internal components have been exposed to fluid.

Warning! Software Quality Control. The operator must follow the manufacturer's assay package insert when modifying software parameters and establishing wash methods, using the washer's onboard software.

Precautions

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



Caution: Service. Only Bio-Tek authorized service personnel should service the instrument. 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°-30°C. Performance may be adversely affected if temperatures fluctuate above or below this range. Storage temperature limits are broader (see **Chapter 4, Preventive Maintenance**).

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.

Caution: Chemical Compatibility - Washers. Some chemicals may cause irreparable damage to washers. The following chemicals have been deemed safe for use in washers: buffer solutions (such as PBS), saline, surfactants, deionized water, 70% ethyl, isopropyl, or methyl alcohol, 40% formaldehyde, and 20% sodium hydroxide. Never use DMSO or other organic solvents. These chemicals may cause severe damage to the instrument. Refer to **Appendix C, Chemical Compatibility**. Use of wash buffers containing acetic acid is limited to washers upgraded with PN 68098 Teflon® valves. Contact Bio-Tek for upgrade information and prior to using other questionable chemicals.

Precautions, Cont'd

Caution: Wash Buffer Solution. Although many precautions have been taken to ensure that the instrument is as corrosion-proof as possible, the washer is not sealed and liquids can seep into sensitive components. Make sure that any spilled wash buffer solution is wiped off the washer. Prolonged exposure to salt solution may corrode parts of the microplate carrier, movement rail, springs, and other hardware.

Caution: Bovine Serum Albumin. Solutions containing proteins, such as bovine serum albumin (BSA), will compromise the washer's performance over time unless a strict maintenance protocol is adhered to. See **Chapter 4, Preventive Maintenance** for cleaning instructions regarding BSA.

Caution: Shipping Bracket. The manifold shipping bracket must be removed prior to operating the ELx405™, and reinstalled before repackaging the washer for shipment. See **Chapter 2, Installation**, for instructions.

Caution: Waste Sensor Port. The port on the back of all ELx405 Washers for the waste sensor is the same type as the 24-VDC power connector on some other Bio-Tek products (like the Bio-Stack Microplate Stacker). If an external 24-VDC power supply is plugged into this waste sensor port, it will permanently damage components on the PCB inside the ELx405.

Caution: High Flow Pump Installation. DO NOT plug the High Flow vacuum pump cable into a wall outlet! Use the adapter provided with the pump to connect the pump to the accessory outlet on the back of the washer. See **Chapter 2, Installation**, for instructions.

Caution: Warranty. Failure to follow preventive maintenance protocols may **void the warranty**. See **Chapter 4, Preventive 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)."



Important! Do **not** plug an external 24-VDC power supply into the waste sensor port on the ELx405!



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

Directive 89/336/EEC: Electromagnetic Compatibility

Emissions - CLASS A

EN 61326-1:1998

CISPR 16-1:1997 and CISPR-2:1999

Immunity

EN 61326-1:1998

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

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

EN 61010-1:2001

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

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)."

Directive 98/79/EC: *In Vitro* Diagnostics (some models)

- Product registration with competent authorities
- Traceability to the U.S. National Institute of Standards and Technology (NIST):
 - ◆ **Microplate Washers:** Dispense precision and average residual volume is traceable to NIST.

Specific data for a particular serial number is available on request from Bio-Tek Instruments. See page xiii for contact information.

EN 61010-2-101:2002

Particular requirements for *in vitro* diagnostic (IVD) medical equipment.

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:

- **Canadian Standards Association CAN/CSA C22.2 No. 61010-1-04**
“Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements.”
- **Underwriters Laboratories UL 61010-1:2004**
“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 instruments:



Alternating current

Courant alternatif
Wechselstrom
Corriente alterna
Corrente alternata



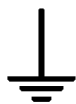
Direct current

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'accompagnement)
Achtung siehe Begleitpapiere
Atención (vease los documentos incluidos)
Attenzione, consultare la doc annessa



Warning, risk of electric shock

Attention, risque de choc électrique
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



Consult instructions for use

Consulter la notice d'emploi
Gebrauchsanweisung beachten
Consultar las instrucciones de uso
Consultare le istruzioni per uso



In vitro diagnostic medical device

Dispositif médical de diagnostic *in vitro*
Medizinisches *In-Vitro*-Diagnostikum
Dispositivo médico de diagnóstico *in vitro*
Dispositivo medico diagnostico *in vitro*



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

Bio-Tek Instruments Warranty Policy

Bio-Tek grants Limited Warranties that are applied to hardware and software products manufactured by Bio-Tek Instruments, Inc. ("Bio-Tek").

This Limited 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 damage and/or bodily injury or death that may result from the use or misuse of any instrument/software by the purchaser, his employees, agents or customers, other than the express warranty contained herein. Under no circumstances shall Bio-Tek be liable to the purchaser or any other person for any direct, incidental or consequential damages, whether rising out of breach of Warranty or otherwise. The implied warranties of merchantability and of fitness for any particular purpose are expressly excluded and do not apply to the instrument/software. This warranty shall not be changed or modified in any way without the express written permission of an officer of Bio-Tek Instruments.

Hardware Warranty

Bio-Tek warrants the hardware instrument for a period of one (1) year from the date of the product shipment from Bio-Tek against defective materials and workmanship. This warranty is limited to the original purchaser and cannot be assigned or transferred. All claims under this limited warranty must be made in writing to Bio-Tek, Attention: Service Department, or to Bio-Tek's authorized representative. Purchaser must ship the product to Bio-Tek, postage pre-paid. Bio-Tek shall either repair or replace with new, like new, or equipment of similar condition 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 material or workmanship.

This warranty is void if the instrument 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 instrument 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 instrument has not been connected, installed, or adjusted strictly in accordance with written directions furnished by Bio-Tek. Batteries, fuses, lamps, and other 'consumable' items used in any of the instruments are not covered by this warranty.

Bio-Tek will continue to stock parts for a minimum 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 instrument.

Registration Card

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 will be assured of receiving prompt information on product enhancements.

Registration Online

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

Chapter 1

Introduction

This chapter introduces the ELx405™ Microplate Washer, and describes variations of the washer, hardware and software features, and technical specifications. Instructions on how to contact Bio-Tek for Technical Assistance are included on page 12.

Introducing the ELx405	2
ELx405 Washer Variations.....	3
Compatibility With the Bio-Stack System.....	4
Hardware Features.....	6
Software Features.....	7
Package Contents	8
Optional Accessories	9
Specifications	10
Performance Specifications.....	11
Technical Support	12
Applications Support	14

Introducing the ELx405

Precise, fast, and easy to use, the ELx405™ is a user-programmable, fully automated microplate washer. Variations of the washer include the ELx405, Select, HT, Magna, and Select CW. Its key features include the following:

- Programmable dispense volumes, flow, and aspiration rates provide for a wide range of washing capabilities, from gentle washing for cellular assays to vigorous washing for ELISA™.
- The bottom washing routine can be applied to lower the background absorbance. The crosswise aspiration routine can be utilized to reduce residual volumes.
- The ELx405 can be used to wash all microplate-based assays, including ELISA, fluorescence, chemiluminescence, RIA, DNA probes, and cellular assays.
- The intuitive menu-driven software allows you to create and store up to 75 washer programs. When you are ready to run a program, simply select the program name and follow the screen prompts. The ELx405 will then process the plate according to the program parameters.
- All ELx405 models support Wash, Prime, Dispense, and Aspirate programs. In addition, these programs can be “linked” together to run automatically.
- An optional external valve-switching module with four different supply bottles can be used with models that have been retrofitted to support the module.
- Built-in fluid flow, fluid detection, and vacuum sensing provide complete protection for unattended operation.
- Several pre-defined programs are provided to simplify preventative maintenance, which should be performed regularly to ensure optimum washer performance.
- In addition to operating on a stand-alone basis, the ELx405, Select, HT, and Select CW models are compatible with the Bio-Stack™ Microplate Stacker. See page 4, **Compatibility With the Bio-Stack System**. (The Magna model is not compatible.)
- All ELx405 models include a robot accessible carrier and can be interfaced into some standard robotic systems.
- All ELx405 models may be serially controlled using Bio-Tek’s Autowasher ActiveX® component, typically for integration into automated systems.
- Models equipped with the Ultrasonic Advantage™ (ultrasonic cleaner) provide extra cleaning power by using ultrasonic pulses in a water bath to remove residue on the manifold tubes.

ELx405 Washer Variations

The ELx405™ is available in the models listed below. See **Figures 18-20** in **Chapter 3, Operation**, for illustrations of these models.

- The **ELx405** is the “standard” model, used to wash 96-well microplates. It has one manifold with 96 sets of dispense and aspirate tubes.
- The **ELx405 Select** can be used to wash standard 96-well plates and 384-well plates. Its patented Dual-Action™ manifold features 96 sets of dispense and aspirate tubes that are arranged in a fixed horizontal position relative to each other but located in two separate manifolds. The two manifolds move independently of each other on the vertical axis.
- The **ELx405 HT** is a fast 384-well microplate washer and is ideal for high throughput washing. The washer includes the Bio-Tek patented Dual-Action manifold that has been fitted with 192 aspirate and dispense tubes, and allows overflow wash/overflow protection in 384 plates for the most demanding assays. The ELx405 HT is also available in two models that include the 96-tube Dual Action manifold as an accessory: the ELx405HT2 and ELx405HTV2 (valve module).
- The **ELx405 Magna** allows the use of magnets for assays that use plastic-coated metal beads as a substrate. The beads are placed in a standard 96-well microplate. A second carrier that travels beneath the microplate carrier can be fitted with a magnetic plate. When the second carrier is below the microplate, the magnet will pull the beads into the bottom of the microwells and hold them there during aspiration of the supernatant and during soaking cycles. The Magna can also be used as a standard 96-well washer.
- The **ELx405 Select CW** or “cell washer” incorporates all the functionality of the ELx405 Select washer with additional low flow tubing for sensitive, cell-based assays. The ELx405 Select CW software includes the standard flow rates of the ELx405 Select as well as two ultra low flow rates for a gentler washing of non-adherent cells or cell lines that are more loosely adhered to the microplate.

All models can be configured to work with the optional valve module, for users who have complex assay requirements. With the valve module attached, the user can create linked programs to automatically draw reagent from up to four separate reservoirs.

Models equipped with the Ultrasonic Advantage™ feature a built-in ultrasonic cleaner for enhanced maintenance of the manifold tubes. A stainless steel cleaning reservoir with an ultrasonic transducer bonded to the bottom of the reservoir is mounted on the washer. An **AUTOCLEAN** function in the onboard Utility menu enables the user to create and run ultrasonic cleaning routines using programmable parameters such as number and duration of loops, and supply sources.

- ❖ Not all Select CW models support the external valve module. If you have questions about your Select CW’s compatibility with this valve module, contact Bio-Tek.
- ❖ Magna models do not support the Ultrasonic Advantage™.

Compatibility With the Bio-Stack System

The ELx405, Select, HT, and Select CW models are compatible with Bio-Tek's Bio-Stack™ Microplate Stacker (see **Figure 1** on the following page). The basecode software of these washers has been modified so that their normal operating displays now include the Bio-Stack options. Upgrade kits are also available for customers who purchased their ELx405 and Select models before modifications to the basecode. (*All HT and Select CW models support the Bio-Stack.*)

Controlled serially by the ELx405™, the Bio-Stack can rapidly and systematically transfer microplates one at a time to and from the washer, 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 the ELx405, Select, HT, and Select CW, refer to the Bio-Stack Operator's Manual for instructions on configuring the washer to run with the Bio-Stack. If you are interested in purchasing the Bio-Stack, contact your local Bio-Tek dealer for more information.



Figure 1: The ELx405™ Microplate Washer With the Bio-Stack

Hardware Features

- 2-line x 24-character LCD display
- Membrane keypad with 25 alphanumeric keys
- Washes standard microwell strips and microplates with a maximum height of 22.86 mm, including:
 - 96-well microplates with 0.355"/9-mm well centers (ELx405™, Select, Magna, Select CW, and HT models with the 96-tube manifold)
 - 384-well microplates with 0.177"/4.5-mm centers (Select, Select CW, and HT models)
- Crosswise aspiration for optimizing washing performance
- Internal switching power supply
- One serial RS-232 COM port (25-pin male connector)
- Positive displacement pump that provides controllable flow rates and volumes to make washing cellular assays and immunoassays equally convenient
 - The settings are adjustable through the on-board software, for low to high velocity dispensing
- 5-amp accessory outlet for automatic vacuum pump control
- Stepper motors for accurate and repeatable carrier and manifold positioning
- Plate carrier that is easily removed for cleaning
- Priming/soaking trough
- Mist shield that protects the user from contaminants
- Waste, fluid, flow, and vacuum detection sensors
- Robot accessible carrier for all models
- Bio-Stack accessible carrier for the ELx405, Select, HT, and Select CW models
- Typical processing speeds for the following models:
 - **Single/Dual 96-tube manifolds:** < 30 seconds (3 cycles, 300 µl/well 96 wells, no soak); < 80 seconds (3 cycles, 100 µl/well 384 wells, no soak)
 - **Dual 192-tube manifold:** < 20 seconds (1 cycle, 400 µl/well overflow washing, 384 wells, with final aspirate)

❖ **Single/Dual 96-tube manifolds** = the ELx405, Select, Select CW, HT2/HTV2, and Magna models.

❖ **Dual 192-tube manifold** = All HT models.

Software Features

- Easy-to-use, menu-driven interface
- Ability to create Wash, Prime, Dispense, and Aspirate programs for automated microplate washing. Wash parameters such as number of cycles, wash volume, flow rate and soak time are individually programmed as part of a wash program and recalled when needed.
- Ability to link up to 10 programs
- Ability to create Soak programs for inclusion in a linked series of programs
- Quick repeat of previously run program
- User-definable washer program names, resulting in the rapid recall of desired wash protocols and plate dimension set-ups
- Programs may be copied, edited or deleted
- Program parameters may be locked. Requires custom program; contact Bio-Tek for more information
- Easy-to-update washer software
- Storage of up to 75 programs
- Preprogrammed maintenance programs
- Five shaking speeds for more intense washing
- Programmable aspiration height - ensures that the tubes do not touch the well bottom, allowing the handling of sensitive cell assays
- Support for the following languages: English, French, German, Italian, and Spanish.

❖ **Note:** Contact Bio-Tek for information on changing to a different language.

Package Contents

Description		PN
Power cord (part numbers vary according to country of use)		Varies
RS-232 serial cable		75053
Microplate carrier (part numbers vary according to model)		Varies
Magnet plate (packaged with magnet plate carrier - Magna model only)		7100558
Mist shield		7102012
Thumbscrews for mist shield (2)		19965
Dust cover		7342066
Stylus – aspirate tubes (all 96-tube and 192-tube manifold models)		7102108
Stylus – dispense tubes	96-tube single or dual manifolds (ELx405, Select, Select CW, Magna, HT2/HTV2)	2872304
	192-tube manifolds (all HT models)	7102139
Accessory 96-tube dual manifold (for HT models only that are sold with this accessory)		7102064 7102068
Storage case for accessory 96-tube manifold		7102136
Manifold shipping bracket	Models without Ultrasonic Advantage™	7102033
	Models with Ultrasonic Advantage	7102152
Hardware for manifold shipping bracket	Screws (all models)	19143
	Flat washers (all models)	17054
	Lock washers (all models)	16016
9/64" (3.57 mm) hex wrench for removing manifold shipping bracket, manifold		48434
Instructions for removal of manifold shipping bracket		7101009
ELx405™ Operator's Guide		7101000
Packing instructions		7101022
Shipping document kit (Warranty Registration Card, Certificate of Compliance and Calibration, FDA Certification)		94075
Declaration of Conformity	For clinical use (IVD label)	7101010
	For non-clinical use (no IVD label)	7101044

Optional Accessories

Description		PN
Complete dispense/waste system	115 volts, 4-liter bottles	7100547
	230 volts, 4-liter bottles	7100548
Complete dispense/waste system with High Flow vacuum pump (recommended for the HT model)	115 volts, 4-liter bottles	7100565
	230 volts, 4-liter bottles	7100566
Auxiliary power cord for vacuum pump connection		75096
Vacuum tubing set		7100533
Dispense tubing set		7100538
External valve module with 4 separate supply bottles		7100540
10-liter dispense bottle		7100559
Waste bottles	10-liter waste bottle	7100557
	20-liter waste bottle	7100556
High Flow vacuum pump 1/3 HP 115 V~ used for applications with a 384-well microplate or where strong aspiration is required		7103003
Liquid testing solutions for Evacuation Efficiency or Dispense Precision tests	Bio-Tek Wetting Agent Solution	7773002
	Bio-Tek Blue Test Dye Solution	7773001
Installation-Operational-Performance Qualification (IQ-OQ-PQ) package		7100567
Bio-Stack™ Microplate Stacker		BIOSTACK
ELx405™ ActiveX Programmer's Package		7100560
ELx405 Service Manual		7101001

❖ **Note:** For accessories not listed here, contact Bio-Tek for more information.

Specifications

Microplates	
96-well plates/strips:	ELx405™, Select, Magna, Select CW, HT2/HTV2 (with the dual/96-tube manifold installed)
384-well plates:	Select, Select CW, all HT models

Electrical	
Voltage range:	100 to 240 V~ at 50 to 60 Hz, ≤ 8.0 A
Accessory Outlet:	≤ 5.0 A, used for vacuum pump

Physical	
Dimensions:	17" D x 14" W x 10" H (43.2 cm x 35.6 cm x 25.4 cm)
Weight:	≤ 30 lb (13.5 kg)

Environmental	
Operating conditions:	15 to 30°C (59 to 86°F)
Relative Humidity:	10% to 85% (non-condensing)

Manifold Type	Compatible with
Single manifold with 96 sets of aspirate and dispense tubes arranged in an 8x12 array to process 96-well microplates.	ELx405 (standard), and Magna
Two manifolds, one with 96 aspirate tubes and the other with 96 dispense tubes, for processing 96- and 384-well plates.	Select, Select CW, and HT2/HTV2
Two manifolds, one with 192 aspirate tubes and the other with 192 dispense tubes, for processing 384-well plates.	All HT models

Other	
Waste bottle volume:	4, 10, or 20 liters, depending on the accessory package
Supply bottle volume:	3.7 liters
User interface (LCD):	2 line x 24-character LCD display, 25 alphanumeric keys

Performance Specifications

Average Residual Volume (Evacuation Efficiency)		
Single/Dual 96-Tube Manifolds	ELx405 Select, Magna Select CW HT2/HTV2	Average residual volume in the microwells is $\leq 5 \mu\text{l}$ per well after a 3-cycle wash, when 300 μl of deionized water with 0.1% Tween 20, or buffer equivalent, is dispensed per well into a Costar 96-well flat-bottomed plate. The aspirate height adjustment is optimized for the plate prior to testing.
Dual 192-Tube Manifold	All HT models	Average residual volume in the microwells is $\leq 2 \mu\text{l}$ per well after a 3-cycle wash, when 100 μl of deionized water with 0.1% Tween 20, or buffer equivalent, is dispensed per well into a Costar 384-well flat-bottomed plate. The aspirate height adjustment is optimized for the plate prior to testing.

Dispense Precision		
Single/Dual 96-Tube Manifolds	ELx405 Select Magna Select CW HT2/HTV2	$\leq 4.0\% \text{ CV}$, when dispensing 300 μl per well of deionized water with 0.1% Tween 20 [®] , with FD&C #1 blue dye at a rate of 300 μl per well, per second (3.0% CV is typical) into a Costar 96-well flat-bottomed plate. The absorbance of the solution is read at 630 nm and 450 nm reference.
Dual 192-Tube Manifold	All HT models	$\leq 4.0\% \text{ CV}$ when dispensing 80 μl per well of deionized water with 0.1% Tween 20, with FD&C #1 blue dye at a rate of 102 μl per well, per second (rate 5) into a Costar 384-well flat-bottomed plate. The absorbance of the solution is read at 630 nm and 450 nm reference.

Technical Support

Bio-Tek's ELx405™ Microplate Washer 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 washer 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 software configuration information. To see this information, start at the washer Main Menu and follow the path below:

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 **Appendix B, Error Codes**)
- A daytime phone number
- Your name and company information
- A fax number and/or e-mail address, if available.

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

Repackage the washer properly (see **Repackaging and Shipping** in **Chapter 2, Installation**), and ship the instrument to Bio-Tek at the shipping address listed on the following page.

❖ **Note:** Bio-Tek offers a **Depot Service Contract** for instruments after the initial warranty has expired, and field service contracts for several locations. Please refer to the Bio-Tek website for more information: www.biotek.com.

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

Facsimile Support

You may send a fax with your questions or requests for help 24 hours a day to the following number:

- **Technical Assistance Center:** 802-655-3399

Written Communication

If you prefer, you may write a letter with your comments and send it to:

Bio-Tek Instruments, Inc.
Technical Assistance Center
P.O. 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

❖ Please call or e-mail TAC for an RMA number **before** shipping the instrument.

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 washing cell-based assays, integrating a unique data reduction transformation, 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

Installation

This chapter includes instructions for unpacking and setting up the ELx405™ Microplate Washer, installing its components, and repackaging the instrument for shipment.

Unpacking and Inspecting the Instrument	16
Removing the Manifold Shipping Bracket	21
Setting Up the Washer.....	22
Verifying Performance	35
Installation of the Washer for Operation with the Bio-Stack.....	36
Repackaging and Shipping	37

Unpacking and Inspecting the Instrument



Important! Save **all packaging materials**. If the ELx405™ is shipped to the factory for repair or replacement, it must be carefully repackaged, according to the instructions in this chapter, using the original packing materials (PN 7103000). Using other forms of commercially available packing materials, or failing to follow the repackaging instructions may **void your warranty**. If the original packing materials have been damaged, replacements are available from Bio-Tek.

For customers who purchased the **optional Valve Module** (PN 7100540): The valve module should be returned with the ELx405 in order to ensure that the washer will meet published performance specifications when used with the valve module. Refer to the instructions in this chapter for unpacking the module and repackaging the unit for shipment. Use the original packaging materials for the valve module.

See ***Repackaging and Shipping*** at the end of this chapter for complete shipping instructions.

The ELx405 washer and its accessories are securely packaged inside custom-designed shipping materials. This packaging should protect the instrument from damage during shipping. Inspect the shipping box, packaging, instrument, and accessories for signs of damage.

If the washer is damaged: Notify the carrier and your manufacturer's representative. 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.

Refer to the unpacking instructions and **Figures 2** through **7** on the following pages when removing the instrument, its accessories, and the external valve module from the shipping containers, and **Figure 8** for removing the manifold shipping bracket.

See ***Repackaging and Shipping*** at the end of this chapter for complete shipping instructions.

To unpack the washer and its accessories:

1. Carefully open the top of the outer shipping box.
2. Lift out the inner shipping box that contains the washer and accessories (**Figure 2**) and place it on a level surface.
3. Open the top of the inner shipping box.
4. Remove the mist shield, model-specific carrier, shipping document kit, and other accessories (**Figure 3**) listed in ***Package Contents, Chapter 1***.

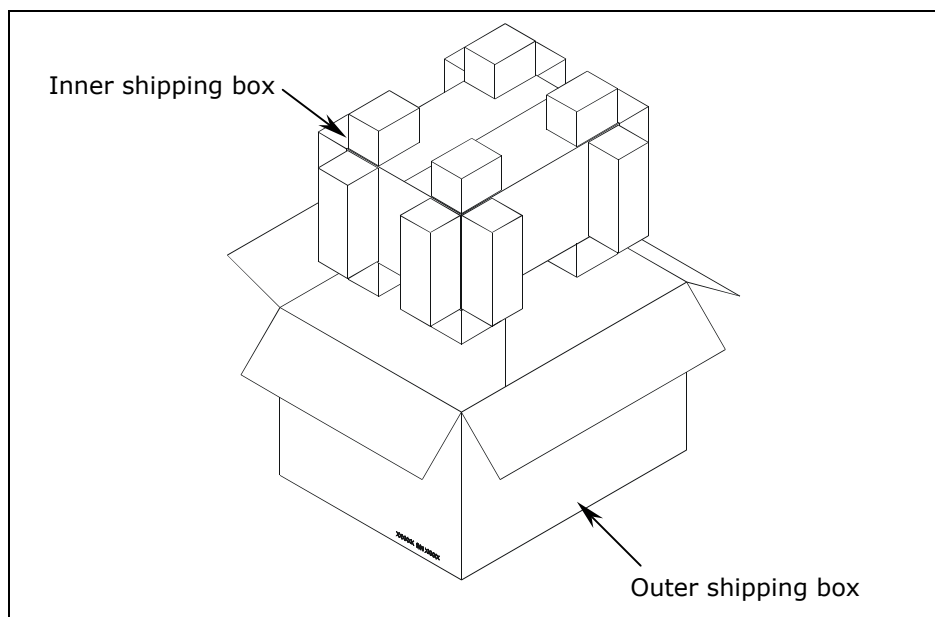


Figure 2: Removing the Inner Shipping Box

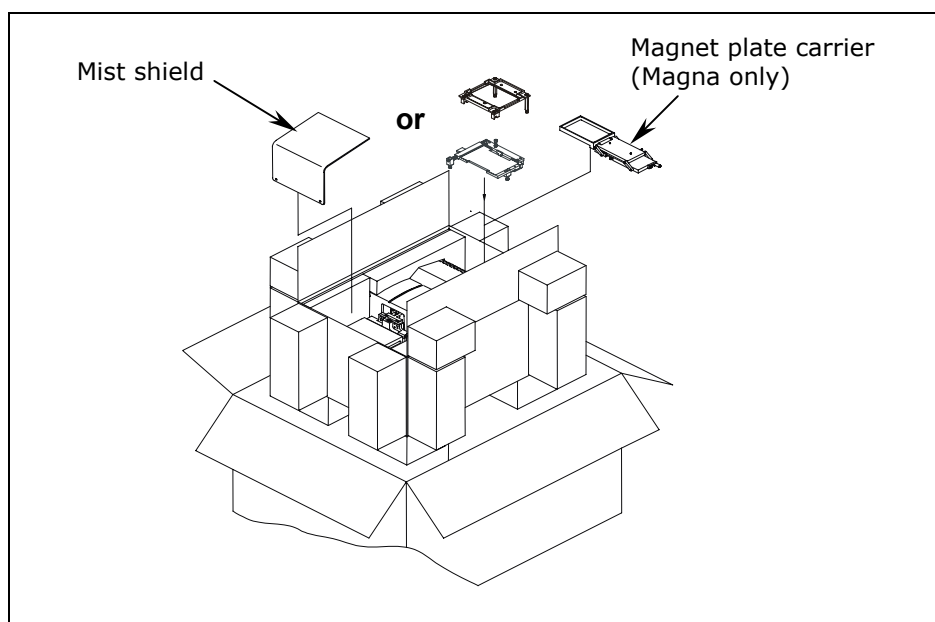


Figure 3: Removing the Carrier and Other Accessories

- ❖ **HT2/HTV2 models with the 96-tube manifold:** The washer is shipped with the 192-tube manifold installed; the 96-tube manifold is packaged in a special case and included in the accessories.
- ❖ **Magna models:** The magnet plate carrier is packaged with the magnetic plate in a small container, and is included in the shipping accessories, with the Magna's microplate carrier.

5. Carefully lift the washer out of the inner shipping box and place it on a level surface.
6. Remove the left and right end caps and the plastic bag (**Figure 4**).
7. Save the end caps, bag, and shipping containers for repackaging.
8. Note the manifold shipping bracket in **Figure 5** (the Select model is shown). Follow the instructions on page 21 for removing the bracket.

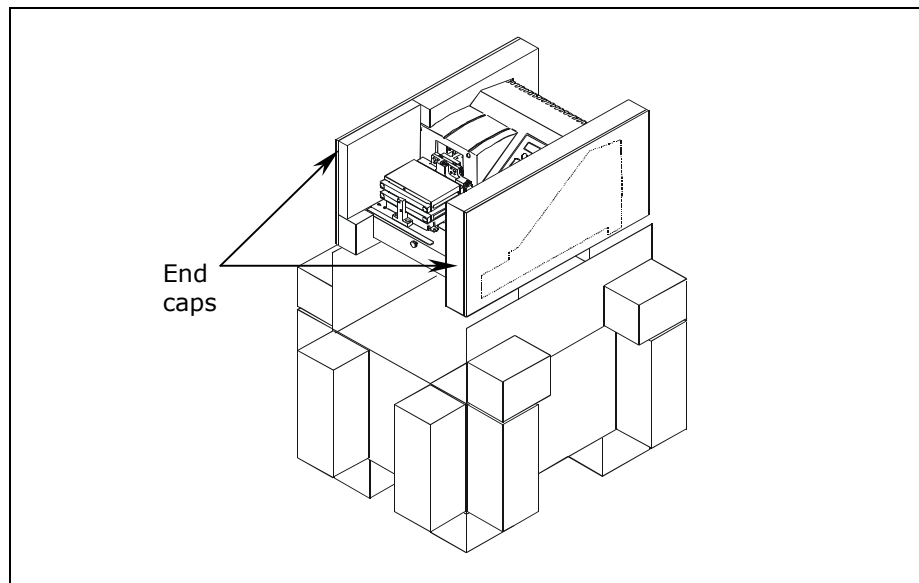


Figure 4: Removing the End Caps

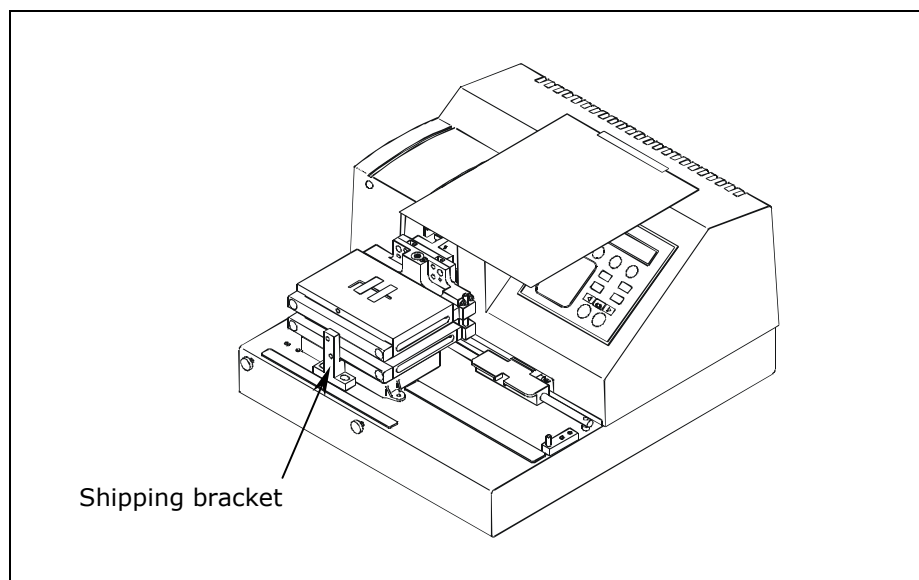


Figure 5: Manifold Shipping Bracket

Unpacking the Valve Module

To unpack the optional valve module and its accessories:

1. Carefully open the top of the shipping container.
2. Lift out the valve module as shown in **Figure 6** and place it on a level surface.
3. Remove any bubble wrap enclosing it.
4. Lift out the two wire holders containing the four supply bottles, the tubing and other accessories (**Figure 7**).
5. Remove the bubble wrap between the two bottle holders and place it in the shipping container with any other shipping materials that came with the valve module.
6. Store these shipping materials with the packaging containers for the washer and accessories.

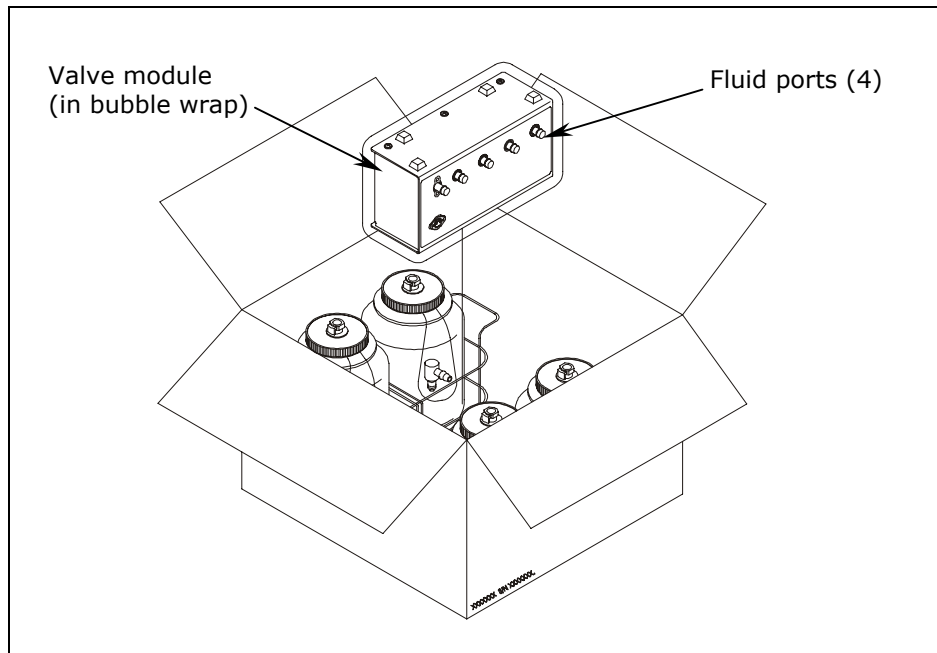


Figure 6: Removing the Valve Module From the Shipping Container

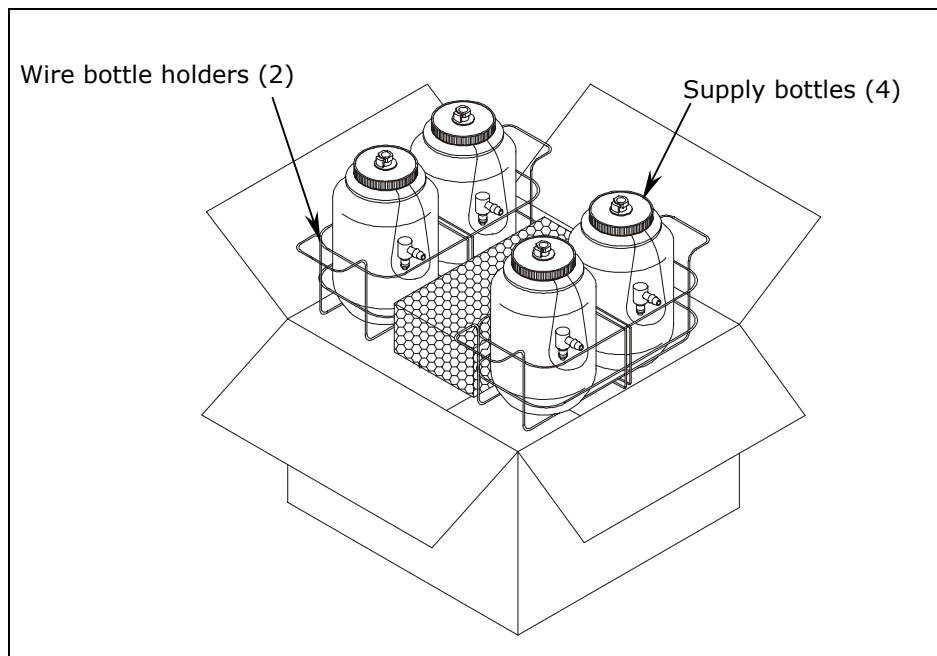


Figure 7: Removing the Wire Holders, Supply Bottles, and Other Accessories From the Shipping Container

Removing the Manifold Shipping Bracket



Important! The ELx405™ washer is shipped with a protective **manifold shipping bracket**. This bracket must be *removed* before the washer is used, and must be *reinstalled* prior to shipping to avoid irreparable damage to the manifold. Failure to properly remove and reinstall the shipping bracket may **void your warranty**. Do not discard the shipping bracket!

Refer to **Figure 8** for the following (the Select model is shown):

1. Using the 9/64" (3.57 mm) hex wrench supplied, unscrew the socket head cap screws located at the base of the shipping bracket.
2. To store the bracket, mount it on the back of the instrument using the hardware that was removed from the front, as illustrated.

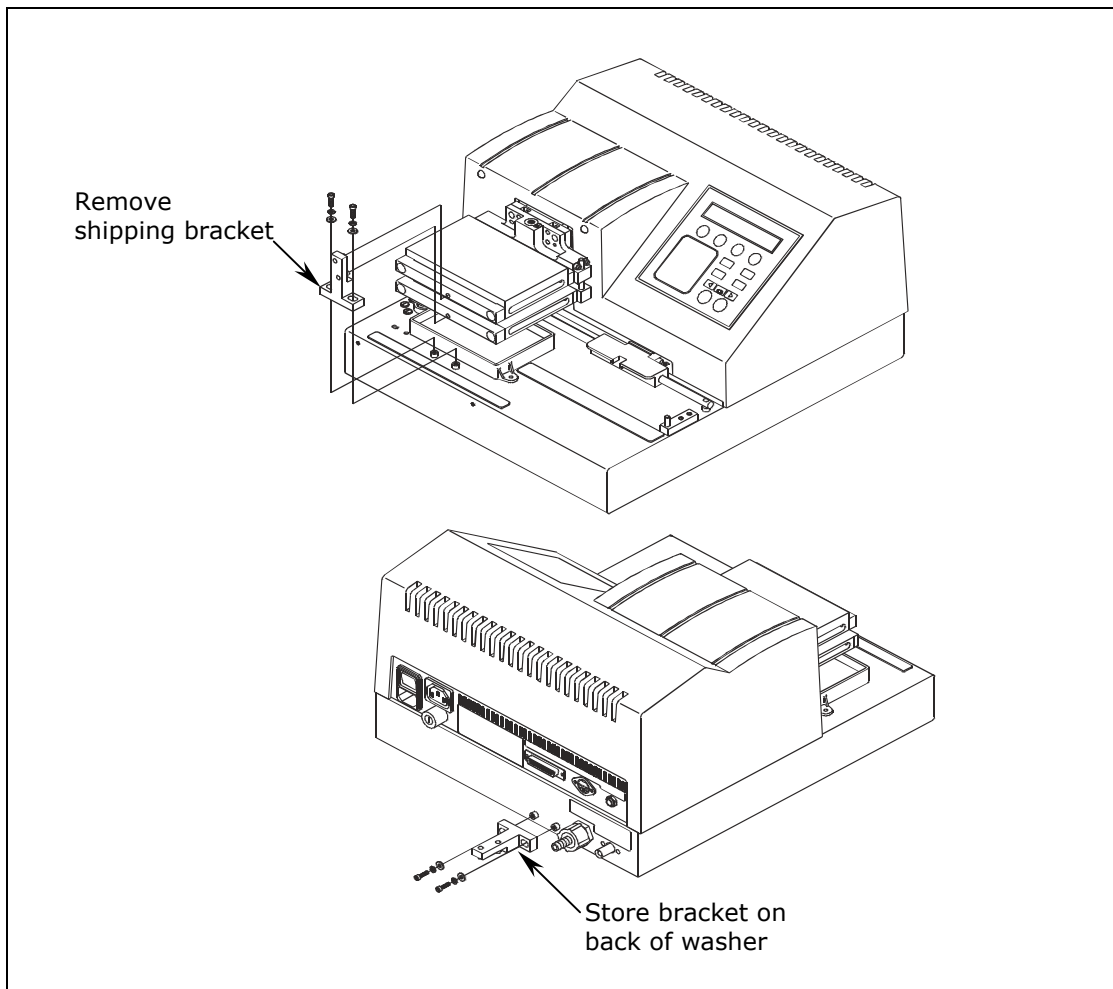


Figure 8: Removing and Storing the Manifold Shipping Bracket

Setting Up the Washer



Important! Avoid excessive humidity. Condensation directly on the sensitive electronic circuits can cause the instrument to fail internal self-checks.

Operating Environment

The washer is sensitive to extreme environmental conditions. For optimal operation, install the ELx405™ Washer under the following conditions:

- On a level surface.
- In an area where ambient temperatures between 15°C and 30°C can be maintained.
- Away from excess humidity: 10% to 85% (non-condensing).

Installing the Microplate Carrier



Important! The microplate carrier has a **serial number** etched on the bottom side. This serial number should match the washer's serial number. If the numbers do not match, call Bio-Tek immediately.

Refer to **Figure 9** for the ELx405 model, **Figure 10** for the Select, Select CW, and all HT models, and **Figure 11** for the Magna model.

1. Line up the pin on the underside of the carrier with the slot on the carrier transport.
2. Snap the two carrier rail guides onto the transport rail. The pin should sit in the slot.

❖ The **Magna** model comes with a magnet plate carrier that travels beneath the microplate carrier. Install the magnet plate carrier first: Line up the pin on the side of the carrier with the slot on the magnet plate carrier transport (lower) rail. Press down gently on the carrier to ensure that it is level with the washer's base plate.

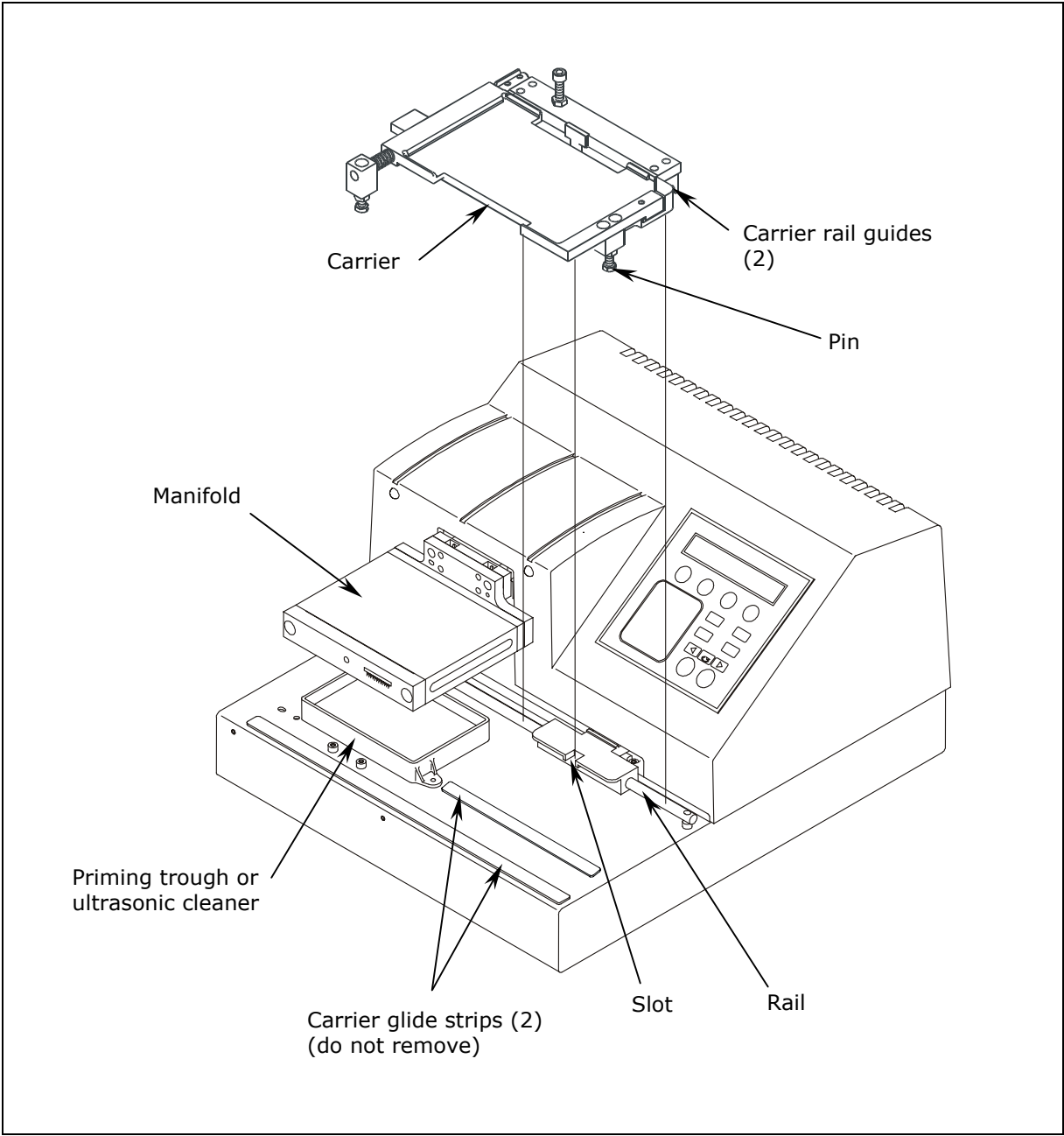


Figure 9: Installing the Microplate Carrier for the ELx405™ Model

❖ The ultrasonic cleaner is available in Ultrasonic Advantage™ models only.

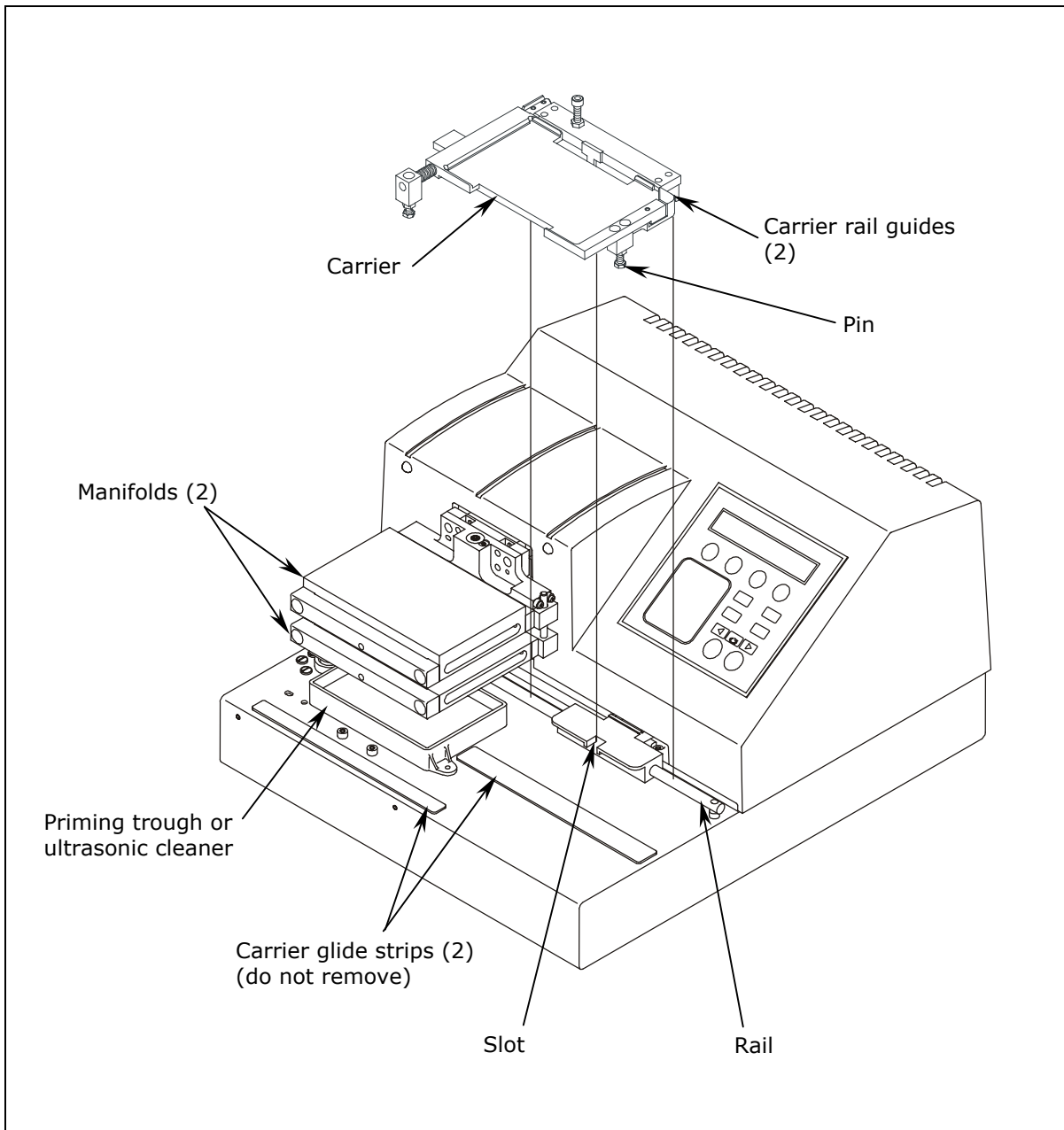


Figure 10: Installing the Microplate Carrier for the Select, Select CW, and all HT Models

❖ The ultrasonic cleaner is available in Ultrasonic Advantage™ models only.

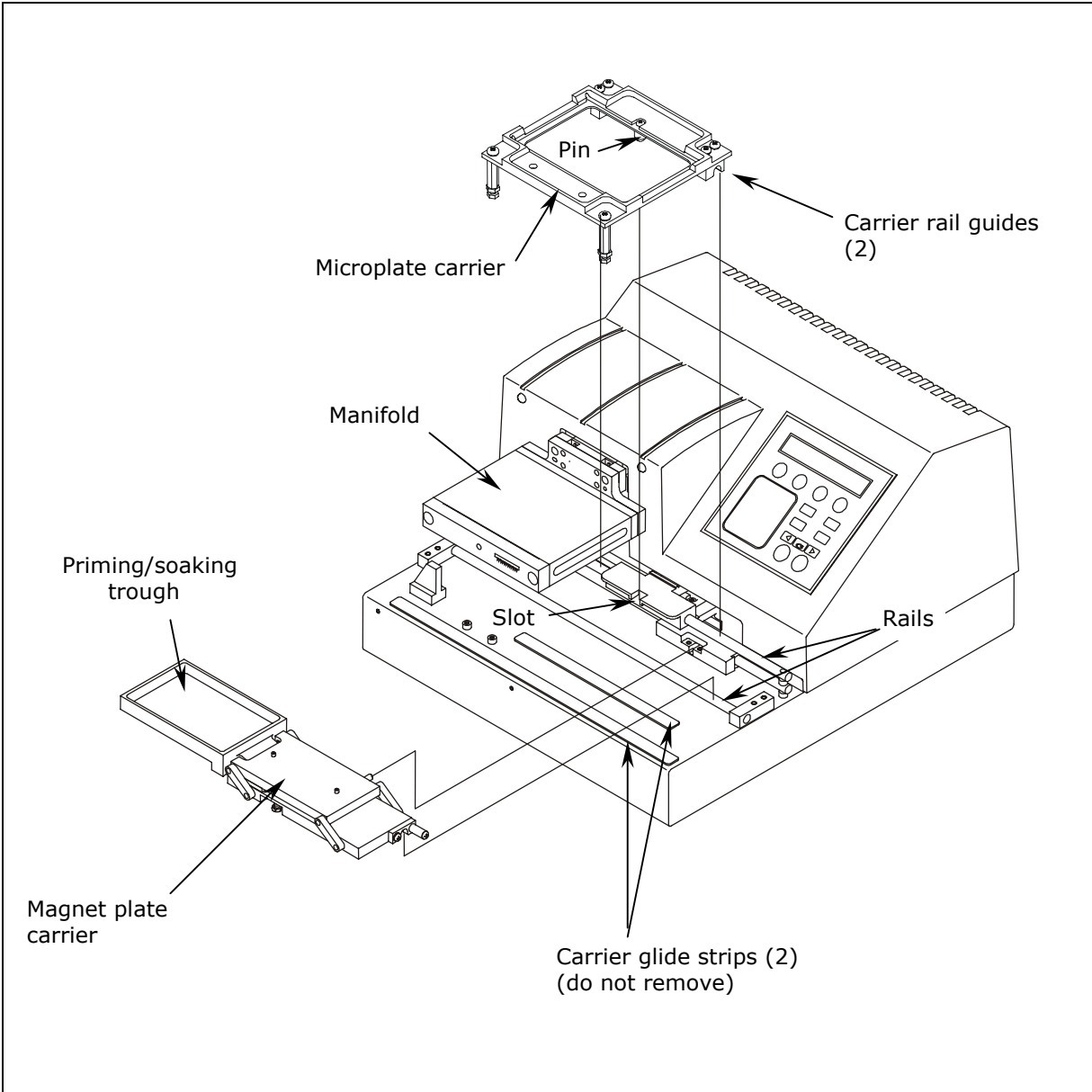


Figure 11: Installing the Microplate and Magnet Plate Carriers for the Magna Model

Connecting the Tubes and Bottles



Important! If you are using the **Bio-Stack Microplate Stacker** with the ELx405™, do not plug the external 24-VDC power supply that came with the Bio-Stack into the waste sensor port! See **Figure 12** for the location of this port.

For optimal operation of the ELx405 washer, all tubing, cables, and fittings for the waste and supply systems must be properly connected.

Figure 12 on the following page illustrates the rear panel of instrument and the locations of the ports and connections for the waste and supply systems.

Before Connecting the Tubes and Bottles

Rinse all waste and supply bottles with deionized or distilled water before connecting them to the waste and supply tubing. This rinsing eliminates particles that may have collected during packing or unpacking.

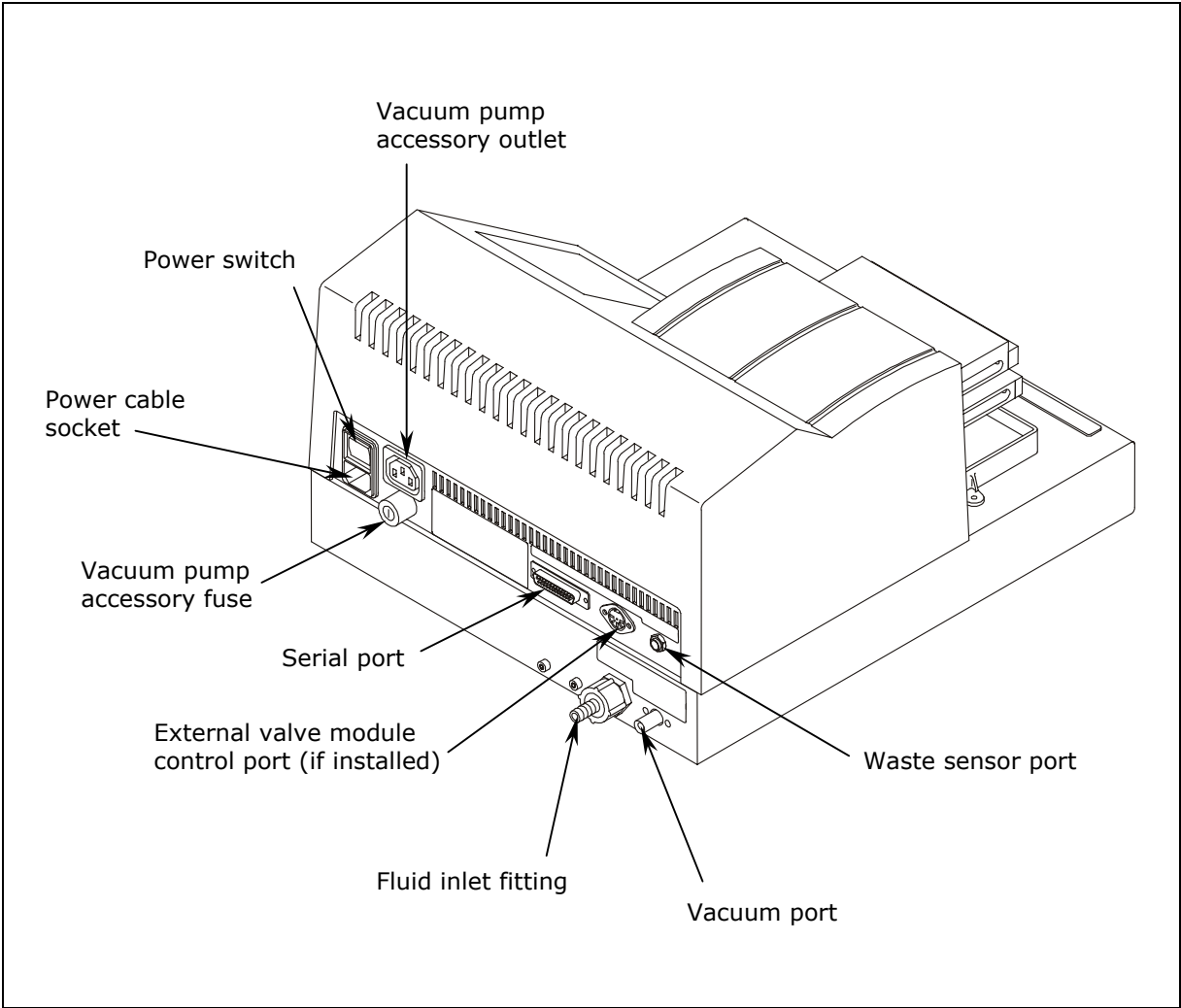


Figure 12: Rear Panel

Waste System



Caution: High Flow Pump Installation. **DO NOT** plug the High Flow vacuum pump cable into a wall outlet! Use the adapter provided with the pump to connect the pump to the accessory outlet on the back of the washer. See **Figure 12** for an illustration of the vacuum pump accessory outlet and **Figure 13** for an illustration of the connection of the cable to the outlet. (See also the High Flow Pump Installation instructions, PN 7101049, included in the package contents of your ELx405™ washer.)

There is no regulator on the pump; therefore, if the pump is plugged directly into a wall outlet, the pump will run continuously, resulting in vacuum levels outside the specified range. This requires the pump to draw a much higher current at setup in order to operate, and may blow the auxiliary 5-amp fuse (PN 46055) and/or produce arcing in the pump's On/Off switch.

A **Vacuum Dissipation Delay** feature is available in the **Setup** utility that allows you to increase the delay, thereby preventing the pump from drawing excess current and blowing the 5-amp fuse. The delay should be set at 10 seconds or greater if using 10-liter bottles, and 20 seconds if using 20-liter bottles. Refer to **Setup Utilities, Vacuum Dissipation Delay** in **Chapter 3, Operation**.

Refer to **Figures 12** and **13** for the following instructions.

1. Attach the single vacuum tube to the vacuum port on the back of the instrument and to the inlet port of the waste bottle.
2. Attach the waste sensor cable to the waste sensor port.
3. **Important!** Connect the vacuum pump to the vacuum pump accessory outlet on the back of the washer (see **Caution** above). Use the accessory outlet adapter provided.
4. Place the waste bottles and vacuum on the same surface as the washer to ensure optimum performance.

❖ **Note:** To facilitate correct connection of the tubing to the waste bottles, the waste tubes have green or yellow labels that correspond to the green or yellow dots next to the inlet/outlet ports on the waste bottles.

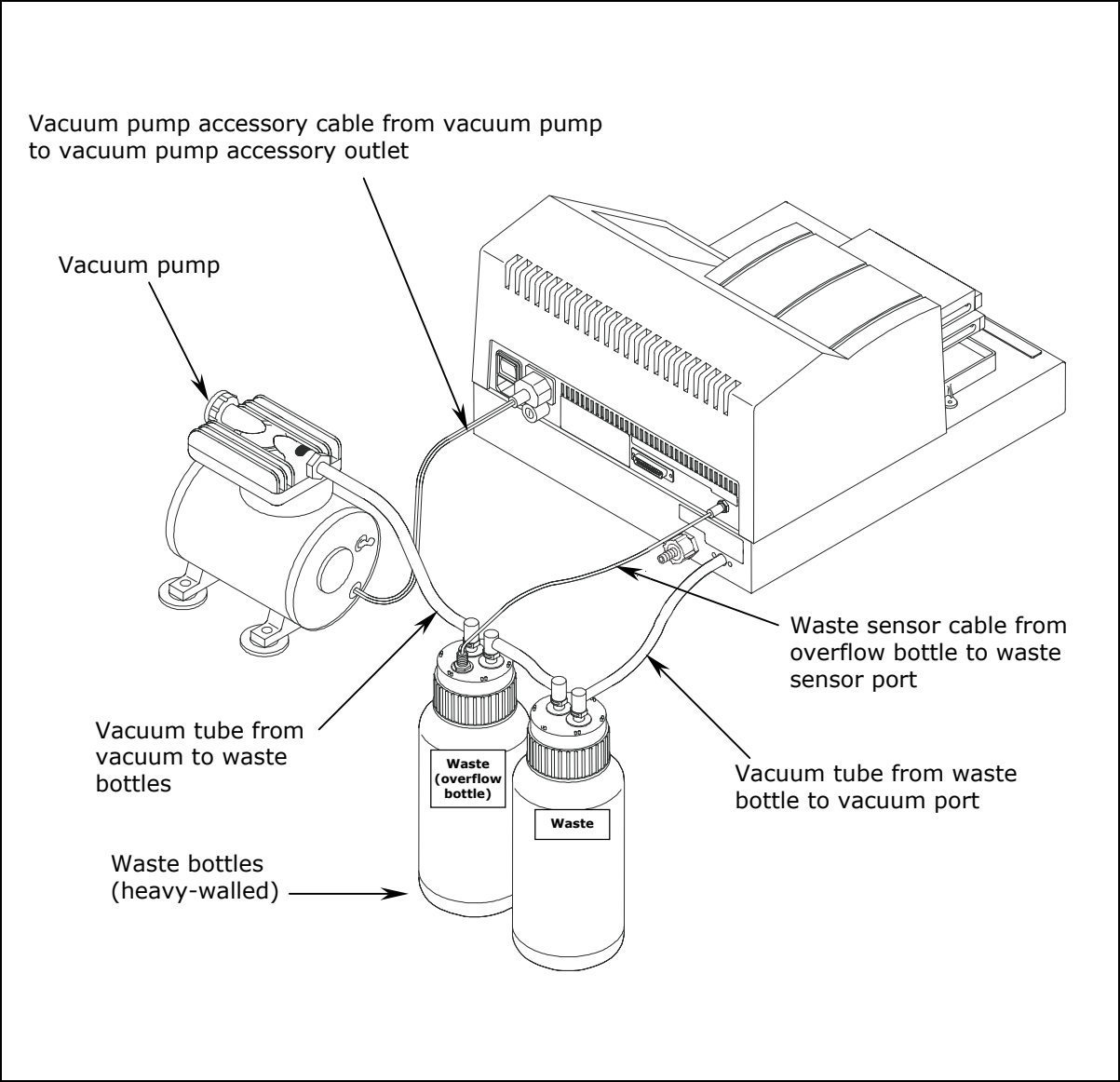


Figure 13: Washer With Vacuum Pump and Waste Tubing Connections

Supply System

Refer to **Figure 14** for the following instructions.

1. There is one supply tube. Connect one end to the fluid inlet port and the other end to the supply bottle.
2. To optimize dispense accuracy, the supply bottle should be on the same surface as the washer.

External Valve Module (if Equipped)

Refer to **Figure 15** for the following instructions.

1. To install the optional valve module, connect the valve cable from the module to the valve control port on the back panel of the washer.
2. Attach the tubing from one of the supply bottles to Valve A in the valve module.
3. Repeat step 2 with the other three supply bottles for Valves B, C, and D.
4. Place the four supply bottles and valve module on the same surface as the washer to optimize performance.

Final Check

1. Verify that the tubing was not crimped during installation.
2. Ensure that there are no loose fittings or cable connections.

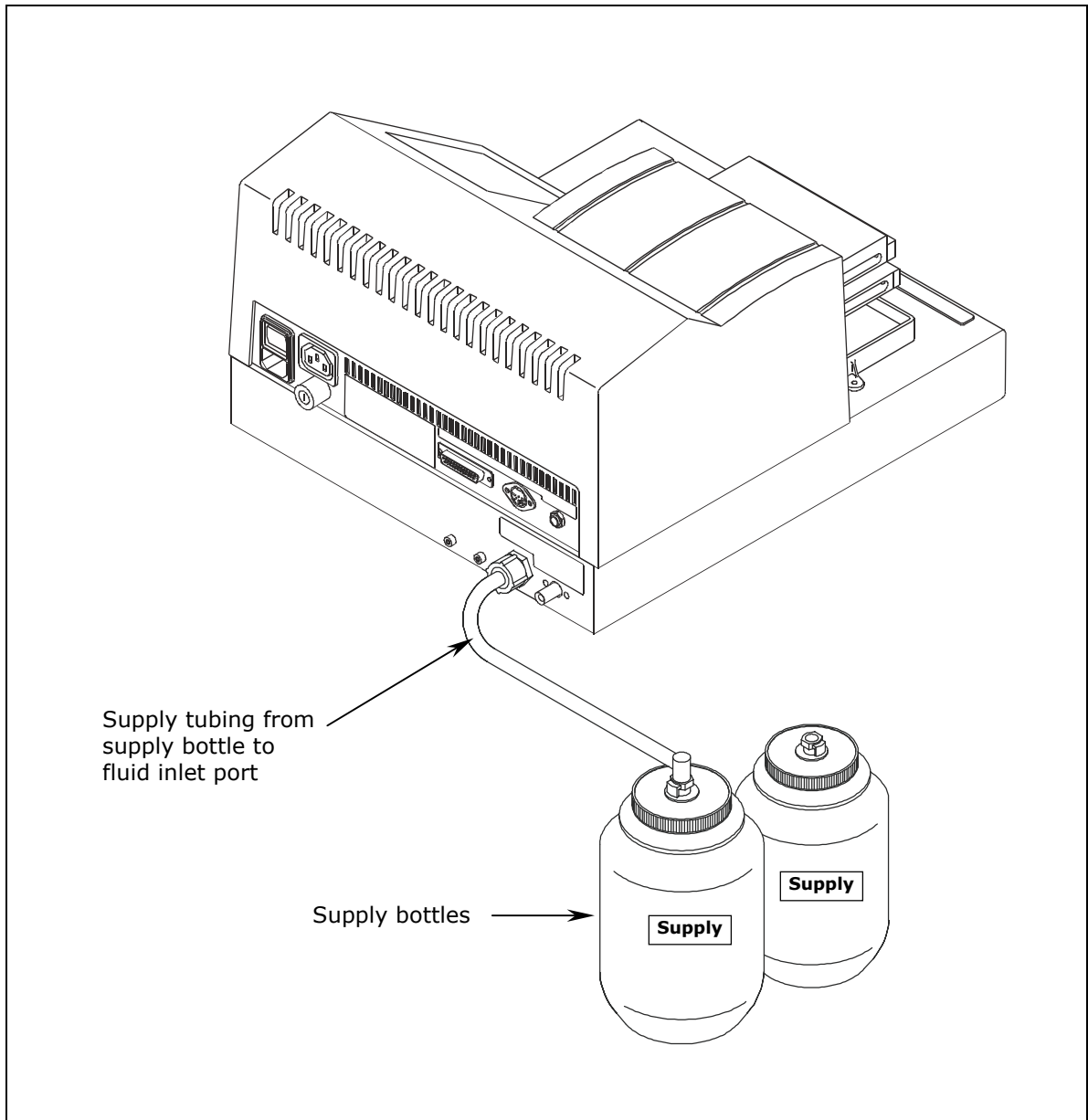


Figure 14: Washer With Supply Tubing Connections (Without Optional External Valve Module)

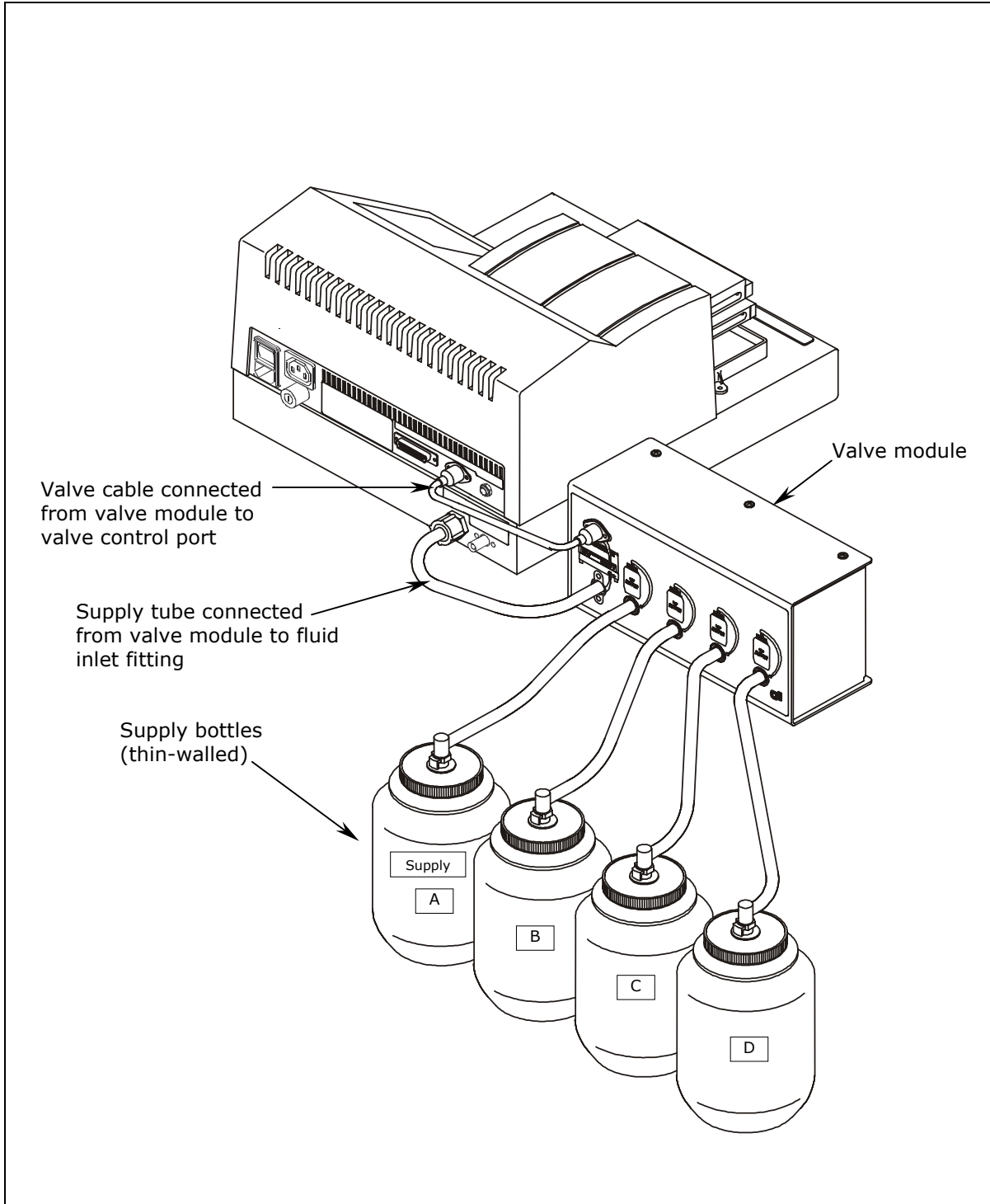


Figure 15: Washer With Optional External Valve Module

Attaching the Mist Shield

1. Align the mist shield with the washer so it rests on top of the two posts (shown in **Figure 16** below) and the two thumbscrew holes in the shield are lined up with the two holes in the front base of the washer.
2. Insert the two thumbscrews and finger-tighten only.

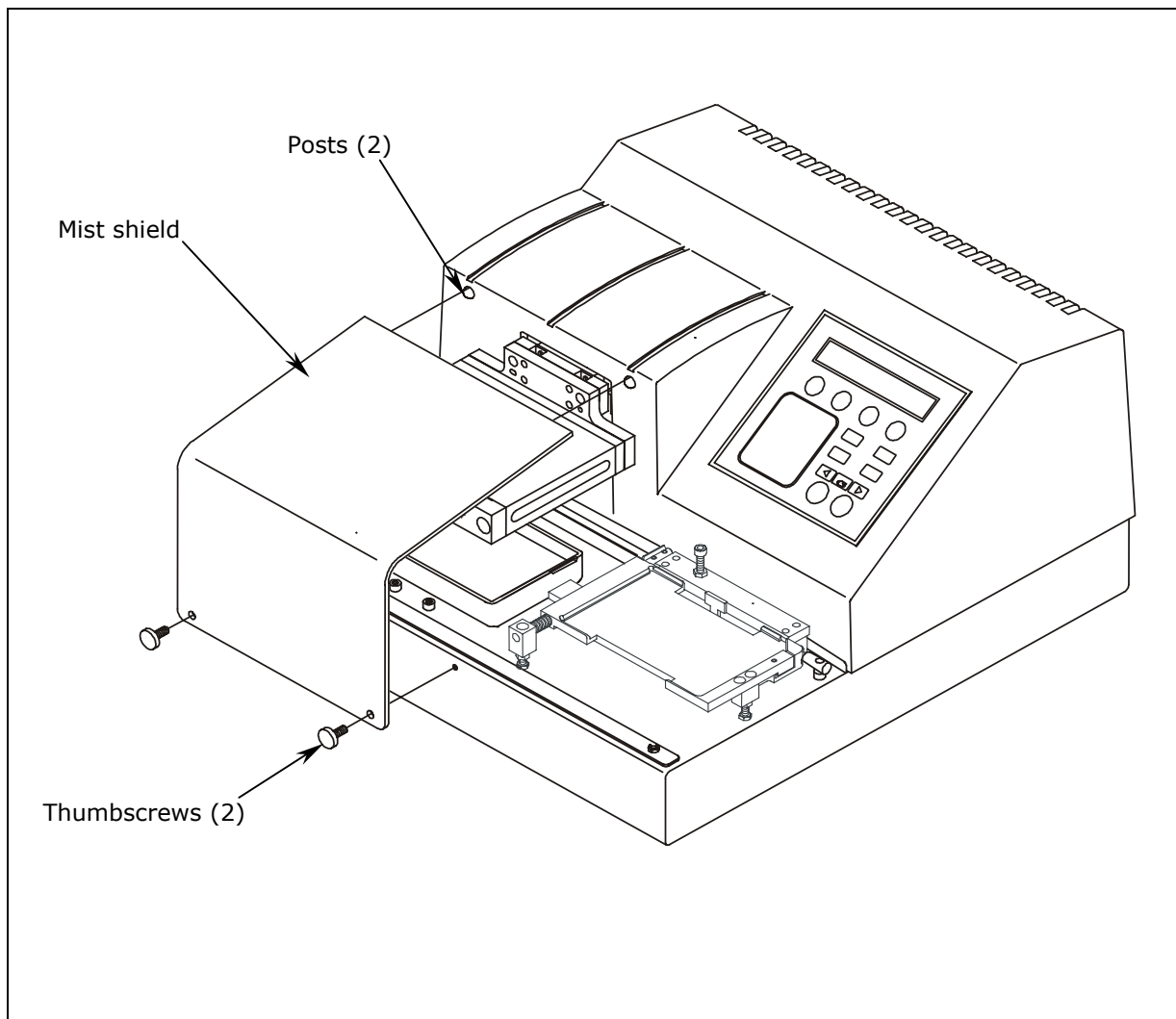


Figure 16: Attaching the Mist Shield

Connecting the Power Cord



Warning! Power Rating. The ELx405™ must be connected to a power receptacle that provides voltage and current within the specified rating for the system. Use of an incompatible power receptacle may produce electrical shock and fire hazards.



Warning! Electrical Grounding. Never use a two-prong plug adapter to connect primary power to the ELx405. Use of a two-prong adapter disconnects the utility ground, creating a severe shock hazard. Always connect the system power cord directly to a three-prong receptacle with a functional ground.

The ELx405 has a built-in switching power supply that automatically adjusts for input voltage in the range of 100-240 V~ at 50-60 Hz.

1. Insert the power cable into the power cable socket in the rear panel of the washer.
2. Insert the three-prong plug into an appropriate three-prong receptacle that has a functional ground.

Serial Port for Communication With Other Devices

The ELx405 has a 25-pin serial (RS-232) port located on the rear panel of the instrument (see **Figure 12**). The serial port allows the washer to receive data from a computer for purposes of factory or dealer service.

Verifying Performance

Before using the ELx405™ Washer for the first time, verify that it is operating properly by turning the washer on. The washer will automatically perform a System Self Test to check the manifold, and manifold-to-carrier positioning. It also performs a magnetic carrier load test on the Magna models.

You can also choose to run this test from the washer's front panel. To run the washer's System Self Test, follow the washer menu path shown below.

UTIL → TESTS → **SLFCHK**

If the test passes, the Main Menu will be displayed.

If the test fails, the washer will beep repeatedly and the display will show an error code. If this happens, note the error code and then press the **Stop** key on the keypad to stop the beeping. Refer to **Appendix B, Error Codes**, to determine its cause. If the problem is something you can fix, turn off the washer, fix the problem, and then turn the washer back on. If the cause is not something you can fix, contact Bio-Tek's Technical Assistance Center.

Chapter 5, Performance Verification/Qualification Tests provides recommended Installation and Operational Qualification 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 successful completion of the Installation Qualification confirms that the washer and its components have been supplied as ordered and ensures that they are assembled and configured properly for your lab environment.

The successful completion of the Operational Qualification confirms that the washer is operating according to specification.

❖ **Note:** An **instrument qualification package** (PN 7100567) for the ELx405 is available for purchase from Bio-Tek. 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.



Important! Before operating this washer, review the **General Usage Guidelines** in **Chapter 3, Operation**. These guidelines include necessary steps to perform before running any program, information on performing periodic maintenance, and points to consider when creating or editing washer programs.

Installation of the Washer for Operation with the Bio-Stack

Installation of the ELx405™ for operation with the Bio-Stack™ Microplate Stacker includes the following:

- Installation of special alignment hardware on both instruments.
- Serial cable connection between the Bio-Stack and the PC controlling the Stacker.

An accessory package (**PN 7310010**) that contains the alignment hardware for both instruments and a serial cable is included with the Bio-Stack.

Please refer to your Bio-Stack Operator's Manual for complete installation instructions.

❖ Some ELx405 instruments may need to be upgraded for Bio-Stack compatibility. Refer to **Upgrade Information** in **Chapter 1** of the Bio-Stack Operator's Manual, or contact Bio-Tek for more information.

Repackaging and Shipping

If you need to ship the ELx405™ Washer to Bio-Tek for service or repair, be sure to use the original packaging. Other forms of commercially available packaging are not recommended and can void the warranty.

If the original packing materials have been damaged or lost, contact Bio-Tek to order **PN 7103000**. See **Technical Assistance** in **Chapter 1** for contact information.

The following table lists all materials included in the ELx405™ shipping package as well as the optional valve module.




Packing materials included in PN 7103000	PN
Outer shipping box	7102099
Inner shipping box	7102097
Left end cap	7102096
Right end cap	7102095
Valve module shipping materials	PN
Shipping box	3740008
Wire holder for buffer bottles	4032066



Important! HT models with the accessory 96-tube dual manifold: HT2/HTV2 models are shipped with the 192-tube manifold installed and the 96-tube manifold packaged in a special case. If you must return the washer to Bio-Tek for service or repair, please ensure that the 192-tube manifold **and protective shipping bracket** have been reinstalled, and that the 96-tube manifold has been repackaged according to the instructions in the following sections.

For instructions on changing the manifolds, refer to **Appendix E, Changing the Manifolds**.

Before Repackaging the Instrument

	<p>Warning! If the washer has been exposed to potentially hazardous material, decontaminate it to minimize the risk to all who come in contact with the washer during shipping, handling and servicing.</p> <p>Decontamination prior to shipping is required by the U.S. Department of Transportation regulations.</p>
	<p>Important! Perform the following steps in the order presented before repackaging the washer for shipment.</p>
	<p>Important! Failure to fasten the manifold in place with the shipping bracket before shipment could result in irreparable manifold damage.</p>

1. **Decontaminate** the washer and its accessories as necessary. Refer to the **Decontamination** procedure in **Chapter 4, Preventive Maintenance** for complete instructions.
2. **HT2/HTV2 models:** If the 192-tube manifold is not installed, install it now. Store the 96-tube manifold in its special case.
3. Run the **PARK** utility. **PARK** prepares the manifold for installing the manifold shipping bracket.

UTIL → SETUP → MORE → **PARK**

4. Turn the washer off and disconnect the power cord and all tubing.
5. Remove the mist shield and carrier, and set aside for packing. Screw the mist shield mounting screws back into the base.
6. Reinstall the **manifold shipping bracket** (see **Figure 5** on page 18 and **Figure 8** on page 21).
7. Obtain a **Return Materials Authorization** (RMA) number from Bio-Tek's Technical Assistance Center through Bio-Tek's website, fax, or e-mail address listed in **Chapter 1**.

When obtaining the RMA, explain whether the washer requires calibration, cleaning, periodic maintenance, warranty work, and/or repair. Make a note of any error messages displayed and their frequency.

Provide Bio-Tek with the name and contact information of a person who may be contacted if questions arise.

Repackaging the ELx405™ and Its Accessories

After the above steps are completed, pack the washer in its original shipping box, using original packing materials, following the steps below.

1. Place the washer into the original plastic bag.
2. Place the left and right end caps on the instrument, and lower it into the inner shipping box as shown in **Figure 4** on page 18.
3. Wrap the mist shield and the carrier in bubble wrap and place them into the box (see **Figure 3**, page 17).
4. **HT models with the accessory 96-tube manifold (HT2/HTV2):** Repackage the 96-tube manifold in its shipping container and place it into the inner shipping box with the other accessories.
5. Close the inner box and place it into the outer box (**Figure 2**). Close and tape shut the outer box.
6. Write the RMA number on the outside of the shipping box.
7. Insure the instrument for full value before shipping to Bio-Tek.

Repackaging the External Valve Module (if equipped)

Refer to **Figures 6** and **7** (on page 20) for the instructions below:

1. Place the four supply bottles into the two wire bottle holders as shown in **Figure 7**, and lower them into bottom of the shipping container.
2. Place approximately two inches of foam or bubble wrap between the two wire bottle holders.
3. Wrap the valve module in bubble wrap and place it between the two wire bottle holders upside down as shown in **Figure 6**.

❖ The fluid ports should be above the wire bottle holder when in the box.

4. Place the remaining accessories inside the box.
5. Fill the remaining space with packing material (no Styrofoam peanuts, please) to secure the contents during shipment.
6. Close and tape the box securely.
7. Write the RMA number on the outside of the box.

Chapter 3

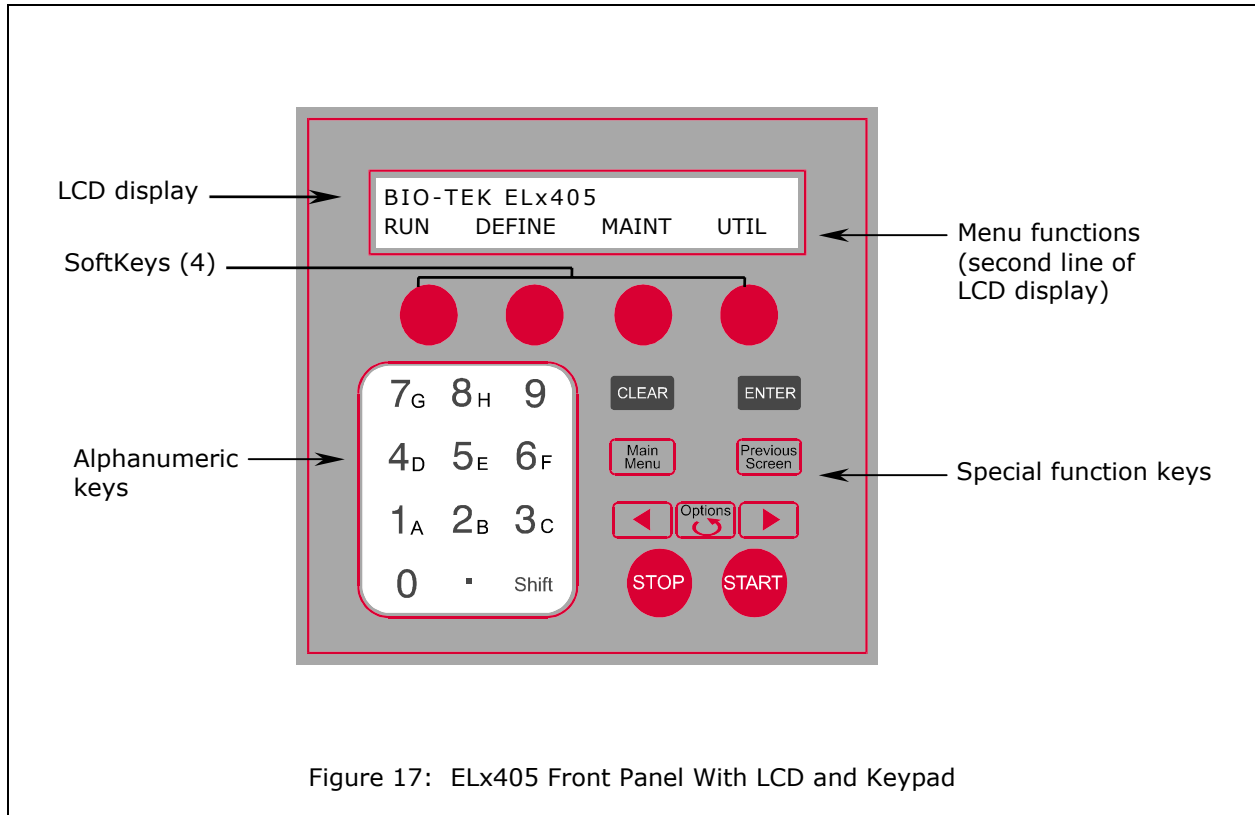
Operation

This chapter includes instructions for operating the ELx405™ Microplate Washer and its software.

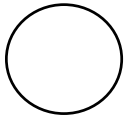
ELx405 Front Panel	42
Keypad Description	43
Entering Program Names	44
System Startup	45
Main Menu	46
Programs	47
Operation With the Bio-Stack	48
General Usage Guidelines	49
Wash	52
Prime	73
Dispense	79
Aspiration	83
Soak	86
Linking Programs	88
Setup Utilities	91
ELx405 Washer Menu Maps	96

ELx405 Front Panel

The front panel on the ELx405™ Microplate Washer features a 25-key keypad and a 2-line x 24-character LCD display as shown below.



Keypad Description



The keypad has four **SoftKeys**, one below each selectable menu option. Press a SoftKey to choose a menu selection. For example, from the **Main Menu**, press the leftmost SoftKey to select **RUN**, the rightmost to select **UTIL**.



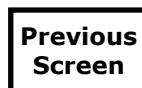
Press **CLEAR** to delete an entry.



Pressing **ENTER** generally saves the current screen settings and advances to the next screen in a series.



Exit the current screen and return to the **Main Menu**. After defining a washer program, press the **Main Menu** key, and then press YES to save the program.



To move to a previous menu, press the **Previous Screen** key.



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.



To scroll through the different options within a program, press the **Options** key or the **Shift + Options** key combination. Press the **ENTER** key to select the current option.



To stop running (abort) a washer program, press the **STOP** key.



To start running a washer program, press the **START** key.

Entering Program Names

Each ELx405™ washer program requires the entry of a unique name, using up to 16 alphanumeric characters. To enter a program name via the washer keypad:

- Press **Shift** + key **A-H**, or scroll through the alphabet with the **Options** key for **A-Z**.
- Press **Shift** + **Options** to reverse direction.
- Use the ► (forward) or ◀ (reverse) arrows to move the cursor within the display.
- Press the **ENTER** key to store the completed program name and continue.

❖ If the program name already exists, the washer software will require you to enter a unique name. This protects washer programs from inadvertently being overwritten.

The **NAME** display offers four symbols that can be used in a program name: dash (hyphen), forward slash, colon, and underscore (see below). These symbols appear in the LCD as SoftKey choices. To include a symbol within a program name, press its corresponding SoftKey.

NAME: COSTAR_FLAT

- / : _

System Startup

To turn on the ELx405™, press the on/off switch on the washer's rear panel. The washer will perform a System Self Test, displaying the screens shown below until initialization is complete. During this time, all keys are inactive.

```
POWERUP SEQUENCE Vx.xx  
INITIALIZING...
```

```
BIO-TEK ELx405  
SELF-TEST.....
```

If the Self Test fails, the washer will “beep” and the display will show an error code. Note the error code and then press the **STOP** key to stop the beeping. Refer to **Appendix A, Troubleshooting** and **Appendix B, Error Codes**, to determine its cause.

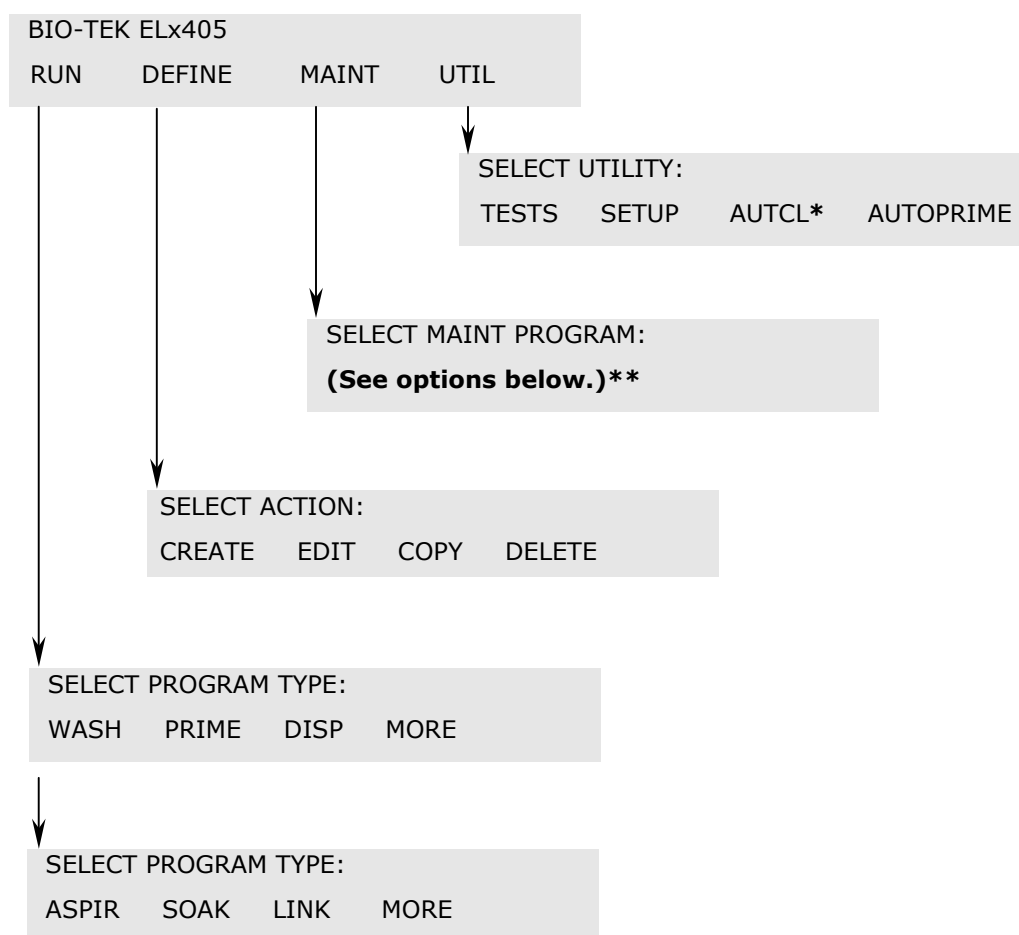
If the problem is something you can fix, turn off the washer, fix the problem, and then turn the washer back on. If the cause is not something you can fix, contact Bio-Tek's Technical Assistance Center (see **Chapter 1**), for further assistance with troubleshooting.

Main Menu

Following successful power-up of the ELx405™, the **Main Menu** appears:

```
BIO-TEK ELx405
RUN   DEFINE   MAINT   UTIL
```

The following options are available through the Main Menu. (See the **Washer Menu Maps** on pages 96 through 100 for a complete listing of menu options.)



* **AUTCL (AUTOCLEAN)** is available only in Ultrasonic Advantage™ models (models with the ultrasonic cleaner).

** **MAINT (MAINTENANCE)** options include: DECONTAMINATION, LONG_SHUTDOWN, OVERNIGHT_LOOP, RINSE_AND_SOAK, and DAY_RINSE.

Programs

The following table lists the program types that can be created through the keypad of the ELx405 Microplate Washer:

Program	Description	Page
WASH	Create a typical wash program with fully customizable dispense and aspirate sequences.	52
PRIME	Set up routines for priming the instrument before washing begins.	73
DISPENSE	Create a dispense-only program, to dispense a user-specified volume into all wells in a microplate.	79
ASPIRATE	Create an aspirate-only program, to evacuate all wells in a microplate.	83
SOAK	Specify the soaking parameters to be included in a Link program.	86
LINK	Link up to 10 Wash, Prime, Dispense, Aspirate, and Soak programs to run sequentially and automatically.	88

❖ See **Appendix D, Default Programs**, for a listing of onboard Wash, Prime, Dispense, Aspirate, and Maintenance programs.

Operation With the Bio-Stack

If you have purchased the **Bio-Stack™ Microplate Stacker** to operate with the washer, refer to the instructions in your Bio-Stack Operator's Manual for setting up and configuring the washer to operate with the Bio-Stack.

You can run Wash, Dispense, Aspirate and Link programs whether the washer is operated with or without the Bio-Stack. The Prime, Soak, and Maintenance programs are run on the washer without the Bio-Stack.

❖ The Magna model does not support the Bio-Stack.


General Usage Guidelines

When operating the washer, follow these guidelines to ensure optimal performance in the washer and to prevent the problems described in the troubleshooting charts in **Appendix A, Troubleshooting**.



Important! HT models with the **96-tube** manifold: The washer software must be configured for operation with the manifold installed (96 or 192). Refer to **Manifold Selection (MANIFOLD)**, on page 95, for instructions. Failure to set the manifold type **before** operating the washer will result in poor performance of the instrument, and may damage the manifold, and **void your warranty**.

Before Running Any Program

- Fill the wash/rinse bottles with sufficient fluid. Make sure the supply tube is in the liquid.
- The supply tube should extend to the bottom of the bottle and be cut at the end (see drawing to the right) to ensure free flow of liquid at the bottom of the supply bottle. 
- Empty the waste bottles and firmly seat the waste bottles' stoppers. To ensure that fluid does not back up into the vacuum pump during operation, always operate the washer with the waste sensor cable installed and the waste detection sensor activated (refer to **Sensor System**, page 91). If fluid collects in the overflow bottle, thoroughly rinse the level switch assembly and bottle.
- Check the external tubing connections for kinks and clogs.
- Make sure the bottles, solutions, and tubing are clean and do not contain any particles or mold. Water and dye solutions that are recycled over several days will grow algae, bacteria, molds, or other undesirable organisms.
- If there are large air pockets in the tubing, run a Prime program *before* running another program. Use the volumes specified for the following models (see **Recommended Prime and Low Flow Prime Volumes**, page 76):
 - **ELx405, Magna, Select, and HT models.** Without the external valve module: 200 ml Prime Volume, when all the lines are empty or when changing fluids. With the valve module: 400 ml Prime Volume, when all the lines are empty or when changing fluids.
 - **Select CW model.** Without the valve module: 200 ml Prime Volume and 150 ml Low Flow Prime Volume, when all the lines are empty; 300 ml Prime Volume and 200 ml Low Flow Prime Volume, when changing fluids. With the valve module: 400 ml Prime Volume and 300 ml Low Flow Prime Volume, when all the lines are empty; 600 ml Prime Volume and 400 ml Low Flow Prime Volume, when changing fluids.

- To avoid creating air bubbles every time the wash or rinse bottle is filled, make a mark halfway down the bottle and refill when the fluid level has dropped to that point. Unscrew the cap and let it hang over the side just enough to avoid emptying the inside tube and enough to refill the bottle.
- When placing a microplate on the carrier, make sure that well A1 is in the left rear corner as you face the front of the washer, and that the plate is firmly seated in the carrier. The microplate spring holds the microplate against the front edge of the carrier.

Maintenance

Rinse and soak the fluid path, clean and replace components, and decontaminate the washer as described in **Chapter 4, Preventive Maintenance**. The following components should be periodically cleaned:

- Bottles
- Plate carrier system
- Manifold
- Aspirate/dispense tubes
- Mist shield
- Inlet filter

❖ Models with the **Ultrasonic Advantage™** (ultrasonic cleaner): An AUTOCLEAN program should be run on a periodic basis.

The following components should be periodically replaced:

- O-rings and channel-end seals

Frequent inspection of the washer, tubing, and bottles for possible causes listed below may help to eliminate many of the problems listed in **Appendix A, Troubleshooting**.

- **Loose or incorrect connections** of power cord, vacuum pump accessory cable, external valve module cable, supply/waste tubing, or fittings
- **Incomplete or incorrect installation** of manifold or carrier, attachment of mist shield, or **placement** of microplate/microstrips in carrier
- **Accumulation of residue** on carrier or inside aspirate/dispense tubes, waste/supply bottles or tubing, manifold, inlet/outlet fittings
- **Worn** tubing, o-rings or channel-end seals
- **Kinked or bent** aspirate/dispense tubes or waste/supply tubing

Programming Considerations

- **Dispense Height:** The dispense (overflow) height in the wash protocol should be low enough to ensure that excess fluid is removed by the aspirate tubes when the manifold is dispensing.
- **Plate Clearance:** Ensure that a sufficient plate clearance height is programmed for plates that are slightly taller than standard plates. See **Plate Clearance Height (PLATE)**, p. 94.
- **Vacuum Dissipation Delay:** Increase the vacuum dissipation delay when using vacuum systems such as the high flow pump. See **Vacuum Dissipation Delay (VACUUM)**, p. 94.
- **Sensor Systems:** Do not deactivate the vacuum, waste, or fluid detection systems, unless priming with air instead of fluid. See **Sensor System (SENSOR)**, p. 91.
- **Manifold Type** (HT models with the dual 96-tube manifold (HT2/HTV2) and Select models upgraded to the HT): The correct manifold (96 or 192) must be chosen in the Manifold Selection feature of the Setup utilities before operating the washer. Refer to **Manifold Selection (MANIFOLD)**, p. 95.
- **Plate Type** (Select, Select CW, and Magna models, and HT2/HTV2 models with the 96-tube manifold installed): Be sure to specify the correct plate type (96 or 384 for the dual manifold models; 96 or 96Bead for the Magna) when defining or editing wash, aspiration, dispense, or link programs.
- **Operation with the Bio-Stack Microplate Stacker:** The washer should be configured to operate with the Bio-Stack (refer to the Bio-Stack Operator's Manual for instructions on configuring the washer for Bio-Stack operation).

Wash

This section discusses how to run, define, edit, copy and delete **Wash** programs. (See **Appendix D, Default Programs** for a list of default Wash programs.)

Run Wash Program



Important! Before running a Wash program, ensure that you have reviewed the **General Usage Guidelines** on the previous pages and that the microplate is properly seated in the plate carrier.

To run a Wash program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below.

RUN → SELECT PROGRAM TYPE → WASH → **SELECT WASH PROGRAM** →
SELECT REAGENT BOTTLE → **PRIME THE WASHER?** →
 PLACE PLATE IN CARRIER AND PRESS <START> KEY →
 WASH PROGRAM RUNNING. PRESS <STOP> KEY TO QUIT →
 WASH PROGRAM COMPLETE. **NEW/REPEAT**

Run Wash Program Options

Option & Description	Models	Action/Comments
Select Wash Program Select a Wash program to run.	All	Press the Options key to cycle through the available Wash programs.
Select Reagent Bottle Select the supply source for this program.	All	Select bottle A, B, C, or D . This only appears if the washer is equipped with the external valve module.
Prime the Washer? Choose to run a prime program before starting the wash program.	All	This only appears after power-up and before a Prime, Dispense, or Wash program has been run.
New/Repeat Action to take after program is complete.	All	Select NEW to start a new program or REPEAT to repeat the last one. Press Main Menu to return to the Main Menu.

Define Wash Program

❖ **Note:** To quickly define a new wash program with some or all of the same parameters as an existing program, copy the existing program and then edit parameters as necessary. See **Copy Wash Program** on page 71.

To define a Wash program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below.

DEFINE → SELECT ACTION → CREATE → SELECT PROGRAM TYPE →
WASH → **NAME** → **SELECT REAGENT BOTTLE** → **PLATE TYPE** →
DEFINE WASH COMPONENT → **MAIN MENU** KEY →
OK TO SAVE PROGRAM?

Define Wash Program Options

Option & Description	Models	Action/Comments
Name Enter a unique name for the Wash program.	All	Use up to 16 alphanumeric characters. See Entering Program Names on page 44 for instructions.
Select Reagent Bottle Select the supply source for this program.	All	Select bottle A, B, C or D . This only appears if the washer is equipped with the external valve module.
Plate Type Specify the microplate type.	Select, Select CW, HT/96-tube	The options are 96 or 384. Note: For higher throughput of the HT with 384-well plates, use the 192-tube manifold.
	Magna	The options are 96 or 96Bead.
Define Wash Component Specify program parameters.	All	Select METHOD, DISP (Dispense), or ASPIR (Aspirate). See METHOD, DISP, and ASPIR Program Options tables on the following pages.
Press Main Menu to Save.	All	After all wash components have been selected, press Main Menu then select YES to save the program.

Define Wash METHOD Program Options

Option & Description	Models	Action/Comments
<p>Number of Cycles</p> <p>Specify 1 to 10 complete wash cycles.</p>	All	<p>A complete wash cycle represents an aspirate and dispense sequence, which may or may not end with a final aspiration of the liquid from the wells.</p> <p>Note: If Bottom Wash is enabled, an additional aspirate and dispense is performed using unique bottom-washing dispense parameters.</p>
<p>Wash Format</p> <p>Specify how the wells should be processed (384-well plate).</p>	Select, Select CW, HT/96-tube	<p>Only appears if Plate Type is 384.</p> <p>Plate format applies each cycle to the entire plate before it starts the next cycle.</p> <p>Sector format applies each cycle to one quarter of the plate before it moves to the next quarter (sector).</p> <p>Note: For higher throughput of the HT with 384-well plates, use the 192-tube manifold.</p>
<p>Soak/Shake?</p> <p>Specify soaking and/or shaking.</p>	All	Choose YES to soak and/or shake the wash buffer in the microwells after the buffer has been dispensed.
<p>Soak Duration</p> <p>Specify the time to allow the wash buffer to remain in the wells before aspiration.</p>	All	<p>The duration range is from 0 to 600 seconds.</p> <p>A soak begins after the wash buffer is dispensed to the wells. In some chemistries it enhances washing by allowing unbound material to diffuse into the wash buffer.</p> <p>When washing wells in a plate format, use a soak that lasts as long as it takes to process one wash cycle of all wells.</p>
<p>Shake Before Soak?</p> <p>Specify whether to agitate the microwells back and forth linearly along the carrier track to aid in dispersal.</p>	All	<p>Select YES or NO.</p> <p>Before the microwells begin shaking, the manifold raises so that the dispense and aspirate tubes clear the microwells, and the carrier returns to its home position.</p>
<p>Shake Duration</p> <p>Specify the length of time for microwell agitation.</p>	All	The duration range is from 1 to 600 seconds.
<p>Shake Intensity</p> <p>Specify the intensity of microwell shaking.</p>	All	<p>The options range from 1 to 5, where 1 = Least Intense, and 5 = Most Intense.</p> <p>The washer display shows the corresponding cycles/sec value for each option.</p>

Define Wash METHOD Program Options, Cont'd

Option & Description	Models	Action/Comments
Re-Move Magnet? Move the magnet carrier out from under the carrier for shake cycle?	Magna	Select YES or NO . This is an option in the Magna model if either 96 or 96bead was selected for Plate Type.
Prime After Soak? Prime the dispense tubes after a soak cycle?	All	Select YES or NO . Note: A prime after soak is an option for Magna models only if 96 was selected for Plate Type ; it is not an option in the Magna if 96bead was selected.
Prime Volume The volume, in milliliters, of the solution used to prime the dispense tubes.	All	The volume range is 1 to 999 ml.
Prime Flow Rate The rate at which the priming fluid is pumped into the dispense tubes.	All	The flow rate options range from 1 to 9 (1 = Slowest, and 9 = Fastest).
Press Main Menu to save.	All	After all wash components have been selected, press Main Menu , then select YES to save the program.

Wash METHOD Defaults and Ranges

Parameter	Units	Default	Range	Models
Number of Cycles		3	1-10	All
Wash Format		Plate	Plate/Sector	Select, Select CW, HT/96-tube
Soak/Shake?		No	No/Yes	All
Soak Duration	seconds	30 sec	0-600	
Shake Before Soak?		No	No/Yes	
Shake Duration	seconds	5	1-600	
Shake Intensity*		3	1-5	
Re-Move Magnet?		No	No/Yes	
Prime After Soak?		No	No/Yes	All (Magna models must have 96 Plate Type selected)
Prime Volume	milliliters	40	1-999	
Prime Flow Rate		7	1-9	

Define Wash DISPENSE (DISP) Program Options

Option & Description	Models	Action/Comments
Dispense Volume The volume (in microliters) of wash solution to dispense per microwell, per wash cycle.	ELx405, Magna, Select, Select CW, HT/96-tube	The volume range is 50 to 3,000 μl /well.
	HT/192-tube	The volume range is 25 to 3,000 μl /well.
Dispense Flow Rate The rate at which the fluid is dispensed from the tubes.	All	The flow rate options range from 1 to 9, where 1 = Slowest, and 9 = Fastest.
	Select CW	Two additional flow rates, 10 and 11, are provided for gentle washing. Rates 1 to 9 range from lowest to highest flow. Rate 10 is lower than rate 1. Rate 11 is higher than 10. Note: Rates 10 and 11 are not recommended for 384-well plates. Performance of rates 10 and 11 may vary, depending upon the plate and buffer used.
Vacuum on Volume The vacuum pump turns on when the defined volume is reached.	Select CW	Appears only if flow rates 10 or 11 have been selected for the Dispense Flow Rate (see above). The volume range is 50 to 3000 μl /well. Bio-Tek recommends that you set the vacuum on volume equal to your dispense volume for small volumes. Refer also to application notes on the Bio-Tek website for more information (www.biotek.com).
Dispense Height (Overflow Position) The height between the bottom of the aspirate tubes and the carrier surface on which the plate rests during the dispense part of a wash cycle. The dispense tubes are shorter than the aspirate tubes. See Figures 18 to 20 .	All	The options range from 12 to 180. 12 is the closest to the carrier surface; 180 is the furthest. The washer display shows the corresponding measurement in millimeters for each option. Note: Due to hardware variations, the 180 value may be out of range for some washers; it is recommended, therefore, that the highest value be closer to 175 .
		Note: When dispensing volumes greater than the well capacity, set a dispense height that positions the aspirate tubes at the top of wells to draw off any overflow. To visually determine the best offset parameters for a microplate or assay, use the Adjust Utility (see page 92).

Define Wash DISPENSE (DISP) Program Options, Cont'd

Option & Description	Models	Action/Comments
<p>Horizontal Disp Pos</p> <p>Horizontal Dispense Position represents the left and right position of the dispense tubes when the carrier is beneath the manifold.</p>	ELx405, Magna	The range is -30 to 30.
	Select, Select CW, HT/96-tube	The range is -45 to 45 with 96-well plates.
	Select, Select CW, HT/96-tube, HT/192-tube	<p>The range is -25 to 25 with 384-well plates.</p> <p>Note: For higher throughput of the HT with 384-well plates, use the 192-tube manifold.</p>
<p>The washer display shows the corresponding measurement in millimeters for each option.</p> <p>A negative offset positions the dispense tubes toward the left side of the well. A positive offset positions the dispense tubes toward the right side of the well. The default setting of 0 indicates no offset (0.000 mm).</p> <p>Note: A more negative offset combined with a low flow rate, are the recommended settings for "gentle washing," such as required by cell-based assays.</p> <p>To visually determine the best offset parameters for a microplate or assay, use the Adjust Utility (see page 92).</p>		
<p>Horiz Y Disp Pos</p> <p>Horizontal Y Dispense Position represents the carrier Y axis position (front/back movement) which aligns the microplate wells with the manifold tubes during a dispense.</p>	Select, Select CW, HT/96-tube	The range is -20 to 20 with 96-well plates.
	Select, Select CW, HT/96-tube, HT/192-tube	<p>The range is -10 to 20 with 384-well plates.</p> <p>Note: For higher throughput of the HT with 384-well plates, use the 192-tube manifold.</p>
	<p>The washer display shows the corresponding measurement in millimeters for each option.</p> <p>A negative offset positions the dispense tubes toward the front side of the well.</p> <p>A positive offset positions the dispense tubes away from the front side of the well.</p> <p>A setting of 0 indicates no offset (0.000 mm).</p> <p>To visually determine the best offset parameters for a microplate assay, use the Adjust Utility (see page 92).</p>	

Define Wash DISPENSE (DISP) Program Options, Cont'd

Option & Description	Models	Action/Comments
<p>Bottom Wash First?</p> <p>Bottom washing consists of an initial dispense/aspirate sequence, which adds another wash cycle to the specified number of cycles.</p>	All	The manifold is positioned at the specified Bottom Disp Height. The reagent is simultaneously dispensed and aspirated at this height to create cleaning turbulence. The manifold descends to aspirate again and ends with a final dispensing of fluid to fill the well.
<p>Bottom Disp Volume</p> <p>The volume of wash solution to dispense per microwell during the bottom wash.</p>	All	The volume range is 50 to 3000 µl/well.
<p>Bottom Flow Rate</p> <p>The rate at which the fluid is dispensed from the tube during the bottom wash.</p>	All	The flow rate options range from 1 to 9, where 1 = Slowest, 9 = Fastest.
<p>Bottom Disp Height</p> <p>Bottom Dispense Height represents the height between the bottom of the aspirate tubes and the carrier surface on which the plate rests during the wash. See Figures 18 to 20.</p>	All	<p>The Bottom Disp Height options range from 12 to 180. The washer display shows the corresponding measurement in millimeters for each option. 12 is the closest to the carrier surface; 180 is the furthest from this surface. The dispense tubes are shorter than the aspirate tubes.</p> <p>Note: Due to hardware variations, the 180 value may be out of range for some washers; it is recommended, therefore, that the highest value be closer to 175.</p>
<p>Bottom Horiz Pos</p> <p>See the description for Horizontal Disp Pos on the preceding page.</p>	All	The only difference is that Bottom Horiz Pos specifically refers to Bottom Washing.
<p>Bottom Horiz Y Pos</p> <p>See the description for Horiz Y Disp Pos on the preceding page.</p>	All	The only difference is that Bottom Horiz Y Pos specifically refers to Bottom Washing.
<p>Prime Before Start?</p> <p>Prime the dispense tubes before starting the wash program.</p>	All	Select YES or NO .

Note: The shaded options above are **not** available for Dispense-only programs.

Define Wash DISPENSE (DISP) Program Options, Cont'd

Option & Description	Models	Action/Comments
Prime Volume The volume of the buffer or rinse used to prime the dispense tubes.	All	The volume range is 1 to 999 ml.
Prime Flow Rate The rate at which the priming fluid is dispensed from the tubes during the prime.	All	The flow rate options range from 1 to 9, where 1 = Slowest, 9 = Fastest.
Press Main Menu to save	All	Select YES to save the program.

Wash DISPENSE (DISP) Defaults and Ranges

Parameter	Units	Default	Range	Models
Dispense Volume (In a Dispense-only program, the default volume is 250.)	μl/well	300	50-3000	ELx405, Magna, Select, Select CW, HT/96-tube
			25-3000	HT/192-tube
Dispense Flow Rate		5	1-9	All
			Additional flow rates 10 and 11	Select CW
Vacuum on Volume (Appears only in the Select CW if Flow Rates 10 or 11 were selected.)	μl/well	10	50-3000	Select CW
Dispense Height	See note below.	120	12-180	All
Notes: <ul style="list-style-type: none"> • Dispense Flow Rate - Select CW: Flow rates 10 and 11 are not recommended for 384-well plates. • Dispense Height: The display shows the corresponding measurement in mm. Although the range is 12-180, the recommended highest value is 175. 				

Wash DISPENSE (DISP) Defaults and Ranges, cont'd

Parameter	Units	Default	Range	Models
Horizontal Dispense Position	quarter steps	0	-30 to 30	ELx405 or Magna
			-45 to 45 with 96-well plates	Select, Select CW, HT/96-tube
			-25 to 25 with 384-well plates	Select, Select CW, HT/96-tube HT/192-tube
Horizontal Y Dispense Position (Select, Select CW, HT only)	quarter steps	0	-20 to 20 with 96-well plates	Select, Select CW HT/96-tube
			-10 to 20 with 384-well plates	Select, Select CW HT/96-tube HT/192-tube
Bottom Wash First?		No	No/Yes	All
Bottom Dispense Volume	μl/well	300	50-3000	
Bottom Flow Rate		5	1-9	
Bottom Dispense Height		60	12-180	
Notes:				
<ul style="list-style-type: none"> The shaded options above are not available for Dispense-only programs. Horizontal Dispense Position and Horizontal Y Dispense Position: For higher throughput of the HT with 384-well plates, use the 192-tube manifold. Bottom Dispense Height: Although the range is 12-180, the recommended highest value is 175. 				

Wash DISPENSE (DISP) Defaults and Ranges, cont'd

Parameter	Units	Default	Range	Models
Bottom Horizontal Dispense Position	quarter steps	0	-30 to 30	ELx405, Magna
			-45 to 45 with 96-well plates	Select, Select CW, HT/96-tube
			-25 to 25 with 384-well plates	Select, Select CW, HT/96-tube HT/192-tube
Bottom Horizontal Y Dispense Position (Select, Select CW, HT only)	quarter steps	0	-20 to 20 with 96-well plates	Select, Select CW, HT/96-tube
			-10 to 20 with 384-well plates	Select, Select CW, HT/96-tube HT/192-tube
Prime Before Start?		No	No/Yes	All
Prime Volume	milliliters	40	1-999	
Prime Flow Rate		7	1-9	
Notes:				
<ul style="list-style-type: none"> The shaded options above are not available for Dispense-only programs. Bottom Horizontal Dispense Position and Bottom Horizontal Y Dispense Position: For higher throughput of the HT with 384-well plates, use the 192-tube manifold. 				

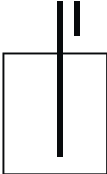
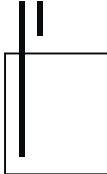
Define Wash ASPIRATE (ASPIR) Program Options

Option & Description	Models	Action/Comments
<p>Aspirate Height</p> <p>Represents the height between the bottom of the <i>aspirate</i> tubes and the carrier surface on which the plate rests when <i>aspirating</i> the microwells.</p> <p>The aspirate tubes are longer than the dispense tubes. See Figures 18 to 20.</p>	All	<p>The Aspirate Height range is 12 to 180.</p> <p>The washer display shows the corresponding measurement in millimeters for each option.</p> <p>12 is the closest to the carrier surface; 180 is the furthest from this surface.</p> <p>It is not recommended that the aspirate tubes touch the well bottoms.</p> <p>Use the Adjust Utility (see page 92) to determine at what setting the aspirate tubes hit the bottom of the well, and choose a setting 2 to 4 steps higher in your wash program.</p> <p>Note: Due to hardware variations, the 180 value may be out of range for some washers; it is recommended, therefore, that the highest value be closer to 175.</p>
<p>Horizontal Aspr Pos</p> <p>Horizontal Aspirate Position represents the left and right position of the aspirate tubes when the carrier is beneath the manifold.</p>	<p>ELx405, Magna</p> <hr/> <p>Select, Select CW, HT/96-tube</p> <hr/> <p>Select, Select CW, HT/96-tube HT/192-tube</p>	<p>The range is -30 to 30.</p> <hr/> <p>The range is -55 to 55 with 96-well plates.</p> <hr/> <p>The range -25 to 25 with 384-well plates.</p> <p>Note: For higher throughput of the HT with 384-well plates, use the 192-tube manifold.</p> <hr/> <p>The washer display shows the corresponding measurement in millimeters for each option.</p> <p>A negative offset positions the aspirate tubes toward the left side of the well. A positive offset positions the aspirate tubes toward the right side of the well. A setting of 0 indicates no offset (0.000 mm).</p> <p>It is recommended that aspirate tubes be positioned close to the sides of a flat-bottom well, and in the center of a round-bottom well. Use <i>UTIL</i> to experiment with settings.</p>
<p>Magnet Aspirate Height</p> <p>The height of the magnet carrier during aspiration.</p>	Magna	<p>Appears only on the Magna model, if 96bead (instead of 96) was selected for Plate Type.</p> <p>A range of -20 to 20 may be selected; the default is 0.</p> <hr/> <p>Use the Adjust Utility (see page 92) to determine the height of the magnet carrier in relation to the microplate carrier.</p>

Define Wash ASPIRATE (ASPIR) Program Options, Cont'd

Option & Description	Models	Action/Comments
<p>Horiz Y Aspr Pos</p> <p>Horizontal Y Aspirate Position represents the carrier y-axis position that aligns the microplate wells with the manifold tubes during aspiration.</p>	<p>Select, Select CW, HT/96-tube</p> <hr/> <p>Select, Select CW, HT/96-tube HT/192-tube</p>	<p>The range is -55 to 55 with 96-well plates.</p> <hr/> <p>The range is -10 to 20 with 384-well plates.</p> <p>Note: For higher throughput of the HT with 384-well plates, use the 192-tube manifold.</p> <hr/> <p>The washer display shows the corresponding measurement in millimeters for each option.</p> <p>A negative offset positions the aspirate tubes toward the front side of the well. A positive offset positions the aspirate tubes away from the front side of the well. A setting of 0 indicates no offset (0.000 mm).</p>
<p>Aspirate Rate</p> <p>The rate at which the washer manifold travels down into the microwells while aspirating fluid.</p>	<p>All</p>	<p>The selection range is 1 to 10. When a rate is chosen, its corresponding mm/second value is displayed. The optimal rate depends on the type of assay being performed.</p> <hr/> <p>For most assays (non cell-based), a rate from 1 to 5, where 1 = slowest, and 5 = fastest, is sufficient. With any of these rates, the tubes slow their descent as they approach the programmed 'Aspirate Height'.</p> <p>For delicate, cell-based assays, rates 7 to 10, where 7 = slowest and 10 = fastest, are designed to minimize turbulence (disturbance) in the wells. With any of these "rapid" rates (indicated by an "R"), the tubes descend at a constant rate to the programmed 'Aspirate Height'.</p> <p>Rate 6 provides the least disturbance to delicate, cell-based assays. Like rates 7 to 10, the tubes descend at a constant rate to the programmed 'Aspirate Height', however, rate 6 is <i>faster</i> than rate 10.</p> <p>Note: Viscous fluids may be more effectively aspirated using a slower rate.</p>
<p>Aspirate Delay</p> <p>The time that aspirate tubes remain at the defined aspirate height.</p>	<p>All</p>	<p>The Aspirate Delay range is 0 to 5000 milliseconds.</p> <p>The delay applies to the normal (initial) aspiration if Crosswise Aspirate is not enabled. If Crosswise Aspirate is enabled, the delay applies to the crosswise, not the normal initial, aspiration.</p>

Define Wash ASPIRATE (ASPIR) Program Options, Cont'd

Option & Description	Models	Action/Comments
<p>Crosswise Aspir?</p> <p>Specify whether to perform a Crosswise Aspiration.</p>	All	<p>A crosswise aspiration is a two-step aspiration. The wells are <i>first</i> aspirated at the Horizontal Aspirate Position.</p> <p>The aspirating tubes raise a fixed number of steps and then do a <i>second</i> (crosswise) aspiration at the Crosswise Horizontal Position.</p>
<p>The purpose of crosswise aspiration is to eliminate residual sample or reagent from the wall perimeter. If the buffer is water without any wetting agent (such as Tween[®] 20), crosswise aspiration might aid in removing higher than expected residual.</p> <p>Crosswise aspiration is used only with flat-bottom plates. Lower residuals can often be achieved without crosswise aspiration if the horizontal aspiration position is programmed correctly.</p> <p>Select YES to designate a second aspiration.</p> <p>Example of initial and then crosswise aspiration in a microwell:</p>		
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div>		
<p>Horizontal Aspirate Position 10</p>		<p>Crosswise Horizontal Position -40</p>
<p>Crosswise On</p> <p>Specify how the Crosswise Aspiration shall be performed.</p>	All	<p>Select ALL to perform a crosswise aspiration on all aspirations within the wash program, or FINAL to perform the crosswise aspiration on just the final aspiration.</p>
<p>Crosswise Height</p> <p>See the description for Aspirate Height on the preceding page.</p>	All	<p>The only difference is that Crosswise Height specifically refers to Crosswise Aspiration.</p>
<p>Crosswise Horiz Pos</p> <p>See the description for Horizontal Aspr Pos on the preceding page.</p>	All	<p>The only difference is that Crosswise Horizontal Position specifically refers to Crosswise Aspiration. The recommended range is +10 to +35.</p>
<p>Note: The shaded options above are not available for Aspirate-only programs.</p>		

Define Wash ASPIRATE (ASPIR) Program Options, Cont'd

Option & Description	Models	Action/Comments
Crosswise Horiz Y Pos See the description for Horizontal Y Aspr Pos on the preceding page.	Select, Select CW, HT	The only difference is that Crosswise Horiz Y Pos specifically refers to Crosswise Aspiration.
Final Aspirate? Perform a final aspiration of the wells?	All	Select YES to designate a final aspiration, leaving the wells empty.
Final Aspir Delay Final Aspiration Delay is the time that the tubes remain at the defined aspiration height.	All	The Final Aspr Delay range is 0 to 5000 milliseconds.
Press Main Menu to save.	All	Select YES to save the program.
Note: The shaded options above are not available for Aspirate-only programs.		

Wash ASPIRATE Defaults and Ranges

Parameter	Units	Default	Range	Models
Aspirate Height		24	12 to 180	ELx405, Magna, Select, Select CW
		16	12 to 180	HT/96-tube or 192-tube
Horizontal Aspirate Position	quarter steps	0	-30 to 30	ELx405, Magna
			-55 to 55 with 96-well plates	Select, Select CW, HT/96-tube
			-25 to 25 with 384-well plates	Select, Select CW, HT/96-tube HT/192-tube
Notes: <ul style="list-style-type: none"> • Aspirate Height: Although the range is 12-180, the recommended highest value is 175. • Horizontal Aspirate Position: For higher throughput of the HT with 384-well plates, use the 192-tube manifold. 				

Wash ASPIRATE Defaults and Ranges, Cont'd

Parameter	Units	Default	Range	Models
Magnet Aspirate Height Magna only		0	-20 to 20	Magna (if 96bead Plate Type was selected)
Horizontal Y Aspirate Position Select, Select CW, HT only	quarter steps	0	-55 to 55 with 96-well plates	Select, Select CW HT/96-tube
			-10 to 20 with 384-well plates	Select, Select CW, HT/96-tube, HT/192-tube
Aspirate Rate		3	1 to 10	All
Aspirate Delay	milliseconds	0	0-5000	
Crosswise Aspirate?		No	No/Yes	
Crosswise On		Final	Final, All	All
Crosswise Height		24	12-180	All
Crosswise Horizontal Position	quarter steps	0	-30 to 30	ELx405, Magna
			-55 to 55 with 96-well plates	Select, Select CW, HT/96-tube
			-25 to 25 with 384-well plates	Select, Select CW, HT/96-tube HT/192-tube
Notes:				
<ul style="list-style-type: none"> The shaded options are not available for Aspirate-only programs. Horizontal Y Aspirate Position and Crosswise Horizontal Position: For higher throughput of the HT with 384-well plates, use the 192-tube manifold. Crosswise Height: Although the range is 12-180, the recommended highest value is 175. 				

Wash ASPIRATE Defaults and Ranges, Cont'd

Parameter	Units	Default	Range	Models
Crosswise Horizontal Y Position Select, Select CW, HT	quarter steps	0	-55 to 55 with 96-well plates	Select, Select CW, HT/96-tube
			-10 to 20 with 384-well plates	Select, Select CW, HT/96-tube HT/192-tube
Final Aspirate?		Yes	Yes/No	All
Final Aspirate Delay	milliseconds	0	0 to 5000	
Notes:				
<ul style="list-style-type: none"> The shaded options are not available for Aspirate-only programs. Crosswise Horizontal Y Position: For higher throughput of the HT with 384-well plates, use the 192-tube manifold. 				

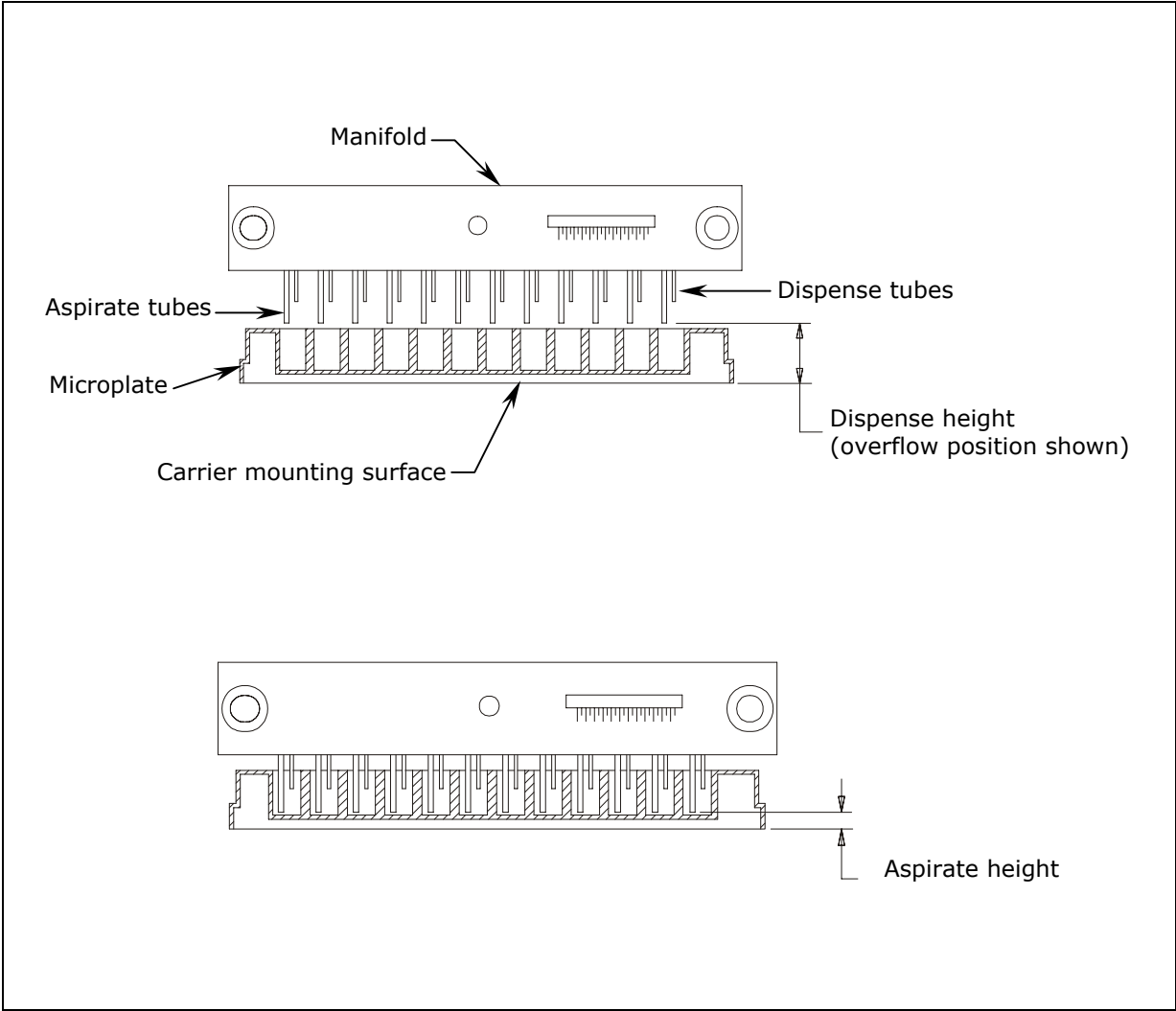


Figure 18: Dispense and Aspirate Heights for the ELx405 and Magna Models

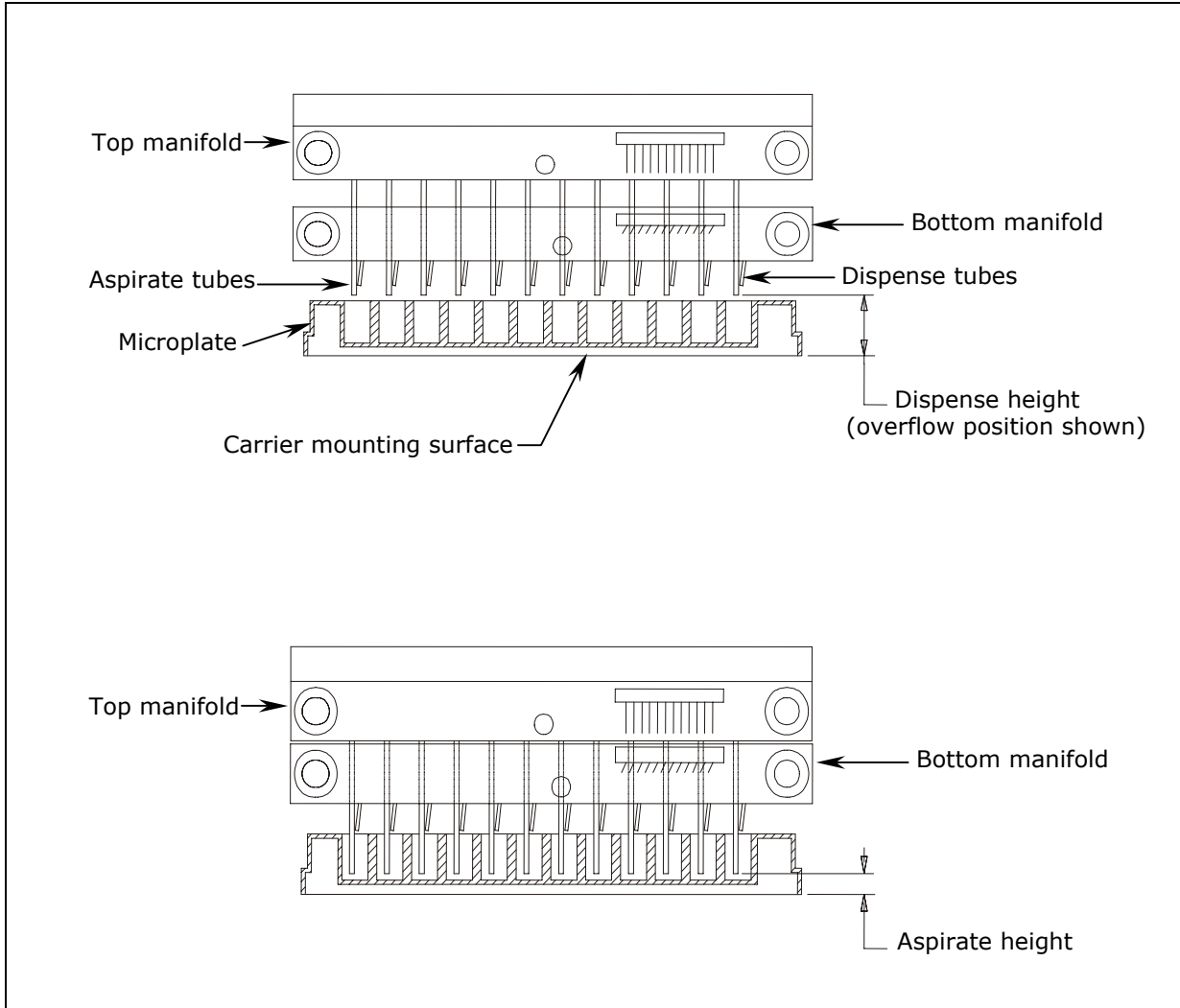


Figure 19: Dispense and Aspirate Heights for the Select, Select CW, and HT2/HTV2 Models With Dual/96 Manifold

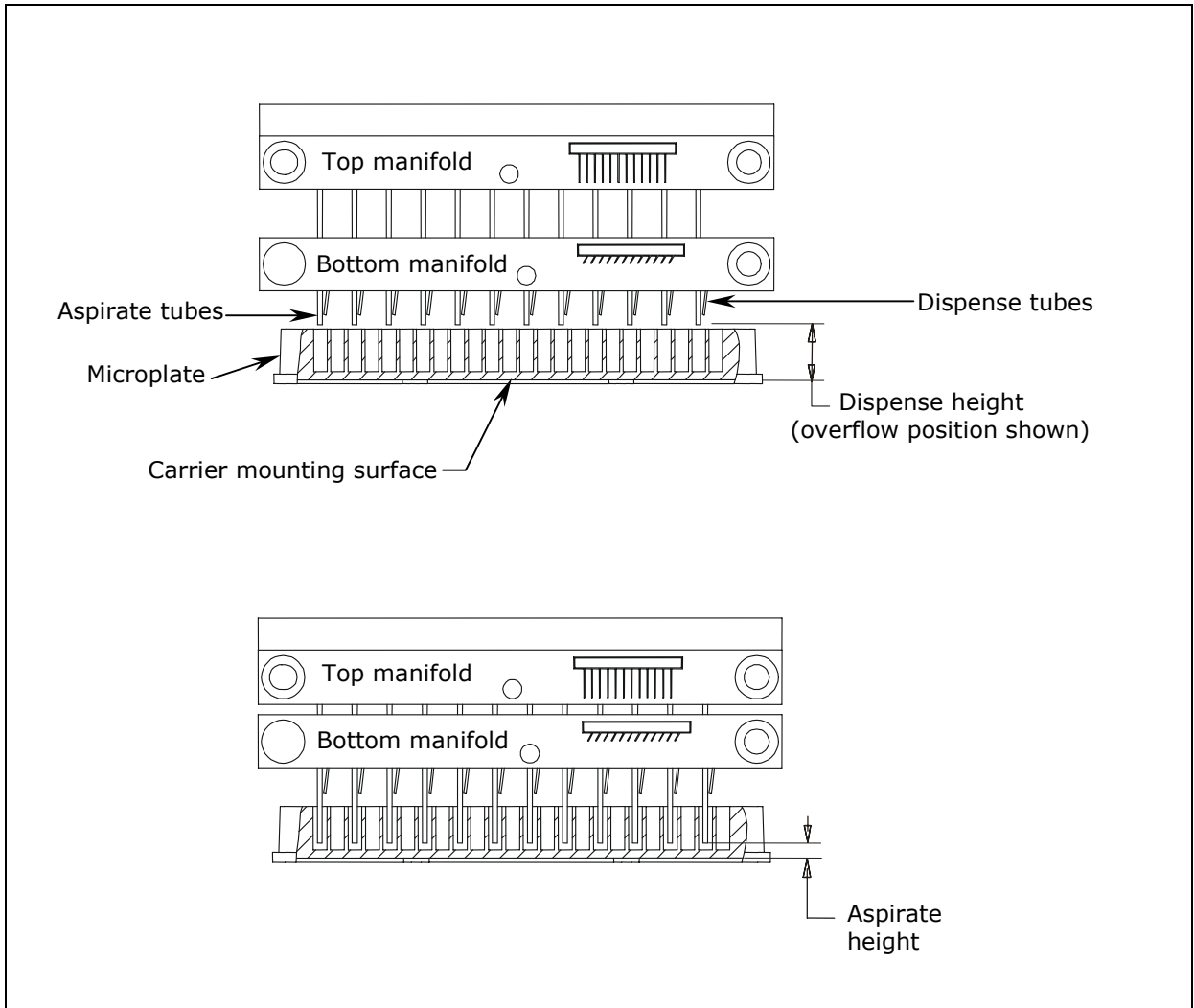


Figure 20: Dispense and Aspirate Heights for the HT Model

Edit Wash Program

To modify a Wash program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described below:

DEFINE → SELECT ACTION → EDIT → WASH → SELECT WASH PROGRAM →
SELECT REAGENT BOTTLE → NAME → **PLATE TYPE** →
 DEFINE WASH COMPONENT → MAIN MENU KEY → OK TO SAVE PROGRAM?

The following options appear only on the specified models:

- **SELECT REAGENT BOTTLE:** washers equipped with the external valve module (excludes earlier models of the Select CW).
- **PLATE TYPE:** Select, Magna, Select CW, and HT models with the accessory 96-tube manifold installed.

Copy Wash Program

To copy a Wash program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → COPY → SELECT PROGRAM TYPE →
 WASH → **SELECT WASH PROGRAM** → **NAME** → **OK TO COPY?**

Copy Wash Program Options

Option & Description	Models	Action/Comments
Select Wash Program Select the Wash program you wish to copy.	All	Press the Options key to cycle through the available Wash Programs.
Name Enter a unique name for the new Wash program.	All	Use up to 16 alphanumeric characters. See Entering Program Names on page 44 for instructions.
OK To Copy?	All	Select YES to copy the program.

Delete Wash Program

To delete a Wash program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → DELETE → SELECT PROGRAM TYPE →
WASH → **SELECT WASH PROGRAM** → **OK TO DELETE?**

Delete Wash Program Options

Option & Description	Models	Action/Comments
Select Wash Program Select the Wash program you wish to delete.	All	Press the Options key to cycle through the available Wash Programs.
OK To Delete?	All	Select YES to delete the program.

Prime

This section discusses how to run, define, edit, copy and delete **Prime** programs. (See **Appendix D, Default Programs** for a list of default Prime programs.)

Run Prime Program



Important! Before running a Prime program, ensure that you have reviewed the **General Usage Guidelines** on page 49 and that the microplate is properly seated in the plate carrier.

To run a Prime program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

RUN → SELECT PROGRAM TYPE → PRIME → **SELECT PRIME PROGRAM** →
CONNECT REAGENT BOTTLE AND PRESS <START> KEY →
 PRIME PROGRAM RUNNING. PRESS <STOP> KEY TO QUIT →
 PRIME PROGRAM COMPLETE. **NEW REPEAT**

Run Prime Program Options

Option & Description	Models	Action/Comments
Select Prime Program Select a Prime program to run.	All	Press the Options key to cycle through the available Prime programs.
New/Repeat Action to take after program is complete.	All	Select NEW to start a new program or REPEAT to repeat the last one. Press Main Menu key to return to the Main Menu.

Define Prime Program

To define a Prime program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → CREATE → SELECT PROGRAM TYPE →
 PRIME → **SELECT REAGENT BOTTLE** → **NAME** → **PRIME VOLUME** →
LOW FLOW PRIME VOLUME → **PRIME FLOW RATE** →
SOAK AFTER PRIME? → **SOAK DURATION** → OK TO SAVE PROGRAM?

The following options appear only on the specified models:

- **SELECT REAGENT BOTTLE:** Washers equipped with the external valve module (excludes earlier models of the Select CW).
- **LOW FLOW PRIME VOLUME:** Select CW model.

Define Prime Program Options

Option & Description	Models	Action/Comments
Select Reagent Bottle Select the supply source for this program.	All	Select bottle A, B, C or D . Only appears if the washer is equipped with the external valve module.
Name Enter a unique name for the Prime program.	All	Use up to 16 alphanumeric characters. See Entering Program Names on page 44 for instructions.
Prime Volume The volume of the buffer or rinse used to prime the dispense.	All	The volume range is 1 to 999 ml. (See Recommended Prime and Low Flow Prime Volumes on page 76.)
Low Flow Prime Volume Only appears on the Select CW model, which is equipped with additional, low flow tubing.	Select CW	Specify the volume, in milliliters, of the solution used to prime the dispense tubes. The volume range is from 1 to 999 ml. Note: The program uses flow rate 10 (not editable by the user).

Define Prime Program Options, Cont'd

Option & Description	Models	Action/Comments
<p>Prime Flow Rate</p> <p>The rate at which the priming fluid is pumped into the dispense tubes.</p>	All	The flow rate options range from 1 to 9, where 1 = Slowest, 9 = Fastest.
<p>Soak after Prime?</p> <p>Soak the manifold tubes after they have been primed?</p>	All	<p>Select YES or NO.</p> <p>After the dispense tubes have been primed, the manifold raises to its home position over the priming trough.</p> <p>The soak solution is then dispensed to the trough. The vacuum pump is turned off and the tubes are lowered into the trough to soak.</p> <p>After the specified Soak Duration, the vacuum pump is turned on and the trough is aspirated.</p>
<p>Soak Duration</p> <p>Represents the time to allow the dispense and aspirate tubes to be soaked in wash buffer, rinse, or disinfectant.</p>	All	The range is from 1 minute to 18 hours.

PRIME Program Defaults and Ranges

Parameter	Units	Default	Range	Models
Parameter	milliliters	40	1-999	All
Low Flow Prime Volume	milliliters	0	1-999	Select CW (For the low flow tubing)
Prime Flow Rate		7	1-9	All
Soak After Prime?		No	No/Yes	
Soak Duration	HH:MM	00:01	1 minute to 18 hours	

Recommended Prime and Low Flow Prime Volumes

The following recommended volumes for priming the washer will yield better than 95% purity, when all the lines are empty or when changing fluids.

❖ See **Default Prime Program: Prime_200** (which contains a default Prime Volume of 200 ml) and **Default Prime Program: Prime_CW** (which contains parameters that may be edited), on page 78.

Models	Recommended Minimum Prime Volumes	
ELx405, Magna, Select, HT	Washers <u>without</u> the valve module	
	200 ml Prime Volume	When all the lines are empty or when changing fluids.
	Washers with the valve module	
	400 ml Prime Volume	When all the lines are empty or when changing fluids.
Select CW	Washers <u>without</u> the valve module	
	200 ml Prime Volume	When all the lines are empty.
	150 ml Low Flow Prime Volume	
	Washers with the valve module	
	300 ml Prime Volume	When changing fluids.
	200 ml Low Flow Prime Volume	
	Washers with the valve module	
	400 ml Prime Volume	When all the lines are empty.
300 ml Low Flow Prime Volume		
Washers with the valve module		
600 ml Prime Volume	When changing fluids.	
400 ml Low Flow Prime Volume		

Edit Prime Program

To modify a Prime program, follow the menu path shown below. Some of these items are options and some are prompts.

DEFINE → SELECT ACTION → EDIT → SELECT PROGRAM TYPE → PRIME →
 SELECT PRIME PROGRAM → **SELECT REAGENT BOTTLE** →
 "Edit program parameters" → MAIN MENU KEY → OK TO SAVE PROGRAM?

SELECT REAGENT BOTTLE only appears if the washer is equipped with the external valve module.

Copy Prime Program

To copy a Prime program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → COPY → SELECT PROGRAM TYPE →
PRIME → **SELECT PRIME PROGRAM** → **NAME** → **OK TO COPY?**

Copy Prime Program Options

Option & Description	Models	Action/Comments
Select Prime Program Select the Prime program you wish to copy.	All	Press the Options key to cycle through the available Prime programs.
Name Enter a unique name for the new Prime program.	All	Use up to 16 alphanumeric characters. See Entering Program Names on page 44 for instructions.
OK To Copy?	All	Select YES to copy the program.

Delete Prime Program

To delete a Prime program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → DELETE → SELECT PROGRAM TYPE →
PRIME → **SELECT PRIME PROGRAM** → **OK TO DELETE?**

Delete Prime Program Options

Option & Description	Models	Action/Comments
Select Prime Program Select the Prime program you wish to delete.	All	Press the Options key to cycle through the available Prime programs.
OK To Delete?	All	Select YES to delete the program.

Default Prime Program: Prime_200

The default prime program **Prime_200** (included in all ELx405™ models) cannot be edited like the other prime programs. This program is very convenient to use when 200 ml is the recommended Prime Volume (see **Recommended Prime and Low Flow Prime Volumes**, page 76). The table below lists the program's default parameters.

❖ The Prime_200 program does **not** prime the Select CW model's Low Flow tubing.

Parameter	Units	Default	Models
Prime Volume	milliliters	200	All
Low Flow Prime Volume	milliliters	0	Select CW
Prime Flow Rate		7	All
Soak After Prime?		No	
Soak Duration		N/A	

Default Prime Program: Prime_CW

The default prime program **Prime_CW** (included in Select CW models only) may be edited. The table below lists the program's default parameters.

Parameter	Units	Default	Models
Prime Volume	milliliters	150	Select CW
Low Flow Prime Volume	milliliters	150	
Prime Flow Rate		7	
Soak After Prime?		No	
Soak Duration	HH:MM	00:01	

Dispense

This section discusses how to run, define, edit, copy and delete **Dispense** programs. (See **Appendix D, Default Programs** for a list of default Dispense programs.)

Run Dispense Program



Important! Before running a Dispense program, ensure that you have reviewed the **General Usage Guidelines** on page 49 and that the microplate is properly seated in the plate carrier.

To run a Dispense program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

RUN → SELECT PROGRAM TYPE → DISP → **SELECT DISP PROGRAM** →
 PRIME THE WASHER? → NUMBER OF STRIPS →
 PLACE PLATE IN CARRIER AND PRESS <START> KEY →
 DISPENSE PROGRAM RUNNING. PRESS <STOP> KEY TO QUIT →
 DISP PROGRAM COMPLETE. **NEW REPEAT**

Run Dispense Program Options

Option & Description	Models	Action/Comments
Select Disp Program Select a Dispense program.	All	Press the Options key to cycle through the available Dispense programs.
New/Repeat	All	Select NEW to start a new program or REPEAT to repeat the last one.

Define Dispense Program

To define a Dispense program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described below the path.

```

DEFINE → SELECT ACTION → CREATE → SELECT PROGRAM TYPE →
DISP → NAME → SELECT REAGENT BOTTLE → PLATE TYPE →
DISPENSE VOLUME → DISPENSE FLOW RATE → VACUUM ON VOLUME →
DISPENSE HEIGHT → HORIZONTAL DISP POS → HORIZ Y DISP POS →
PRIME BEFORE START? → PRIME VOLUME → PRIME FLOW RATE →
OK TO SAVE PROGRAM?

```

The following options appear only on the specified models:

- **SELECT REAGENT BOTTLE:** Washers equipped with the external valve module (excludes earlier models of the Select CW).
- **PLATE TYPE:** Select, Magna, Select CW, and HT models with the accessory 96-tube manifold installed.
- **VACUUM ON VOLUME:** Select CW, if the CW dispense flow rates 10 or 11 were selected.
- **HORIZ Y DISP POS:** Select, HT, and Select CW.

Define Dispense Program Options

See ***Define Wash DISPENSE (DISP) Program Options*** (page 56) for a complete list of dispense program options. Note that the options in the shaded region are *not* available for Dispense-only programs.

Edit Dispense Program

To modify a Dispense program, follow the menu path shown below. Some of these items are options and some are prompts.

DEFINE → SELECT ACTION → EDIT → SELECT PROGRAM TYPE → DISP →
 SELECT DISP PROGRAM → **SELECT REAGENT BOTTLE** → **PLATE TYPE** →
 "Edit program parameters" → MAIN MENU → OK TO SAVE PROGRAM?

The following options appear only on the specified models:

- **SELECT REAGENT BOTTLE:** Washers equipped with the external valve module (excludes earlier models of the Select CW).
- **PLATE TYPE** only appears on the Select, Magna, and Select CW models and HT models with the accessory 96-tube manifold installed.

Copy Dispense Program

To copy a Dispense program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → COPY → SELECT PROGRAM TYPE → DISP →
SELECT DISP PROGRAM → **NAME** → **OK TO COPY?**

Copy Dispense Program Options

Option & Description	Models	Action/Comments
Select Dispense Program Select the Dispense program you wish to copy.	All	Press the Options key to cycle through the available Dispense programs.
Name Enter a unique name for the new Dispense program.	All	Use up to 16 alphanumeric characters. See Entering Program Names on page 44 for instructions.
OK to Copy?	All	Select YES to copy the program.

Delete Dispense Program

To delete a Dispense program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → DELETE → SELECT PROGRAM TYPE →
DISP → **SELECT DISP PROGRAM** → **OK TO DELETE?**

Delete Dispense Program Options

Option & Description	Models	Action/Comments
Select Dispense Program Select the Dispense program you wish to delete.	All	Press the Options key to cycle through the available Dispense programs.
Delete?	All	Select YES to delete the program.

Aspiration

This section discusses how to run, define, edit, copy and delete Aspiration programs. (See **Appendix D, Default Programs** for a list of default Aspiration programs.)

Run Aspiration Program



Important! Before running an Aspiration program, ensure that you have reviewed the **General Usage Guidelines** on page 49 and that the microplate is properly seated in the plate carrier.

To run an Aspiration program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

RUN → SELECT PROGRAM TYPE → MORE → ASPIR →
SELECT ASPIR PROGRAM →
 PLACE PLATE IN CARRIER AND PRESS <START> KEY →
 ASPIR PROGRAM RUNNING. PRESS <STOP> KEY TO QUIT →
 ASPIR PROGRAM COMPLETE. **NEW REPEAT**

Run Aspiration Program Options

Option & Description	Models	Action/Comments
Select Aspir Program Select an Aspiration program.	All	Press the Options key to cycle through the available Aspiration programs.
New/Repeat	All	Select NEW to start a new program or REPEAT to repeat the last one.

Define Aspiration Program

To define an Aspiration program, follow the menu path shown below. Some of these items are options and some are prompts.

DEFINE → SELECT ACTION → CREATE → SELECT PROGRAM TYPE → MORE →
 ASPIR → NAME → **PLATE TYPE** → ASPIRATE HEIGHT →
 HORIZONTAL ASPR POS → **MAGNET ASPIR HEIGHT** →
HORIZ Y ASPR POS → ASPIRATE RATE → ASPIRATE DELAY →
 CROSSWISE ASPIR? → CROSSWISE HEIGHT → CROSSWISE HORIZ POS →
CROSS HORIZ Y POS → OK TO SAVE PROGRAM?

The following options appear only on the specified models:

- **PLATE TYPE:** Select, Magna, Select CW models, and HT models with the accessory 96-tube manifold installed.
- **MAGNET ASPIR HEIGHT:** Magna.
- **HORIZ Y ASPR POS** and **CROSS HORIZ Y POS:** Select, HT, and Select CW.

Define Aspiration Program Options

See **Define Wash ASPIRATE (ASPIR) Program Options** (page 62) for a complete listing of Aspiration Program Options. Note that options in the shaded region are *not* available for Aspiration-only programs.

Edit Aspiration Program

To modify an Aspiration program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described below:

DEFINE → SELECT ACTION → EDIT → SELECT PROGRAM TYPE → MORE →
 ASPIR → SELECT ASPIR PROGRAM → **PLATE TYPE** → EDIT PROGRAM →
 MAIN MENU → OK TO SAVE PROGRAM?

PLATE TYPE only appears on the Select, Magna, Select CW, and HT models with the accessory 96-tube manifold installed.

Copy Aspiration Program

To copy an Aspiration program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → COPY → SELECT PROGRAM TYPE → MORE →
ASPIR → **SELECT ASPIR PROGRAM** → **NAME** → **OK TO COPY?**

Copy Aspiration Program Options

Option & Description	Models	Action/Comments
Select Aspir Program Select the Aspiration program you wish to copy.	All	Press the Options key to cycle through the available Aspiration programs.
Name Enter a unique name for the new Aspiration program.	All	Use up to 16 alphanumeric characters. See Entering Program Names on page 44 for instructions.
OK to Copy?	All	Select YES to copy the program.

Delete Aspiration Program

To delete an Aspiration program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described below:

DEFINE → SELECT ACTION → DELETE → SELECT PROGRAM TYPE →
MORE → ASPIR → **SELECT ASPIR PROGRAM** → **OK TO DELETE?**

Delete Aspiration Program Options

Option & Description	Models	Action/Comments
Select Aspir Program Select the Aspiration program you wish to delete.	All	Press the Options key to cycle through the available Aspiration programs.
OK to Delete?	All	Select YES to delete the program.

Soak

This section discusses how to define, edit, copy and delete **Soak** programs.

- A soak begins after the wash buffer is dispensed to the wells. In some assays, a soak cycle enhances washing by allowing extra reaction time for binding.
- A Soak program cannot be run on its own; it must be selected as part of a **Link** program (see page 88).
- Soak *parameters* can also be defined within a Wash program (see page 54).

Define Soak Program

To define a Soak program, follow the menu path shown below. Some of these items are options and some are prompts.

```
DEFINE → SELECT ACTION → CREATE → SELECT PROGRAM TYPE →  
MORE → SOAK → NAME → SOAK DURATION → SHAKE BEFORE SOAK? →  
SHAKE DURATION → SHAKE INTENSITY → OK TO SAVE PROGRAM?
```

Define Soak Program Options

See **Define Wash METHOD Program Options** (page 54) for a complete listing of Soak Program Options.

Edit Soak Program

To modify a Soak program, follow the menu path shown below. Some of these items are options and some are prompts.

```
DEFINE → SELECT ACTION → EDIT → SELECT PROGRAM TYPE →  
MORE → SOAK → SELECT SOAK PROGRAM → "Edit the soak parameters" →  
OK TO SAVE PROGRAM?
```

Copy Soak Program

To copy a Soak program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → COPY → SELECT PROGRAM TYPE → MORE →
SOAK → **SELECT SOAK PROGRAM** → **NAME** → **OK TO COPY?**

Copy Soak Program Options

Option & Description	Models	Action/Comments
Select Soak Program Select the Soak program you wish to copy.	All	Press the Options key to cycle through the available Soak programs.
Name Enter a unique name for the new Soak program.	All	Use up to 16 alphanumeric characters. See Entering Program Names on page 44 for instructions.
OK to Copy?	All	Select YES to copy the program.

Delete Soak Program

To delete a Soak program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described below:

DEFINE → SELECT ACTION → DELETE → SELECT PROGRAM TYPE →
MORE → SOAK → **SELECT SOAK PROGRAM** → **OK TO DELETE?**

Delete Soak Program Options

Option & Description	Models	Action/Comments
Select Soak Program Select the Soak program you wish to delete.	All	Press the Options key to cycle through the available Soak programs.
OK to Delete?	All	Select YES to delete the program.

Linking Programs

This section discusses how to run, define, and delete **Link** programs.

- Pre-defined Wash, Prime, Aspirate, Dispense, and Soak programs can be “linked” together and run sequentially and automatically.
- A Link program can contain up to ten Wash/Prime/Aspirate/Dispense/Soak programs, all of which must specify the same plate type (96, 96Bead, or 384).
- The linked program will not ask for a buffer if the external valve hardware is present. Each pre-defined program, within the linked program, will specify its own buffer.
- Once defined, a Link program can be viewed, run, or deleted; it cannot be edited or copied. The individual programs specified within the Link program, however, can be edited.

Run Link Program



Important! Before running a Link program, ensure that you have reviewed the **General Usage Guidelines** on page 49 and that the microplate is properly seated in the plate carrier.

To run a Link program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

```
RUN → SELECT PROGRAM TYPE → MORE → LINK →
SELECT LINK PROGRAM →
PLACE PLATE IN CARRIER AND PRESS <START> KEY →
LINK PROGRAM RUNNING. PRESS <STOP> KEY TO QUIT →
LINK PROGRAM COMPLETE. NEW REPEAT
```

Run Link Program Options

Option & Description	Models	Action/Comments
Select Link Program Select a Link program.	All	Press the Options key to cycle through the available Link programs.
New/Repeat	All	Select NEW to start a new program or REPEAT to repeat the last one.

Define Link Program

To define a Link program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → CREATE → SELECT PROGRAM TYPE →
 MORE → LINK → **NAME** → **PLATE TYPE** → **SELECT LINK 01 TYPE:** →
SELECT LINK 02 TYPE: → **SELECT LINK 03 TYPE:** →(UP TO 10) →
 OK TO SAVE PROGRAM?

PLATE TYPE only appears on the Select, Magna, Select CW, and HT models with the accessory 96-tube manifold installed.

Define Link Program Options

Option & Description	Models	Action/Comments
Name Enter a unique name for the new Link program.	All	Use up to 16 alphanumeric characters. See Entering Program Names on page 44 for instructions.
Plate Type Specify the microplate type.	Select, Select CW, Magna, HT/96-tube	Choose 96 or 384. Note: For higher throughput of the HT with 384-well plates, use the 192-tube manifold.
	Magna	Choose 96 or 96Bead.
Select Link (n) Type Select each Wash, Prime, Dispense, Aspirate, and/or Soak program to be included in the Link program.	All	Programs will be run in the order in which they are selected. If the Plate Type option is presented (see above), then only programs with the selected Plate Type will be accessible for inclusion in the Link program.
Press Main Menu to save.	All	Select YES to save the program.

Delete Link Program

To delete a Link program, follow the menu path shown below. Some of these items are options and some are prompts. The options are described in the table below:

DEFINE → SELECT ACTION → DELETE → SELECT PROGRAM TYPE →
MORE → LINK → **SELECT LINK PROGRAM** → **OK TO DELETE?**

Delete Link Program Options

Option & Description	Models	Action/Comments
Select Link Program Select the Link program you wish to delete.	All	Press the Options key to cycle through the available Link programs.
OK to Delete?	All	Select YES to delete the program.

Setup Utilities

To access the **SETUP** utilities, start at the Main Menu and select **UTIL → SETUP**. The **EDIT SETUP** screen will appear with the following options: **RS232, SENSOR, ADJUST, PARK, BIOSTACK, DISP, PLATE, VACUUM, MANIFOLD**. These options are described below and on the following pages.

RS-232 Settings (RS232)

The **RS232** utility allows the user to change the baud rate or view the fixed RS-232 settings (parity, stop-bits, data-bits). To change the baud rate or view other communication settings, follow the washer menu path below. (The default baud rate for the washer is 9600.)

UTIL → SETUP → **RS232** → SELECT BAUD RATE →
9600 1200 2400 9600 VIEW

Sensor System (SENSOR)

The **SENSOR** feature allows the user to activate or deactivate the detection systems on the washer, however, Bio-Tek recommends that the sensor detection systems **remain activated**.

Once exception would be, for instance, if you wish to run a prime program using air instead of fluid, deactivate the vacuum detection, fluid detection, and flow detection sensors, to avoid getting errors.

To change the status of a detection system, follow the washer menu below.

UTIL → SETUP → **SENSOR** → VACUUM DETECTION (YES/NO) →
WASTE DETECTION (YES/NO) → FLUID DETECTION (YES/NO) →
FLOW DETECTION (YES/NO)

Adjust Utility (ADJUST)

The **ADJUST** utility allows the user to view the positions of the aspirate and dispense tubes in relation to the microwells, and “single-step” the carrier or manifold axes through their offset ranges to select the best offset. For example, use the Adjust utility to determine the most effective setting for the Horizontal Dispense Position in a Wash program.

1. Place a microplate on the carrier.
2. To view aspirate/dispense tube positions or adjust an offset, follow the menu path below.

UTIL → SETUP → ADJUST → PLATE TYPE →
ADJUSTMENT POSITION → AXIS

3. From the **PLATE TYPE** screen, choose **96** or **384** for the Select, Select CW, and HT/96-tube manifold, and **96** or **96Bead** for the Magna. (PLATE TYPE does not appear in the standard ELx405 or HT with the 192-tube manifold installed.)
4. At the **ADJUSTMENT POSITION** screen, select a tube position: **ASPIR** (aspiration), **DISP** (dispense), or **MAGNET** (magnetic plate – Magna model only). Only one tube position may be viewed at a time.
5. At the **AXIS** selection screen, choose an axis. The top line of the display indicates which axis is active, and the offset position of that axis. The axis options are model-dependent, as follows:

MAN	Manifold (up/down movement)	All models
CARX	Carrier x-axis (left/right movement)	All models
CARY	Carrier y-axis (front/back movement)	Select, Select CW, HT
MAGNET	Magnet plate carrier (up/down movement)	Magna

6. Press the ◀ (reverse) key to single-step the offset in a negative direction, and the ▶ (forward) key to single-step the offset in a positive direction. See the examples in **Figure 21** on the following page.
7. When the desired offset position is found, record the position number for later use when selecting an offset for a wash, dispense, or aspirate program.
8. To quit the Adjust utility, press **Main Menu**. When the selection is made, the software automatically repositions the carrier and manifold to their *default* positions.

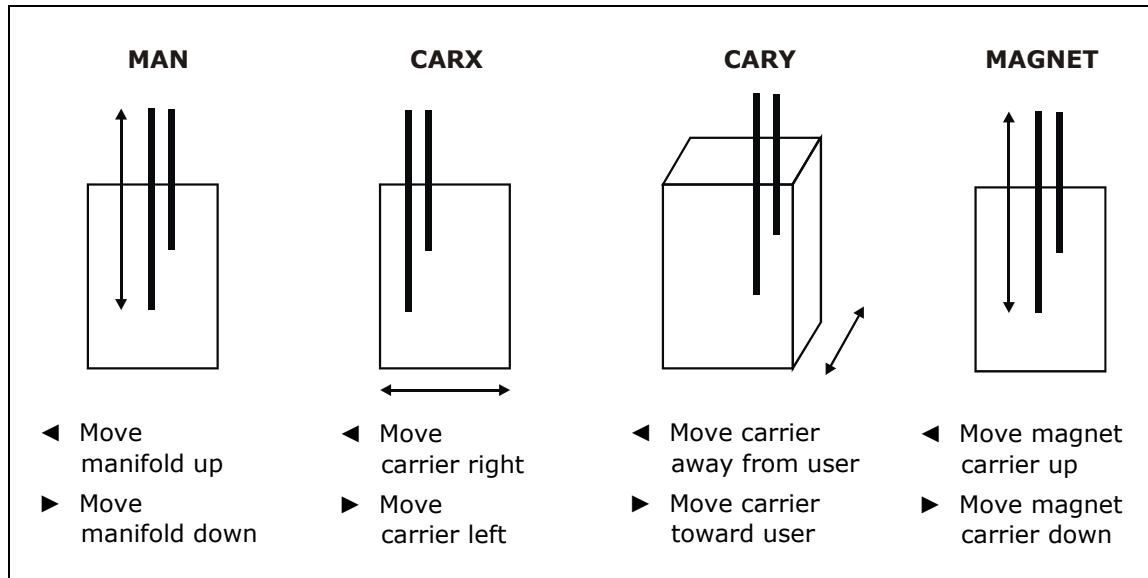


Figure 21: Using the Adjust Utility

Park Utility (PARK)

Before repackaging the instrument, the **PARK** utility must be used to position the manifold to the priming trough aspirate height in preparation for installing the manifold shipping bracket.

To park the washer, start at the Main Menu and select the following:

UTIL → SETUP → MORE → **PARK**

The manifold will immediately move to the Park or “pre-defined” position.

Bio-Stack Utilities (BIOSTACK)

Select **BIOSTACK** to display the Stacker’s **UTILITIES** screen. The washer can then be configured for proper operation with the Bio-Stack™, by selecting the **CONF** (Configuration), **ALIGN** (Alignment), and **VERIFY** (Verification) utilities. Refer to your Bio-Stack Operator’s Manual for instructions if you are operating the washer with the Bio-Stack.

UTIL → SETUP → MORE → **BIOSTACK** → BIOSTACK UTILITIES →
CONF ALIGN VERIFY

Delay After Dispense (DISP)

A **Delay After Dispense** feature enables you to change the value for the delay period between dispensing and aspirating in Wash programs. The delay range is 0 to 2000 msec, with a default value of 1000 msec.

To change the delay period, select the following:

UTIL → SETUP → MORE → MORE → **DISP** → DELAY AFTER DISP

Plate Clearance Height (PLATE)

A **Plate Clearance Height** option has been added to accommodate plates that are slightly taller than standard plates to ensure that the manifold tubes are raised high enough above the plate to prevent crashes when the plate carrier moves. The clearance height range is 12 (3.048 mm) to 180 (22.86 mm), with a default value of 130 (16.510 mm). Due to hardware variations, however, the 180 value may be out of range for some washers; it is recommended, therefore, that the highest value be closer to **175**.

To change the plate clearance height, select the following:

UTIL → SETUP → MORE → MORE → **PLATE** → PLATE CLEAR HEIGHT

Vacuum Dissipation Delay (VACUUM)

The **Vacuum Dissipation Delay** feature enables you to change the value for vacuum dissipation delay at the completion of a program. The delay range is 1 to 50 sec with a default value of 5 sec.

Increasing the delay prevents some vacuum systems, such as the High Flow Pump, from drawing excess current and blowing the auxiliary 5-amp fuse (PN 46055). A delay of 10 seconds or greater is recommended when using the High Flow pump with 10-liter bottles; a delay of at least 20 seconds is recommended when using the High Flow Pump with 20-liter bottles.

To change the vacuum dissipation delay, select the following:

UTIL → SETUP → MORE → MORE → **VACUUM** → VAC DISSIPATE DELAY

❖ **Note:** The **Delay After Dispense** and **Vacuum Dissipation Delay** features allow for overall faster plate processing, which may be useful for high-throughput microplate washing, for example, when the washer is used in conjunction with the Bio-Stack™ or other automated system. For standalone use, Bio-Tek does not recommend changing these parameters from the default setting, **unless** you are increasing the vacuum dissipation delay for the High Flow vacuum pump. If this is the case, please contact TAC if you need assistance with changing the these parameters.

Manifold Selection (MANIFOLD)

Some washer models can support two types of manifolds:

- The HT2/HTV2 supports the dual 192-tube manifold and the dual 96-tube manifold.
- The Select can be upgraded to an HT, in which case it can support the dual 192-tube manifold and the dual 96-tube manifold.

When a manifold is installed at the factory, a parameter is set on the washer to indicate which manifold type is installed. This parameter is called “Manifold Selection” and it can be set to **96** or **192**.

For the models described above, this parameter must be changed each time the manifold is changed. For example, the HT2/HTV2 is shipped with the 192-tube manifold installed and the 96-tube packaged as an accessory. If the 192-tube manifold is removed and the 96-tube installed, the manifold selection parameter must be changed from 192 to 96. See **Appendix E, Changing the Manifolds** for complete instructions.

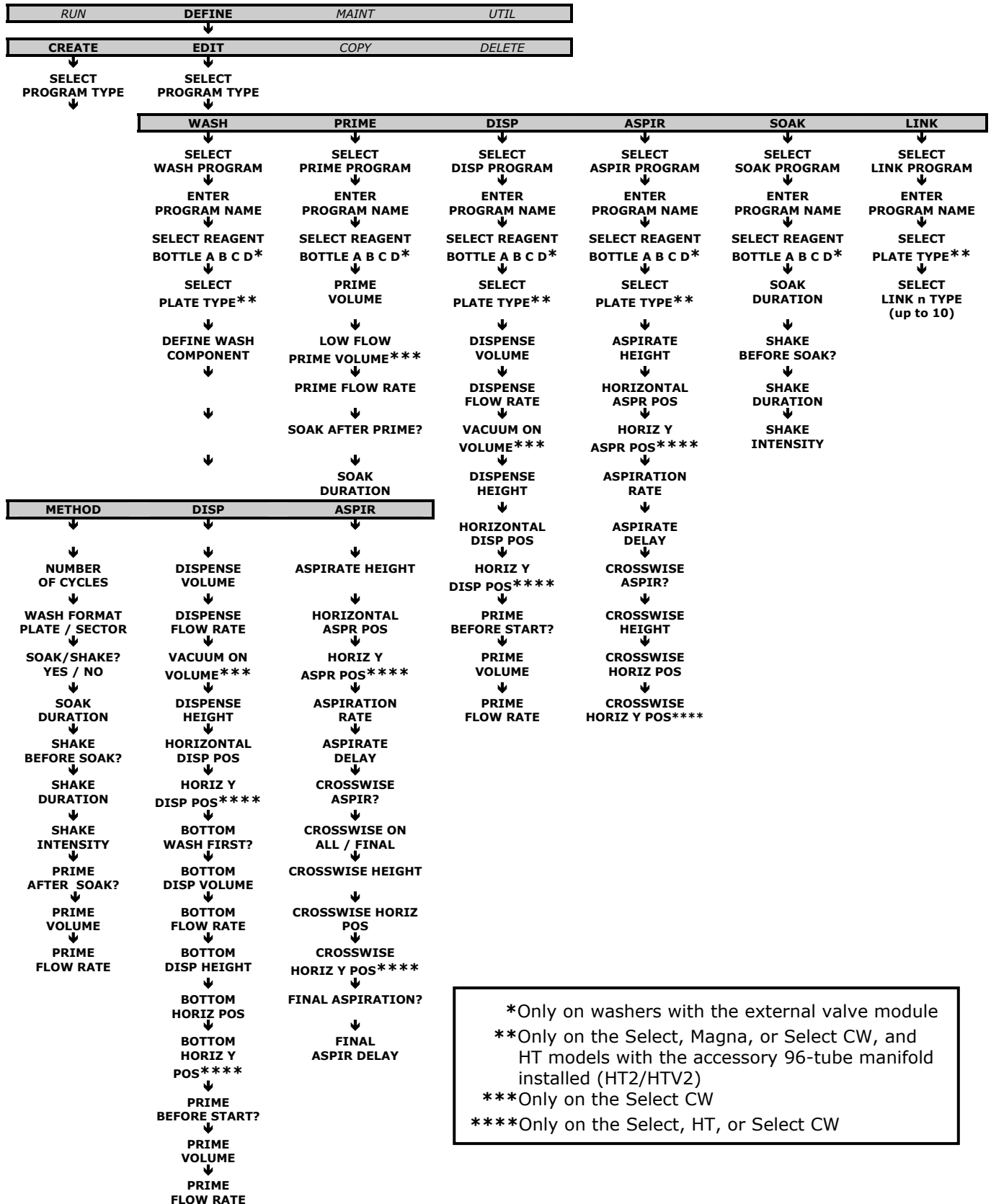
To view or change the Manifold Selection parameter, select the following:

UTIL → SETUP → MORE → MORE → MORE → **MANIFOLD** →
MANIFOLD SELECTION 96 or 192

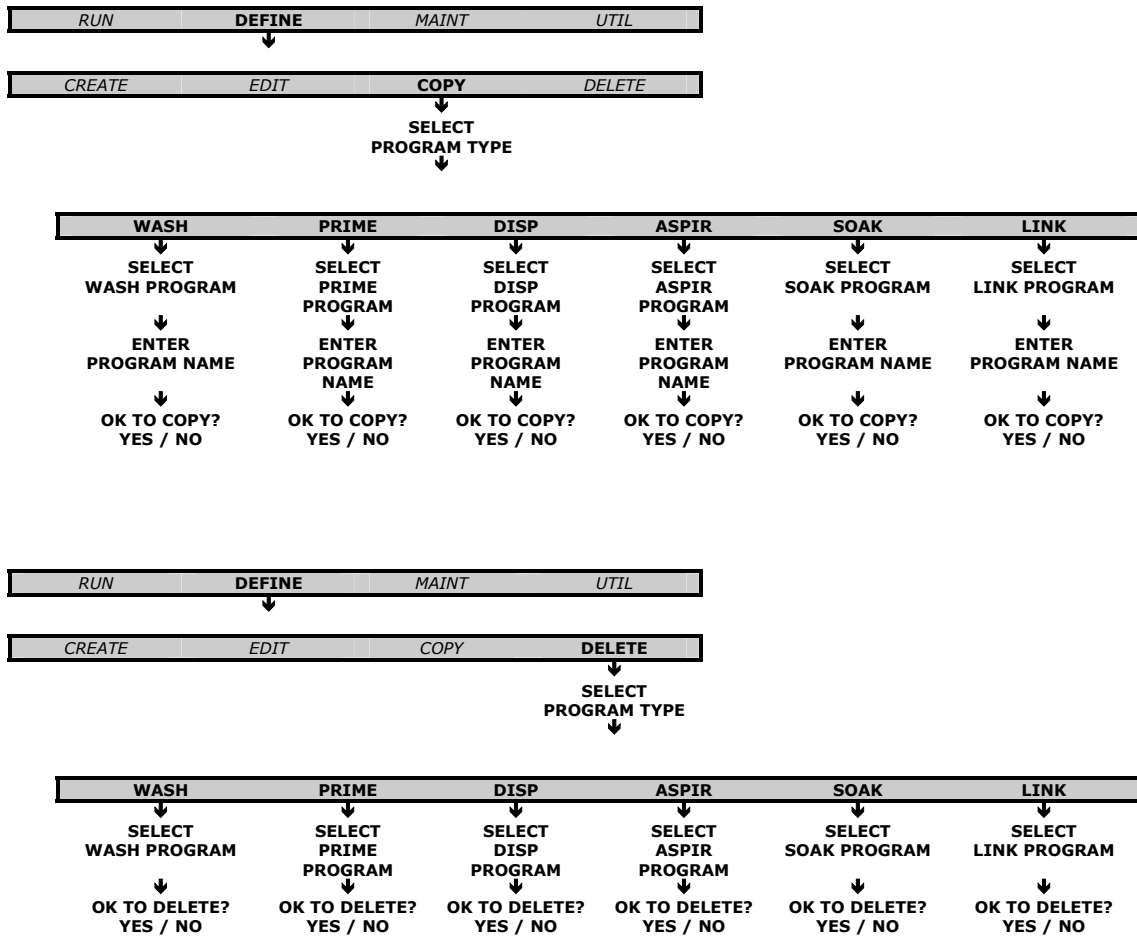
ELx405 Washer Menu Maps

Refer to the **Washer Menu Maps** on pages 97 through 100 for a complete listing of options available through the Main Menu.

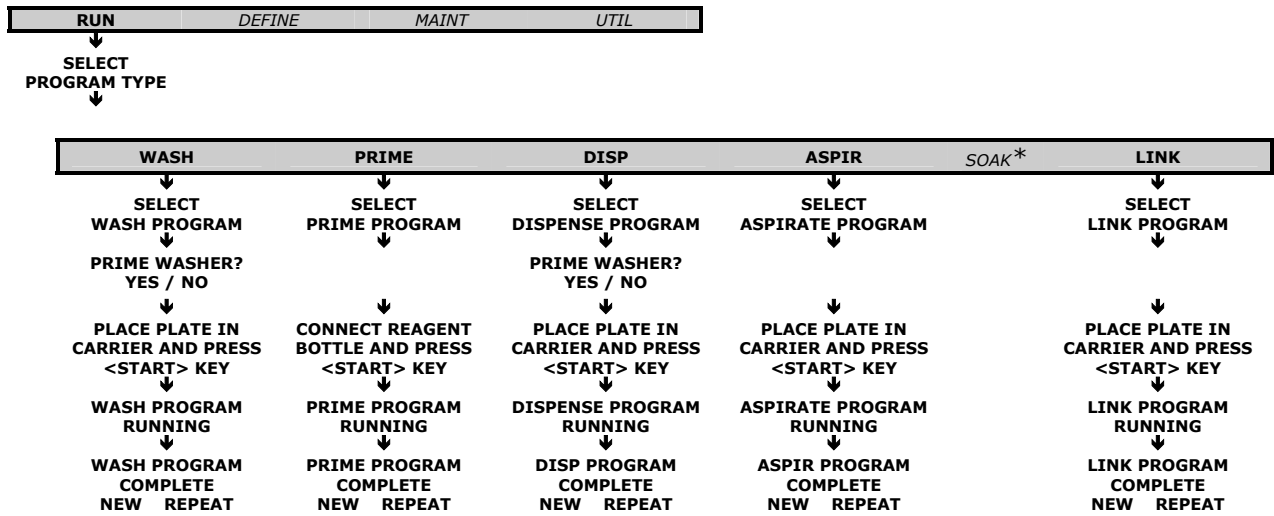
Main Menu (DEFINE function path for Create and Edit)



Main Menu (DEFINE function path for Copy and Delete)



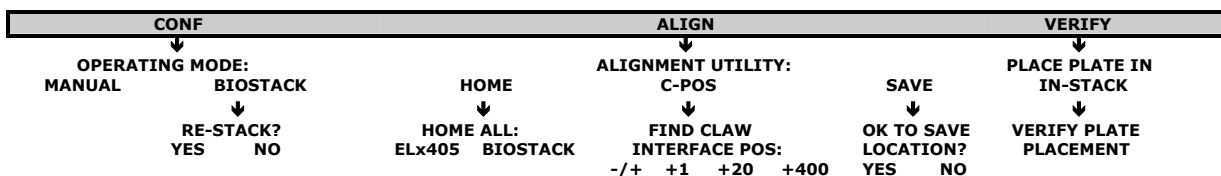
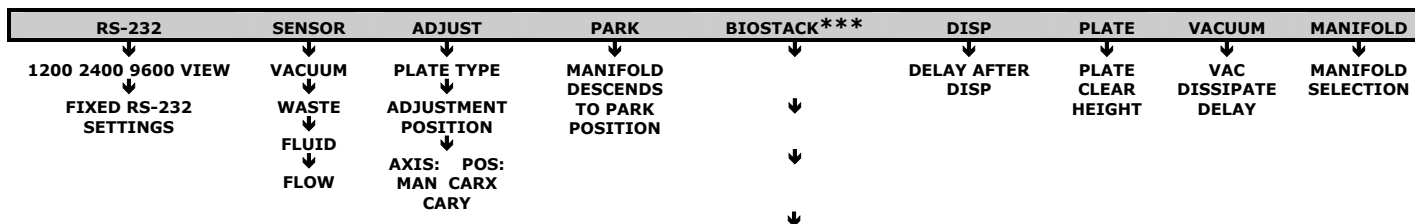
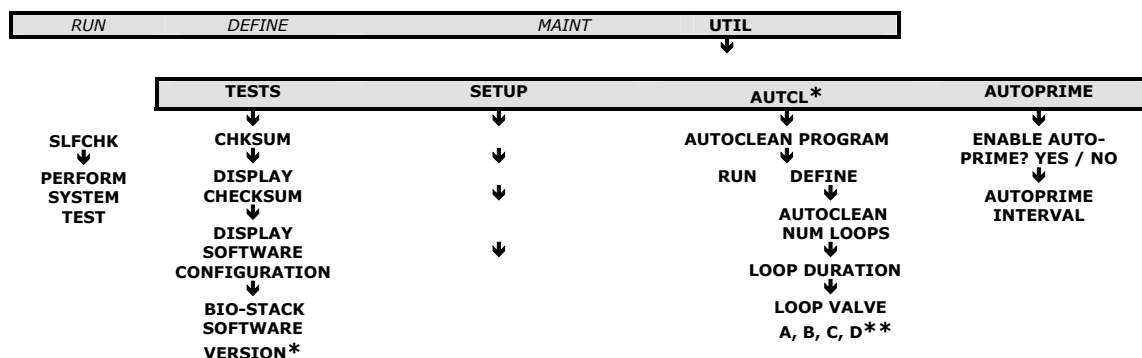
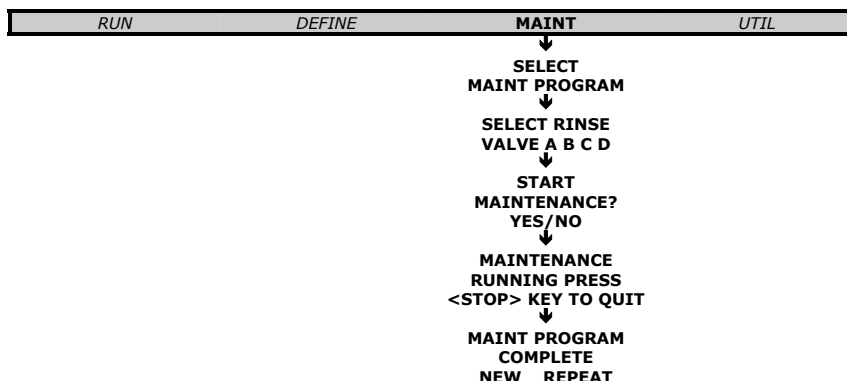
Main Menu (RUN function path)



- ❖ If the NEW option is selected at the Wash, Prime, Dispense, Aspirate, or Link Program Complete screen, control is returned to the corresponding Select Program screen. For example, if REPEAT is selected after a Wash program completes, the program returns to the Select Wash Program Screen.
- ❖ If the REPEAT option is selected at the Wash, Prime, Dispense, Aspirate, or Link Program Complete screen, the program will run through another complete cycle.

*A Soak program cannot be run independently; it must be selected within a Link program. Soak parameters **can** be defined within a Wash program (see "Main Menu, DEFINE function path for Create and Edit").

Main Menu (MAINT, UTIL function path)



*AUTCL options available only in models with the Ultrasonic Advantage™ (ultrasonic cleaner)
 **Only on washers with the external valve module
 ***Bio-Stack options available on all ELx405™ models, except the Magna

Chapter 4

Preventive Maintenance

This chapter describes how to maintain the washer, prepare it for storage or shipment, and decontaminate the instrument.

Overview	102
Recommended Maintenance Schedule.....	103
Required Materials	104
Warnings & Precautions	105
Maintenance Programs	106
Prime Programs	107
Rinse/Soak the Fluid Path	109
Clean Components.....	114
Decontaminate the Washer	128
Prepare for Storage or Shipment.....	134
Replace Components.....	136

Overview

A **Preventive Maintenance (PM)** regimen for the ELx405™ includes rinsing and soaking the fluid path and cleaning the washer's various components.

The chart on the next page summarizes Bio-Tek's recommended maintenance tasks, and indicates approximately how often each task should be performed. Daily and periodic routines and minimal guidelines for frequency are listed. Beyond that, it is difficult for Bio-Tek to recommend a fixed frequency for each task to be performed. The risk and performance factors of your assays should determine the frequency with which to conduct these tasks.

Therefore, Bio-Tek recommends you develop a maintenance schedule for your washer based on the characteristics of the fluids used and the washer's activity level. Some questions you should consider are:

- *Are the fluids you're using prone to dry and harden quickly?* If yes, the dispense and aspirate tubes can clog quickly, and therefore they must be rinsed frequently and cleaned regularly.
- *Is the washer in use continuously, or does it sit idle for several hours or days at a time?* If the washer will be sitting idle, the tubes should be soaked to keep them in a "wetted" state. The rinsing procedure (or the AUTOPRIME program) should be performed if the washer is idle for more than 3 hours.
- *Is a solution containing surfactant used throughout the day?* The wash solutions in use will affect the rinsing frequency. If the solution does not contain surfactant, consider rinsing (or running AUTOPRIME) at least once an hour.

Schedule

The following chart recommends preventive maintenance tasks, the frequency with which each task should be performed, and the pre-defined onboard Maintenance program that should be run (if applicable).

❖ It is important to note that the risk and performance factors associated with your assays may require that some or all of the procedures be performed more frequently than presented in this schedule.

❖ Models with the **Ultrasonic Advantage™**: The ultrasonic cleaner does not require maintenance.

Recommended Maintenance Schedule

Tasks	Frequency				
	Daily	Overnight /Multi-Day	Weekly	Periodic/ Monthly	Before storage/ shipment
Rinse/Soak the Fluid Path					
Run DAY_RINSE, p. 109	✓	✓			
Run AUTOPRIME, p. 110	✓				
Run OVERNIGHT_LOOP, p. 111		✓			
Run RINSE_AND_SOAK, p. 112		✓			
Remove protein residuals and fungi growth, (if necessary), p. 112	✓		✓	✓	
Clean Components					
Check/empty waste bottle, p. 115	✓				✓
Clean bottles, p. 115				✓	✓
Clean plate carrier system, p. 115			✓		✓
Clean carrier transport arm, p. 116			✓		✓
Clean manifold and mist shield, p. 118				✓	✓
Clean aspirate and dispense tubes, p. 118				✓	✓
Run AUTO CLEAN (Ultrasonic Advantage™), p. 123				✓	✓
Clean fluid inlet filter, p. 126				✓	✓
Decontaminate the Washer					
Decontaminate external surfaces, p. 129				✓	✓
Run DECONTAMINATION, p. 130				✓	✓
Prepare the Washer for Storage or Shipment					
Run LONG_SHUTDOWN, p. 134					✓
Replace Components					
Replace o-rings, and channel-end seals, p. 136	<i>Annually</i>				

Required Materials

For rinsing/soaking the fluid path, and for cleaning the components:

- Deionized or distilled water
- Sodium hypochlorite (NaClO or bleach)
- 70% isopropyl alcohol (or ethanol)
- Dispense and aspirate tube styluses (supplied with the washer)
- Phillips head screwdriver
- 9/64" (3.57 mm) hex wrench (supplied with the washer)
- Lint-free disposable towels
- Dish soap or other mild cleaner
- Soft-bristled brush

For replacing o-rings and channel-end seals:






- O-rings (PN 49941)
- Channel-end seals (PN 49486)

❖ In the following cleaning procedures, when not otherwise specified, "water" means use either deionized or distilled water.

❖ Unless otherwise instructed, **always** connect a supply bottle containing deionized or distilled water to the washer before running the Maintenance programs.

Warnings & Precautions

Please read the following before performing any Maintenance procedures:

	<p>Warning! Internal Voltage. Turn off and unplug the instrument for all maintenance and repair operations.</p>
	<p>Caution! Chemical Compatibility with Washers.</p> <p>Some chemicals may cause irreparable damage to washers. The following chemicals have been deemed safe for use in washers: buffer solutions (such as PBS), saline, surfactants, deionized water, 70% ethyl, isopropyl, or methyl alcohol, 40% formaldehyde, and 20% sodium hydroxide.</p> <p>Never use DMSO or other organic solvents. These chemicals may cause severe damage to the instrument. See Appendix C, Chemical Compatibility, for more information. Use of wash buffers containing acetic acid is limited to washers upgraded with Bio-Tek part number 68098 Teflon[®] valves.</p> <p>Contact Bio-Tek for upgrade information and prior to using other questionable chemicals.</p>
	<p>Warning! Wear protective gloves when handling contaminated instruments. Gloved hands should be considered contaminated at all times; keep gloved hands away from eyes, mouth, nose, and ears.</p>
	<p>Warning! 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 handling contaminated instruments.</p>
	<p>Important! Do not immerse the instrument, spray it with liquid, or use a “wet” cloth on it. Do not allow water or other cleaning solution to run into the interior of the instrument. If this happens, contact Bio-Tek’s Technical Assistance Center.</p>

Maintenance Programs

The ELx405™ onboard software contains the following pre-defined **Maintenance programs** for most of the recommended tasks:

- DAY_RINSE
- OVERNIGHT_LOOP
- RINSE_AND_SOAK
- LONG_SHUTDOWN
- DECONTAMINATION

To **run** a Maintenance program:

1. From the washer's main menu, select **MAINT**.
2. Press the **Options** key to scroll through the available programs. Press the **ENTER** key to select a program.
3. If prompted for additional information (such as **RINSE VALVE** for models with the external valve module), make the appropriate selections.
4. When **START MAINTENANCE?** appears, select **YES** or press the **START** key to begin.

❖ To halt a Maintenance program in progress, press the **STOP** key.

5. When the program is complete, press the **Main Menu** key to return to the washer's main menu.

Prime Programs

Each pre-defined Maintenance program runs a pre-defined **Prime program**. The charts below and on the following page show the default prime program parameters. These parameters can be modified.

To **view** or **edit** the parameters for a particular Prime program, follow this sequence from the washer's main menu:

DEFINE → EDIT → PRIME → SELECT PRIME PROGRAM
(press the **Options key** to cycle through the available programs)

Refer to **Chapter 3, Define Prime Program** for more information on Prime programs and their parameters.

❖ **Note:** In addition to the tubing that every ELx405™ Washer model is equipped with, the Select CW model contains smaller diameter "low flow" tubing for gentle cell washing. The Low Flow Prime Volumes specified in the charts below and on the following page are necessary to purge the Select CW's low flow tubing.

Maintenance Program: DAY_RINSE		Prime Program: P_DAY_RINSE
Parameter	Default	Selectable Range
Prime Volume	400 ml (All models except Select CW); 300 ml (Select CW)	1-999 ml
Low Flow Prime Volume (Select CW models only)	200 ml	1-999 ml
Flow Rate	7	1-9
Soak After Prime?	No; N/A for the Select CW	Yes/No

Maintenance Program: OVERNIGHT_LOOP		Prime Program: P_RINSE_LOOP
Parameter	Default	Selectable Range
Prime Volume	60 ml (All models)	1-999 ml
Low Flow Prime Volume (Select CW models only)	0 ml	1-999 ml
Flow Rate	7	1-9
Soak After Prime?	Yes	Yes/No
Soak Duration	4 hours	1 minute to 18 hours

Maintenance Program: RINSE_AND_SOAK Prime Program: P_RINSE_AND_SOAK		
Parameter	Default	Selectable Range
Prime Volume	400 ml (All models except Select CW); 300 ml (Select CW)	1-999 ml
Low Flow Prime Volume (Select CW models only)	200 ml	1-999 ml
Flow Rate	7	1-9
Soak After Prime?	Yes	Yes/No
Soak Duration	5 minutes	1 minute to 18 hours

Maintenance Program: LONG_SHUTDOWN and DECONTAMINATION Prime Program: P_DECON1		
Parameter	Default	Selectable Range
Prime Volume	400 ml (All models except Select CW); 300 ml (Select CW)	1-999 ml
Low Flow Prime Volume (Select CW models only)	200 ml	1-999 ml
Flow Rate	7	1-9
Soak After Prime?	Yes	Yes/No
Soak Duration	20 minutes	1 minute to 18 hours

Maintenance Program: LONG_SHUTDOWN and DECONTAMINATION Prime Program: P_DECON2		
Parameter	Default	Selectable Range
Prime Volume	800 ml (All models except Select CW); 600 ml (Select CW)	1-999 ml
Low Flow Prime Volume (Select CW models only)	200 ml	1-999 ml
Flow Rate	7	1-9
Soak After Prime?	Yes	Yes/No
Soak Duration	2 minutes	1 minute to 18 hours

Rinse/Soak the Fluid Path

Daily Maintenance

Daily maintenance involves flushing the washer with an appropriate reagent or deionized water throughout the day. Routinely rinsing the washer helps to prevent the aspirate and dispense tubes from clogging between washes.

The recommended **rinsing frequency** depends on the wash solutions currently in use:

- If a solution containing surfactant is used throughout the day, the rinsing procedure should be performed if the washer is idle for more than 3 hours.
- If the solution does not contain surfactant, consider rinsing at least once an hour.

The **DAY_RINSE** and **AUTOPRIME** programs described below and on the following page satisfy daily maintenance requirements.

DAY_RINSE

The DAY_RINSE Maintenance program primes the washer with the Prime Volume specified in the **P_DAY_RINSE** prime program. To view or edit the parameters in this Prime program, see **Prime Programs** on page 107.

To run the DAY_RINSE program, follow this sequence:

Washers not equipped with the **external valve module**:

MAINT → SELECT MAINT PROGRAM: **DAY_RINSE** →
CONNECT RINSE AND PRESS **<START>** KEY

Washers equipped with the **external valve module**:

MAINT → SELECT MAINT PROGRAM: **DAY_RINSE** →
RINSE VALVE? **A B C** or **D** → START MAINTENANCE? **YES**

AUTOPRIME

The AutoPrime feature can be enabled to automatically prime the washer after it has been idle for a user-specified amount of time. The volume, flow rate, and soaking parameters specified in the AUTOPRIME Prime program are used. AUTOPRIME is particularly useful if the washer is used intermittently throughout the day, to keep the fluid lines and manifold in a wetted condition.

- ❖ **Washers with the external valve module:** AUTOPRIME uses the last-used valve (A, B, C, or D) for priming and soaking.
- ❖ **"AUTPRM"** appears only in models with the Ultrasonic Advantage™ (ultrasonic cleaner).

The AutoPrime feature is disabled by default. To enable it:

1. Select **UTIL → AUTOPRIME** (or **AUTPRM**) → **YES**.
2. Enter the **interval** from **10** to **600** minutes, to indicate how often you want the AUTOPRIME Prime program to run.
3. Press **ENTER** and then return to the Main Menu.

AutoPrime is now enabled and priming will occur each time the washer has been idle for <interval> minutes.

- To disable the AutoPrime feature, select **UTIL → AUTOPRIME** (or **AUTPRM**) → **NO**.
- To **halt** the AUTOPRIME program, press the **STOP** key.
- To **view** or **edit** the AUTOPRIME program parameters, select **DEFINE → EDIT → PRIME → AUTOPRIME →** and press the **Options** key to scroll through the parameters you wish to view or edit. The table below shows the AUTOPRIME program parameters and ranges.

Refer to **Chapter 3, Define Prime Program** for more information on Prime programs and their parameters.

Parameter	Default	Selectable Range
Interval	10 minutes	10 to 600 minutes
Prime Volume	60 ml	1 to 999 ml
Low Flow Prime Volume (Select CW models only)	0 ml	1 to 999 ml
Prime Flow Rate	7	1-9
Soak After Prime?	Yes	Yes/No
Soak Duration	3 hours, 50 minutes	1 minute to 18 hours

Overnight/Multi-Day Maintenance

Overnight/multi-day maintenance involves flushing all wash solution out of the instrument, and then periodically rinsing and soaking the tubes to keep them moist. If the washer will be left idle for a period of time (such as overnight or over a weekend), the tubes should be left to soak for several hours at a time.

The **OVERNIGHT_LOOP** and **RINSE_AND_SOAK** programs described below and on the following page satisfy overnight/multi-day maintenance requirements.

- The **OVERNIGHT_LOOP** program requires the washer to remain turned on.
- As an alternative, run **RINSE_AND_SOAK** and turn off the washer after the soak begins. This leaves the tubes soaking in the priming trough until the instrument is turned on again.

❖ If the washer will be left idle for two or more days, run **DAY_RINSE** and **OVERNIGHT_LOOP** **or** run **RINSE_AND_SOAK**.



Important! Keep the manifold in a wetted condition to ensure proper evacuation of fluid. Bio-Tek recommends changing the Soak Duration to 18 hours for overnights and weekends when the washer is not being used. This will decrease flow problems and is a more trouble-free way to operate the washer.

OVERNIGHT_LOOP

The **OVERNIGHT_LOOP** Maintenance program primes and soaks the washer with the Prime Volume and Soak Duration specified in the **P_RINSE_LOOP** Prime program. To view or edit the parameters in this Prime program, see **Prime Programs** on page 107.

To run the **OVERNIGHT_LOOP** program, follow this sequence:

Washers not equipped with the **external valve module**:

MAINT → SELECT MAINT PROGRAM: → **OVERNIGHT_LOOP** →
CONNECT RINSE AND PRESS **<START>** KEY

Washers equipped with the **external valve module**:

MAINT → SELECT MAINT PROGRAM: → **OVERNIGHT_LOOP** →
RINSE VALVE? **A B C** or **D** → START MAINTENANCE? **YES**

RINSE_AND_SOAK

The RINSE_AND_SOAK Maintenance program primes and soaks the washer with the Prime Volume and Soak Duration specified in the P_RINSE_AND_SOAK Prime program. To view or edit the parameters in this Prime program, see **Prime Programs** on page 107.

To run the RINSE_AND_SOAK program, follow this sequence and turn off the washer after the soak begins:

Washers not equipped with the **external valve module**:

MAINT → SELECT MAINT PROGRAM → **RINSE_AND_SOAK** →
CONNECT RINSE AND PRESS **<START>** KEY

Washers equipped with the **external valve module**:

MAINT → SELECT MAINT PROGRAM → **RINSE_AND_SOAK** →
RINSE VALVE? **A B C** or **D** → START MAINTENANCE? **YES**

Removing Protein Residuals and Fungi Growth



Important! Solutions containing proteins, such as bovine serum albumin (BSA), will compromise the washer's performance over time unless a strict maintenance regime is adhered to.

Do not use isopropyl alcohol to flush out BSA.

Bio-Tek recommends performing the following additional Maintenance procedures to thoroughly flush out protein particles and other contaminants from the washer's fluid path, if necessary:

❖ **Four-liter** volumes specified in the following are approximate amounts.

Daily

Using an Enzyme-Active Detergent:

- 1 Mix an enzyme-active detergent according to the manufacturer's directions to fill a four-liter supply bottle. Connect the bottle to the washer (Valve "A" if the valve module is connected).
- 2 Run the **DECONTAMINATION** program. When the program pauses and displays CONNECT RINSE BOTTLE AND PRESS **<START>** KEY, leave the detergent bottle connected and press the **Start** key to continue. Repeat this sequence until the bottle is empty.

- 3 Connect a bottle containing four liters of deionized water and run the **P_DAY_RINSE** Prime program three times to flush the system.

Using Ethanol:

At the end of the day:

- 1 Prepare a four-liter solution of 10% ethanol and deionized water. (**Do not** use isopropyl alcohol.) Connect the bottle to the washer (Valve "A" if the valve module is connected).
- 2 Run the **DECONTAMINATION** Maintenance program.
- 3 Connect a bottle containing four liters of deionized water and flush the system by running either the **P_DAY_RINSE** Prime program (three times), or the **OVERNIGHT_LOOP** Maintenance program.

Using Deionized Water:

If the washer will be idle between plates for longer than 45 minutes, flush the proteins from the washer:

- 1 Fill a supply bottle with deionized water. Connect the bottle to the washer (Valve "A" if the valve module is connected).
- 2 Run the **P_DAY_RINSE** Prime program.
- 3 Enable **AUTOPRIME** for 60-minute intervals.

At the end of the day:

- 1 Fill a supply bottle with deionized water. Connect the bottle to the washer (Valve "A" if the valve module is connected).
- 2 Run the **P_DAY_RINSE** Prime program three times.
- 3 Run the **OVERNIGHT_LOOP** Maintenance program.





Weekly/Monthly

- 1 Flush the system with 0.1-0.5 N NaOH, followed by neutralization with an equivalent normality (0.1-0.5 N) of HCl.
- 2 Rinse well with deionized water to remove the HCl.
- 3 Run the **OVERNIGHT_LOOP** Maintenance program with deionized water, or run the **P_DAY_RINSE** Prime program three times with deionized water if you plan to use the washer immediately.

Clean Components

Periodic Maintenance

Periodic maintenance involves cleaning the washer components on a regular basis to keep the washer running efficiently and in compliance with instrument specifications. The recommended **frequency for cleaning washer components** is *at least monthly*. The risk and performance factors associated with your assays may require that some or all of the procedures be performed more frequently.

	<p>Warning! Internal Voltage. Turn off and unplug the washer for all cleaning operations.</p>
	<p>Important! Do not apply lubricants to manifold o-rings, channel-end seals, bottle cover seals, any tubing connection, or any surface that is a part of the fluid path. <i>The use of any lubricant on the fluid handling components will interfere with the aspirate and dispense performance, and may cause irreparable damage to these components.</i></p>
	<p>Important! When cleaning components:</p> <ul style="list-style-type: none"> • Do not immerse the instrument, spray it with liquid, or use a “wet” cloth on it. • 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 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. • Do not soak the keypad. Instead, moisten a clean cloth with deionized or distilled water and wipe the keypad. Dry it immediately with a clean, dry cloth.
	<p>Important! HT models with the accessory 96-tube manifold (HT2/HTV2): Perform Periodic Maintenance on the manifold (96-tube or 192-tube) most frequently in use.</p> <p>Ensure that the washer is configured for operation with the installed manifold (refer to Manifold Selection in Chapter 3, Operation.) Failure to set the manifold type before operating the washer may damage the manifold and void your warranty.</p>

Cleaning the Bottles

- Clean and rinse the supply bottles with deionized water before the first use, before each refill, and, periodically, as necessary, to prevent bacteria growth.
- Empty the waste bottle often (at least daily), and firmly seat the waste bottle stopper.
- Rinse the covers every time the wash or rinse bottles are filled.
- Accumulated algae, fungi, or mold may require decontamination. Decontamination is described on page 128.

❖ To ensure that fluid does not back up into the vacuum pump during operation, always operate the washer with the **waste sensor cable** installed and the **waste detection sensor** enabled (the sensor is enabled by default; see **Setup Utilities** in **Chapter 3, Operation**). If fluid collects in the **overflow bottle**, thoroughly rinse the level-switch assembly and bottle.

- Check the white hex nuts securing the Quick-Disconnects to the bottle cap to ensure they are not loose or corroded.

Cleaning the Plate Carrier System

If liquid has overflowed onto the plate carrier, transport rail, or glide strips, some buildup may occur and prevent the microplate from seating correctly on the carrier. This can interfere with plate transport. Weekly cleaning is recommended.

1. Turn the washer on and wait for the System Self Test to complete. Turn the washer off when the manifold and tubes are resting above the priming trough (“home” position). Disconnect the power cable.
2. Carefully lift the carrier straight up and off the horizontal transport rail. See **Figures 25, 26, and 27**.
3. Clean the carrier, rail, and glide strips, using mild detergent and hot water, 70% isopropyl alcohol, or 70% ethanol.

❖ **Select** and **HT** models: Take extra care to clean the spring-loaded transport arm that allows these models to move the plate forward and back (Y-axis). The arm fits into the left side of the plate carrier as you face the washer. If more intensive cleaning is required (for example, if reagent has spilled and dried on the stainless steel shaft), see **Cleaning the Carrier Transport Arm (Select, Select CW, and HT Models)** on page 116 for thorough cleaning instructions.

4. If detergent was used, wipe the components with a cloth moistened with water. Use a clean, dry cloth to dry the components.
5. To replace the carrier, line up the pin on the underside of the carrier with the slot on the carrier transport rail. Snap the two carrier rail guides onto the rail. The pin should sit in the slot.

Cleaning the Carrier Transport Arm (Select, Select CW, and HT Models)

For troubleshooting purposes, it may be necessary to disassemble and clean the spring-loaded carrier transport arm that allows the Select, Select CW, and HT models to move forward and back (along the y-axis) when washing 384-well plates.

If reagent has spilled and dried on the stainless steel shaft of the arm, it may interfere with carrier movement. Cleaning the arm will resolve the problem.

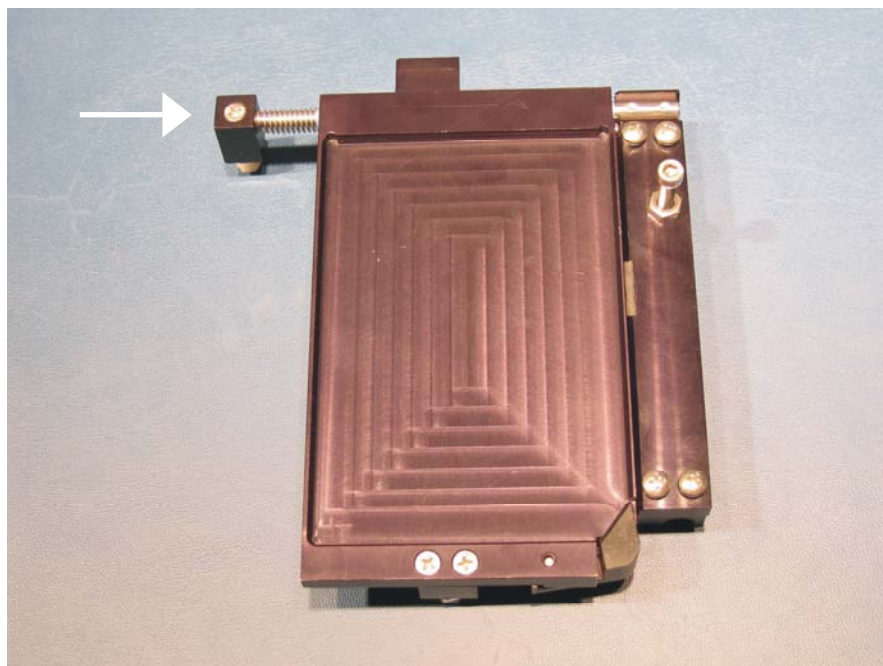


Figure 22: Position of the Transport Arm on the Plate Carrier

The transport arm is noted with an arrow in the photo above. As shown in the photo, the arm fits into the left side of the plate carrier.

Follow the instructions on the next two pages for removing, cleaning, and reassembling the transport arm.

1. Carefully lift the carrier straight up and off the transport rail.
2. Turn the carrier over and lay it face down to expose the two screws that hold the arm in place in the carrier (noted with an arrow in the photo below).

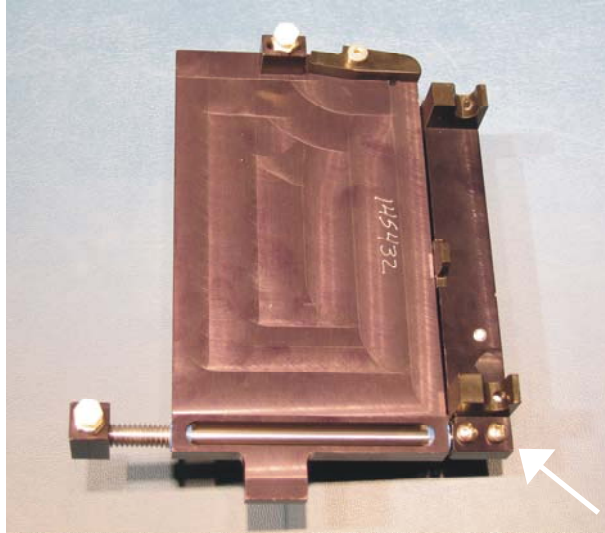


Figure 23: Removing the Screws and Washers From the Transport Arm

3. Remove the screws and washers and slide the arm free from the carrier.

❖ Take note of the orientation of the arm to the plate carrier as it is turned upside down. Be sure to reassemble the components properly.

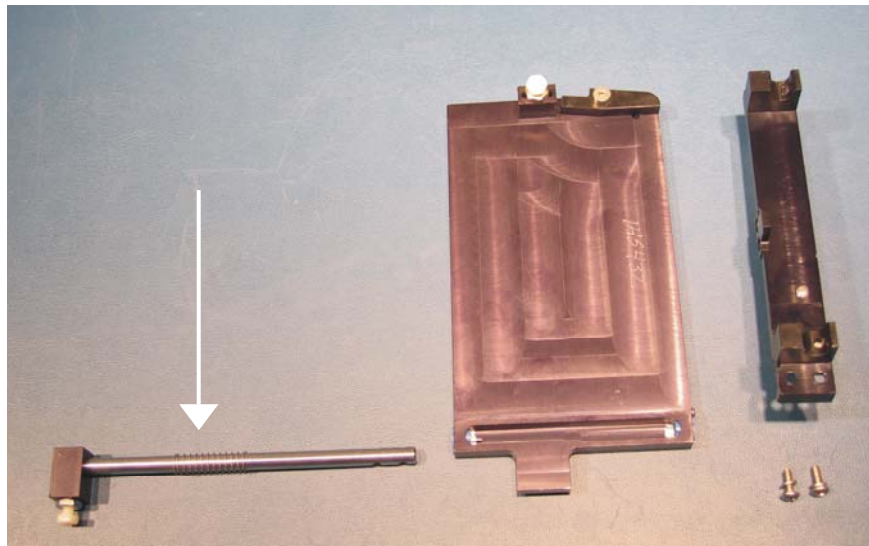


Figure 24: The Transport Arm Removed From the Carrier

4. Clean the arm with a lint-free towel moistened with 70% isopropyl alcohol. Allow it to dry.
5. Reassemble the carrier:
 - Slide the arm back into the open end of the plate carrier.
 - Squeeze the arm spring against the carrier to expose the openings for the screws and washers, and reinstall them.
6. To replace the carrier, line up the pin on the underside of the carrier with the slot on the carrier transport rail. Snap the two carrier rail guides onto the rail. The pin should sit in the slot.

Cleaning the Manifold, Mist Shield, and Tubing

Regular rinsing helps to keep the manifold clean, the aspiration and dispense tubes clear, and it increases the life of the tubing.

If you suspect a particular problem is related to the manifold (for example, clogged tubes can result in poor or uneven aspiration or dispensing), you should perform a thorough cleaning of the dispense and aspirate tubes and channels. When necessary, follow the DECONTAMINATION procedure on page 130 to disinfect the manifold and tubing.

To clean the manifold, mist shield, and tubing:

1. Run the system “dry”:
 - ◆ From the main menu, select **UTIL → SETUP → SENSOR** and set VACUUM DETECTION, FLUID DETECTION, and FLOW DETECTION to **NO**.
 - ◆ Connect an empty supply bottle and prime the washer until the tubing is empty.
 - ◆ **Important!** Set the vacuum, fluid, and flow detection sensors back to **YES**.
2. Turn off the washer and disconnect the power cable.
3. Moisten a lint-free disposable towel with water, or with water and mild detergent. **Do not soak the cloth.**
4. Remove the mist shield if it is attached (see **Figure 16** in **Chapter 2, Installation**). Wipe the inside and outside surfaces of the mist shield with the towel. Wipe the top surface of the instrument base, and all exposed surfaces of the instrument.
5. If detergent was used, wipe all surfaces with a cloth moistened with water.
6. Use a clean, dry cloth to dry all wet surfaces.

❖ Use extra care when removing the **Select, Select CW, and HT dual manifolds**. Hold the two manifolds together as a single unit when removing or replacing.

7. Using the 9/64" (3.57 mm) hex wrench, remove the screws, washers, and springs that hold the manifold(s) in place (see **Figures 25, 26, and 27**). Carefully remove the manifold(s) and end plates.
8. Using a soft-bristled brush, thoroughly clean the outside of the manifold(s). Clean the insides of each tube with the appropriate stylus (aspirate/dispense). Flush hot water through the cross channels.
9. Rinse the manifold with deionized or distilled water. Check to see if water comes out of all dispense and aspirate tubes. If not, soak the manifold in hot, soapy water and repeat.



Caution. When reinstalling the manifold, only tighten the screw-washer-spring assembly that holds it in place until you feel the mechanical stop. You will damage the instrument if you continue tightening past this point, and will **void your warranty**.

10. When satisfied, reassemble the manifold and end plates, making sure that the two o-rings are in place prior to reassembly. **Do not overtighten the manifold screws.**
11. Re-attach the mist shield; finger-tighten the two thumbscrews (**use no tools**). Refer to **Attaching the Mist Shield, Chapter 2, Installation**.
12. Reconnect the power cable and turn on the washer.
13. Prime the system with deionized water by running DAY_RINSE or a similar Maintenance or Prime program. Watch for leaks. If fluid leaks out of the back of the instrument, firmly seat the tubing. If fluid leaks from the manifold, try disassembling and carefully reassembling.
14. Verify aspirate/dispense performance visually or by performing the **Evacuation Efficiency Test** and/or **Dispense Precision Test** in **Chapter 5, Performance Verification/Qualification Tests**.

❖ Replace the o-rings on an annual basis. Replace the 12 (or 24) channel-end seals (rubber plugs) if they show signs of cracking or drying out. See **Replacing the O-Rings and Channel-End Seals** on page 136.

❖ For additional cleaning, an ultrasonic bath may be used, or the AUTOCLEAN program may be run (models with the Ultrasonic Advantage™ only; see the AUTOCLEAN section on page 123).

DO NOT AUTOCLAVE the manifold!

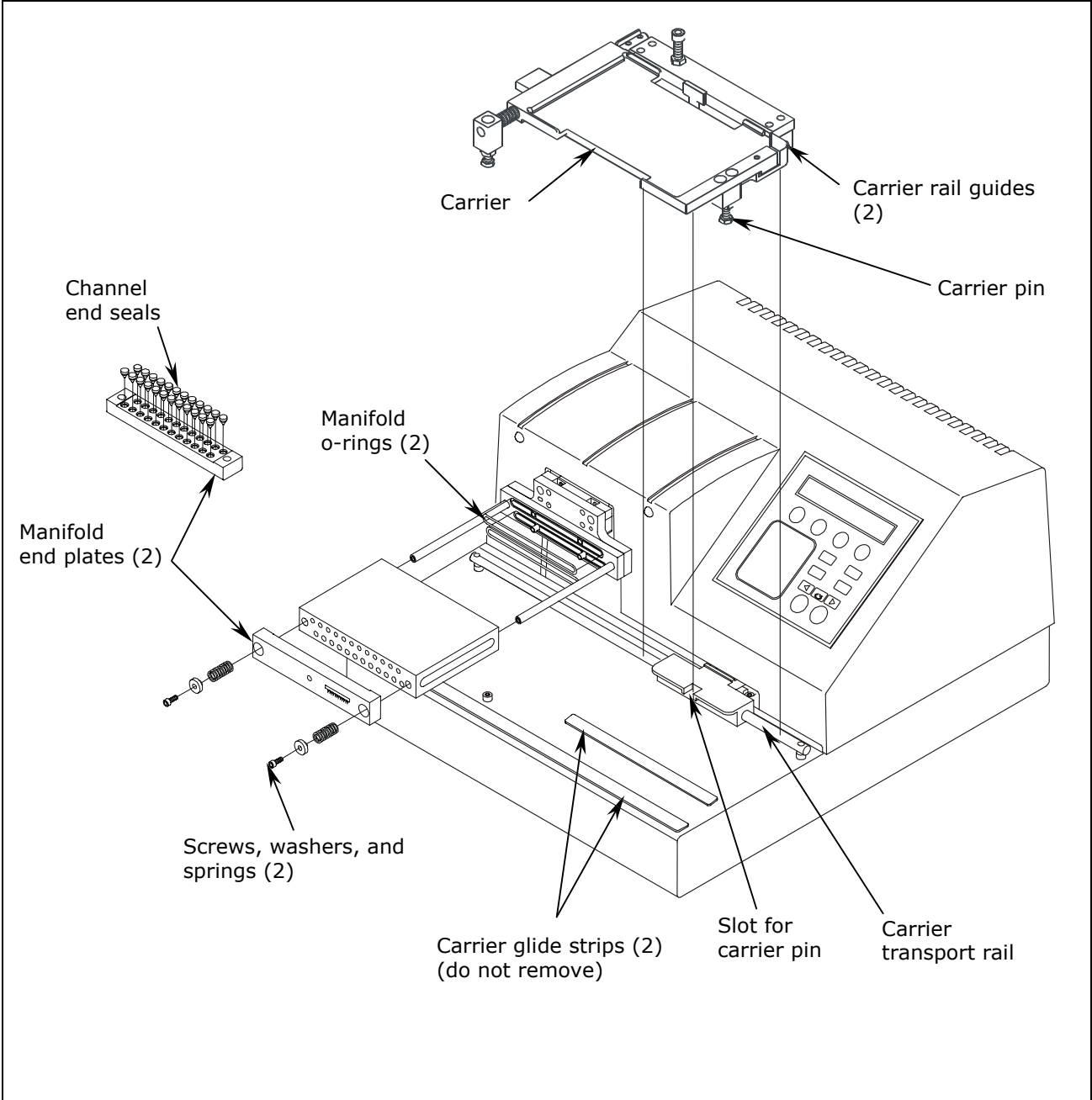


Figure 25: Carrier and Manifold Placement in the ELx405 Model

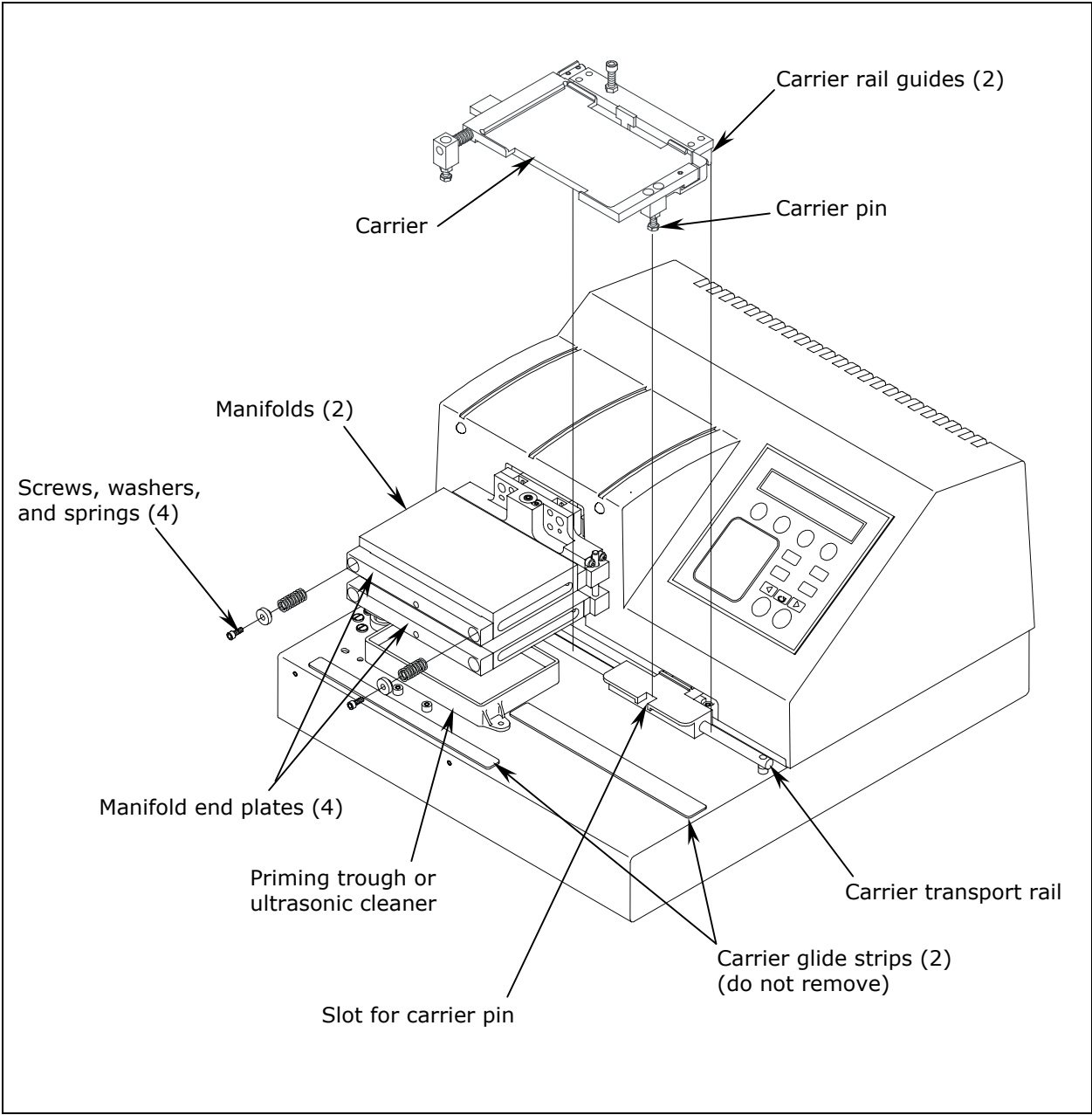


Figure 26: Carrier and Manifold Placement in the Select, Select CW, and HT Models

❖ The ultrasonic cleaner is available in Ultrasonic Advantage™ models only. Do not try to remove the ultrasonic cleaner! Only Bio-Tek authorized service personnel should remove the cleaner for maintenance or repair.

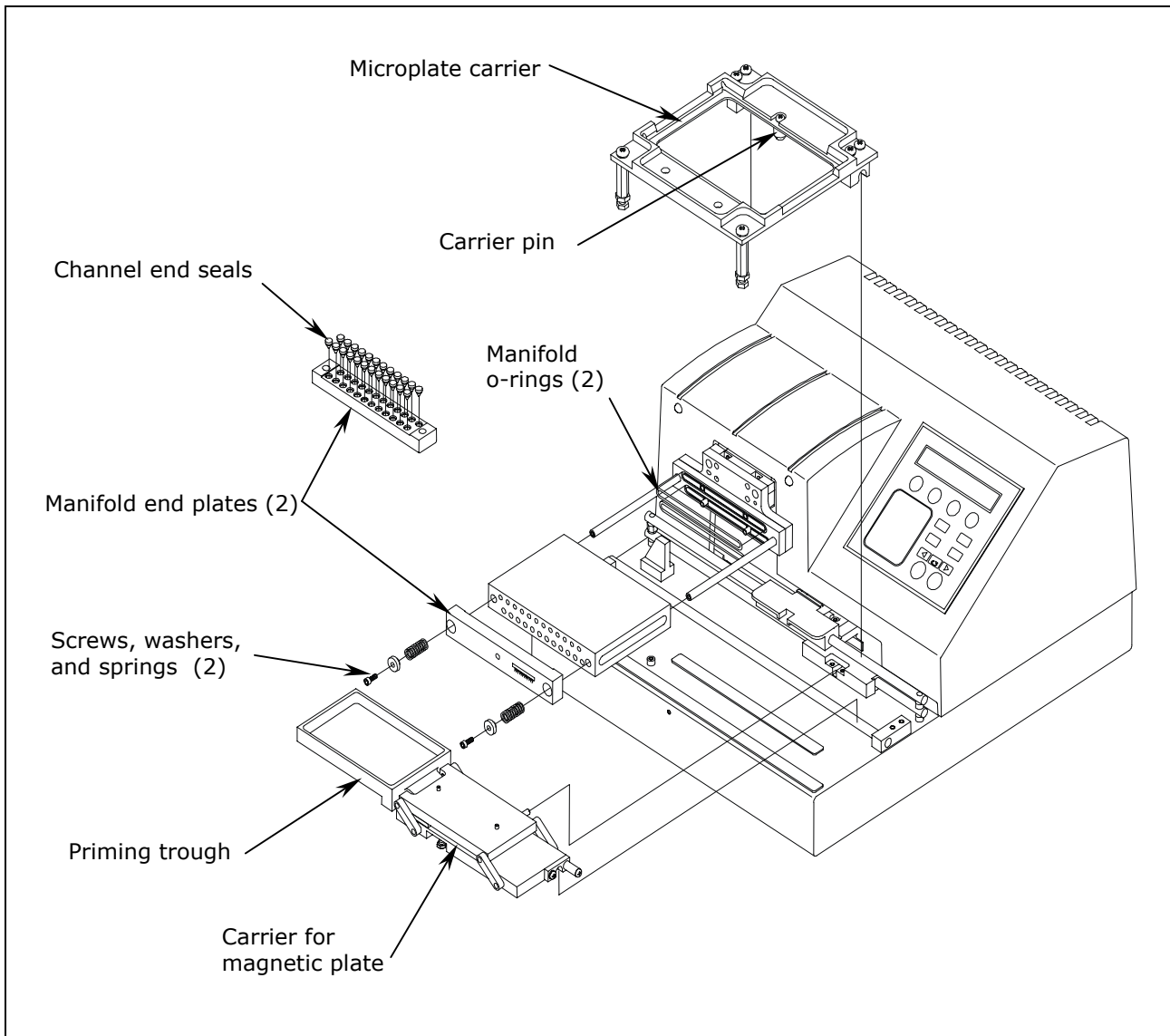


Figure 27: Carrier and Manifold Placement in the Magna Model

AUTOCLEAN (for Ultrasonic Advantage™ models only)

Warning! Ultrasonic energy is present in the cleaning reservoir when an AUTOCLEAN program is running. **Do not put your fingers in the bath!** Ultrasonic energy can be destructive to human tissue.



Important! Ensure that adequate room exists in the vacuum bottle and adequate volume is available in the supply bottle **before** running an AUTOCLEAN program!

Ultrasonic Advantage™ models feature a built-in **ultrasonic cleaner** that provides enhanced periodic maintenance capabilities by using ultrasonic pulses in a water bath to clean residuals from the manifold tubes. Ultrasonic energy causes cavitation forces within the water bath, which in turn cause tiny vapor bubbles to be created. The formation and subsequent collapse of these bubbles is the mechanism that cleans manifold tubes submerged in the bath.

The cleaner consists of a stainless steel reservoir with an ultrasonic transducer bonded to the bottom of the reservoir. The reservoir is mounted on the washer in the same position as the priming trough in other models.

❖ **Do not** try to remove the ultrasonic cleaner! Only Bio-Tek authorized service personnel should remove the ultrasonic cleaner for maintenance or repair.

The onboard **AUTOCLEAN (AUTCL)** function in the Utility menu enables you to define and run an ultrasonic cleaning program that includes one or more cleaning “loops.” Use multiple loops if you want to clean with more than one type of fluid.

AUTOCLEAN Parameter	Selectable Range
Number of Loops	1-10 loops
Duration of each loop	1-60 minutes
Supply bottles	A-D for valve modules

- ❖ **Tip:** Detergent such as Terg-A-Zyme[®] added to deionized water in the supply bottle helps to break down the water's surface tension and enhances the cleaning process.

Terg-A-Zyme[®] also contains protease enzyme for assimilating proteinaceous residue such as bovine serum albumin (BSA).

Run one or more loops in the cleaning program for 30 minutes in each loop. Follow with a rinse loop using deionized water to remove the detergent from the system, or with a wash buffer to leave the instrument primed and ready for use.

Prepare the waste and supply bottles

Empty the waste bottle. Ensure that there is a **sufficient volume** of deionized water and detergent in the supply bottle(s): An AUTOCLEAN program initially primes the system with **200 ml** of fluid from the supply bottle specified for Loop 1; each cleaning loop fills the reservoir with approximately **93 ml** of fluid.

- ❖ Priming with 200 ml is always done for **each successive loop** in models without the valve module, and in models with the valve module, if the valve selection changes between loops.

Define the AUTOCLEAN program parameters:

From the washer's main menu, follow the path below:

- Washers not equipped with the **external valve module**:

UTIL → AUTCL → DEFINE →
 AUTOCLEAN NUM LOOPS: Enter **01** to **10** loops →
 LOOP <loop number> DURATION: Enter **01** to **60** minutes →
 OK TO SAVE PROGRAM? **YES**

- Washers equipped with the **external valve module**:

UTIL → AUTCL → DEFINE →
 AUTOCLEAN NUM LOOPS: Enter **01** to **10** loops →
 LOOP <loop number> DURATION: Enter **01** to **60** minutes →
 LOOP <loop number> VALVE: Select **A**, **B**, **C**, or **D** →
 OK TO SAVE PROGRAM? **YES**

Run the AUTOCLEAN program:

From the washer's main menu, select **UTIL → AUTCL → RUN.**

The program begins with a priming sequence. When priming is complete, the manifold lowers into the reservoir, the washer dispenses approximately 93 ml of fluid, and cleaning LOOP 01 begins. When the loop is complete, the washer aspirates the fluid from the reservoir.

If another loop is specified in the program, the washer is primed (only if valve selection changes or if operating without the valve module), fluid is dispensed, and the next loop begins. This process is repeated until all loops are complete.

❖ **Models without the valve module:** If more than one cleaning loop is defined, the washer will pause between loops and display "CONNECT SUPPLY <next loop number>" to allow you to switch supply bottles. Press the ENTER key to resume cleaning.

While the program is running, the ultrasonic cleaner will pulse on and off approximately every ten seconds (a 50% duty cycle), and you will hear a periodic "hissing" sound that indicates the ultrasonic energy is present.

When **PROGRAM COMPLETE** appears, select **REPEAT** to run the program again, or select **STOP** and press the **Main Menu** key.

Cleaning the Fluid Inlet Filter



Warning! Internal Voltage. Turn off and unplug the washer for all cleaning operations.

Periodically clean the fluid inlet filter (PN 49943) that is located next to the vacuum port on the rear panel of the instrument. To clean the filter:

1. Unscrew the fluid inlet fitting from the back of the washer (see **Figure 28**).
2. Note the orientation of the filter in the fitting (the cone-shaped end of the filter points “in” toward the instrument) and then remove the filter from the housing.
3. Wash the filter with hot water and a soft-bristled brush.
4. Rinse the filter, then replace it in the fitting and reinstall onto the rear of the instrument.

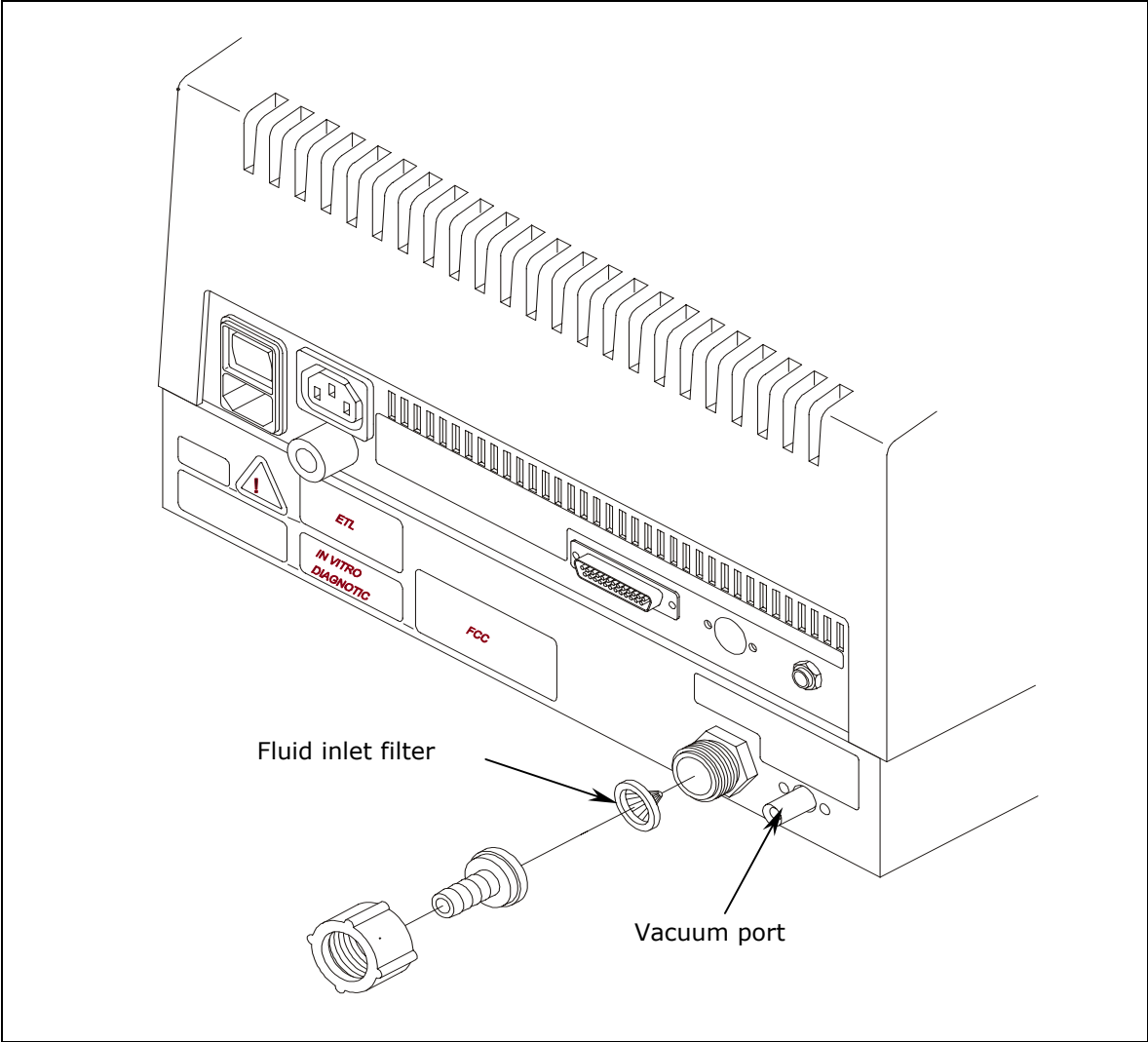








Figure 28: Cleaning the Fluid Inlet Filter

Decontaminate the Washer



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.

The recommended **frequency for decontamination** is at least monthly, and before shipment of the instrument to Bio-Tek for calibration or repair.

	<p>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.</p>
	<p>Warning! Internal Voltage. Turn off and unplug the instrument for all decontamination operations.</p>
	<p>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.</p> <p>Do not soak the keypad.</p>
	<p>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.</p>
	<p>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.</p>
	<p>HT models with the 96-tube manifold (HT2/HTV2): For routine maintenance, decontaminate the manifold (96- or 192-tube) most frequently in use. For shipment of the instrument to Bio-Tek for calibration or repair, decontaminate both manifolds.</p>

Decon Procedure for External Surfaces of the Instrument

	<p>The bleach solution is caustic; wear gloves and eye protection when handling this solution.</p>
	<p>Caution! Be sure to check the percent 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, prepare a 1:20 dilution. Household bleach is typically 5% NaClO; if this is the case, prepare a 1:10 dilution.</p>

1. Turn the washer off and disconnect the power cord. Empty the waste bottle.
2. Prepare an aqueous solution of 0.5% sodium hypochlorite (NaClO, or bleach). As an alternative, 70% isopropyl alcohol (or 70% ethanol) may be used if the effects of bleach are a concern.

❖ **Isopropyl alcohol** is not recommended for removing **proteins** (such as bovine serum albumin).

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.
 - Remove the washer's mist shield if it is attached. Wipe the inside and outside surfaces of the mist shield. Wipe the plate carrier, top surface of the instrument's base, supply bottles and tubing, and all exposed surfaces of the instrument.
4. Wait 20 minutes. Moisten a cloth with DI or distilled water.
 - Wipe the inside and outside surfaces of the mist shield. Wipe the plate carrier, top surface of the instrument's base, supply bottles, tubing, bottle covers and all exposed 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

The recommended onboard Maintenance program is DECONTAMINATION. This program flushes and soaks the supply tubing and manifold with disinfectant, then flushes the system with rinse, and finally purges the system of fluid.

The LONG_SHUTDOWN program primes and soaks the washer with the Prime Volumes and Soak Durations specified in the P_DECON1 and P_DECON2 prime programs. These Prime programs can be edited for optimum cleaning. Refer to the charts in the **Prime Programs** section of this chapter for a list of default parameters and to **Chapter 3, Operation**, for instructions on editing these parameters.

❖ Two supply bottles are required for this procedure: one for disinfectant, and one for rinse.



Caution! Be sure to check the percent 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, prepare a 1:20 dilution. Household bleach is typically 5% NaClO; if this is the case, prepare a 1:10 dilution.

1. Perform the decontamination procedure described on the previous page.
2. Turn the washer off and disconnect the power cord.
3. Empty the waste bottle.
4. Prepare an aqueous solution of 0.5% sodium hypochlorite (NaClO, or bleach).
5. Fill one supply bottle with at least 400 ml of bleach solution (disinfectant).
6. Fill another supply bottle with at least 800 ml of deionized water (rinse).
7. If the washer is equipped with the **external valve module**, connect the supply bottles this way:
 - Valve A: Disinfectant bottle
 - Valve B: Rinse solution bottle
8. Reconnect the power cord and turn on the washer.
9. To run the DECONTAMINATION program, follow this sequence:

❖ While this program is running, you will need to periodically check the display panel and follow the instructions.

Washer not equipped with the **external valve module**:

MAINT → SELECT MAINT PROGRAM: → **DECONTAMINATION** →
CONNECT DISINFECTANT AND PRESS <**START**> KEY
RUNNING: DECONTAMINATION/ DISINFECTING →
CONNECT RINSE BOTTLE AND PRESS <**START**> KEY

Washer equipped with the **external valve module**:

MAINT → SELECT MAINT PROGRAM: → **DECONTAMINATION** →
DISINFECTANT VALVE? **A B C** or **D** → RINSE VALVE?
A B C or **D** → START MAINTENANCE? **YES**

Alternate Decontamination Procedure for Tubing and Manifold

If you are unable to run the DECONTAMINATION program due to a system failure, perform the following alternate decontamination procedure to disinfect the internal tubing and manifold.



Caution! Be sure to check the percent 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, prepare a 1:20 dilution. Household bleach is typically 5% NaClO; if this is the case, prepare a 1:10 dilution.

1. Turn the washer off and disconnect the power cord.
2. Remove the mist shield, if it is attached:
 - Using your fingers, loosen the two thumbscrews on the shield (**use no tools**).
 - Lift the shield off the two posts.
 - Refer to **Decon Procedure for External Surfaces of the Instrument** on page 129 for decontamination of the mist shield.

❖ Use extra care when removing the **Select, HT, and Select CW** dual manifolds. Hold the two manifolds (and end plates) together as a single unit when removing or replacing.
3. Using the 9/64" (3.57 mm) hex wrench, remove the screws, washers, and springs that hold the manifold(s) in place (see **Figures 25, 26, and 27**). Remove the manifold(s) and end plates.
4. Prepare an aqueous solution of 0.5% sodium hypochlorite (bleach). As an alternative, 70% isopropyl alcohol (or ethanol) may be used if the effects of bleach are a concern.

❖ **Isopropyl alcohol** is not recommended for removing **proteins** (such as bovine serum albumin).
5. Soak the tubing and manifold in the bleach or alcohol solution.
6. Wait 20 minutes. Rinse the tubing and manifold with DI or distilled water.
7. Use a clean, dry cloth to dry all wet surfaces of the tubes and manifold.



Caution. When reinstalling the manifold, only tighten the screw-washer-spring assembly that holds it in place until you feel the mechanical stop. You will damage the instrument if you continue tightening past this point, and will **void your warranty**.

8. Reassemble the manifold and end plates, making sure that the two o-rings are in place prior to reassembly. **Do not overtighten the manifold screws.**
9. Re-attach the mist shield:
 - Align the mist shield with the washer so it is resting on top of the two posts, and the two thumbscrew holes in the shield are lined up with the two holes in the front base of the washer. (Refer to **Figure 16** in the section **Attaching the Mist Shield, Chapter 2.**)
 - Insert the two thumbscrews and finger-tighten only (**use no tools**).
10. Prime the system by running DAY_RINSE or a similar Maintenance or Prime program. Watch for leaks. If fluid leaks out of the back of the instrument, firmly seat the tubing. If fluid leaks from the manifold, try disassembling and carefully reassembling.
11. Discard the used gloves and cloths using a Biohazard trash bag and an approved Biohazard container.
12. Verify dispenser performance visually or by performing the **Dispense Precision Test** in **Chapter 5, Performance Verification/Qualification Tests**.

Prepare for Storage or Shipment

Before the washer is shipped or stored, it should be rinsed and soaked with disinfectant and then purged of all fluid. Perform these steps when leaving the washer unused for a long period of time.

Long_Shutdown

The recommended onboard Maintenance program is LONG_SHUTDOWN. This program flushes and soaks the supply tubing and manifold with disinfectant, then flushes the system with rinse, and finally purges the system of fluid.

❖ **For the ELx405™ HT2/HTV2:** Before switching from one manifold to another (e.g., before removing the 192-tube manifold and installing the 96-tube manifold), Bio-Tek recommends that you perform this procedure to thoroughly clean whichever manifold will be removed and stored.

The LONG_SHUTDOWN Maintenance program primes and soaks the washer with the Prime Volumes and Soak Durations specified in the P_DECON1 and P_DECON2 Prime programs. These prime programs can be edited for optimum cleaning. Refer to the charts in the **Prime Programs** section of this chapter for a list of default Prime program parameters and to **Chapter 3, Operation**, for instructions on editing these parameters.

❖ Three supply bottles are required for this procedure: one for disinfectant, one for rinse, and one for air.



Caution! Be sure to check the percent 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, prepare a 1:20 dilution. Household bleach is typically 5% NaClO; if this is the case, prepare a 1:10 dilution.

1. Turn off the instrument. Empty the waste bottle.
2. Prepare an aqueous solution of 0.5% sodium hypochlorite (NaClO, or bleach).
3. Fill one supply bottle with at least 400 ml of bleach solution (disinfectant).
4. Fill another supply bottle with at least 800 ml of deionized water (rinse).
5. Keep the third supply bottle empty (air).

6. If the washer is equipped with the **external valve module**, connect the supply bottles this way:
 - Valve A: Disinfectant bottle
 - Valve B: Rinse solution bottle
 - Valve C: Empty bottle
7. Turn on the washer.
8. To run the LONG_SHUTDOWN program, follow this sequence:

❖ While this program is running, you will need to periodically check the display panel and follow the instructions.

Washers not equipped with the **external valve module**:

MAINT → SELECT MAINT PROGRAM: → **LONG_SHUTDOWN** →
CONNECT DISINFECTANT AND PRESS <**START**> KEY

Washers equipped with the **external valve module**:

MAINT → SELECT MAINT PROGRAM: → **LONG_SHUTDOWN** →
DISINFECTANT VALVE? **A** → RINSE VALVE? **B** → AIR VALVE? **C** →
START MAINTENANCE? **YES**

Storing the Washer

After performing the **Long_Shutdown** procedure:

1. Turn off the washer and disconnect the power cord.
2. Store the washer on a flat surface that is relatively free of vibration, in a dust-free and particle-free environment.
3. Protect the washer from temperature extremes that can cause condensation within the unit and from corrosive fumes and vapors.
4. Store the washer under the following environmental conditions:

Temperature: -20° to 50°C (-4° to 122°F)

Relative humidity: 10% to 85% (non-condensing)

Replace Components

Replacing the O-Rings and Channel-End Seals

For optimal performance and to extend the life of the washer, replace the manifold o-rings once a year and replace the 12 (or 24) rubber plugs (seals) on the channel ends if they show signs of cracking or drying out. Order the replacement o-rings and seals from Bio-Tek (see page 104).

You must remove the manifold to change the seals, so these tasks work best in conjunction with the ***Cleaning the Manifold, Mist Shield, and Tubing*** procedure on page 118.

Replacing the O-Rings

After completing Step 9 of the procedure on page 119:

1. Using your fingers or an appropriate tool, such as a very small, flat screwdriver, remove the two o-rings that are exposed when the manifold is removed.
2. Replace the used o-rings with new ones by fitting them into the grooved slots.
3. If you are not replacing the channel end-seals at this time, reinstall the manifold. **Do not overtighten the manifold screws.**



Caution: When reinstalling the manifold, only tighten the screw-washer-spring assembly that holds it in place until you feel the mechanical stop. You will damage the instrument if you continue tightening past this point.

Replacing/Cleaning the Channel-End Seals

Cleaning or replacing the channel-end seals is most easily and efficiently accomplished in conjunction with ***Cleaning the Manifold, Mist Shield, and Tubing*** procedure on page 118. If the channel-end seals do not need to be replaced, they should be washed with mild detergent or alcohol.

1. If you haven't already done so, remove the manifold end plate to access the channel-end seals as described in Step 7 on page 119, when removing the manifold(s). See **Figure 29** on the following page.

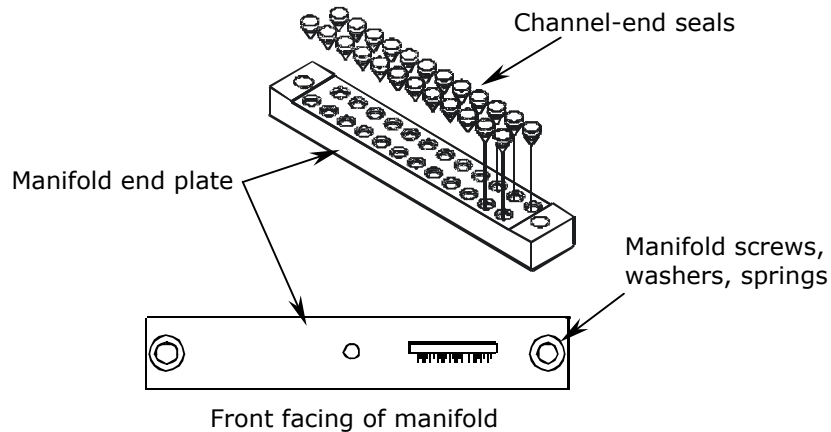


Figure 29: Replacing the Channel-End Seals

The manifold end plate sits in front of the manifold and holds the screws, washers, and springs that hold the manifold in place. The channel-end seals sit in bored holes in the backside of the plate, facing the manifold's channels. The manifold end plate has markings to indicate its position relative to the manifold, e.g., Top or Bottom.

2. Using an appropriate tool, such as a very small, flat screwdriver or a paper clip, remove the seals from the manifold end plate.



Caution: Do not grease any parts of this mechanism. Lubricate the seals and the bored holes with alcohol to assist with reinsertion.

3. Clean the seals if you are not replacing them with new ones.
4. Lubricate both the seals and the bored holes with 70% isopropyl alcohol to facilitate insertion of the seals. Make sure the seals sit firmly in the bored holes in the manifold end plate.

❖ The 9/64" (3.57 mm) hex wrench shipped with the washer is useful for reinserting the seals into the bored holes.

5. When all of the seals are in place, reinstall the manifold end plates and the manifold. **Do not overtighten the manifold screws.**



Caution: When reinstalling the manifold, only tighten the screw-washer-spring assembly that holds it in place until you feel the mechanical stop. You will damage the instrument if you continue tightening past this point.

Chapter 5

Performance Verification/ Qualification Tests

This chapter describes how to verify the performance of the ELx405™ Microplate Washer.

Overview	140
Verification Schedule	141
Installation Qualification (IQ).....	142
Operational Qualification (OQ)	142
Performance Qualification (PQ)	143
System and Checksum Tests	144
Liquid Tests	146

Overview

Instrument verification for the ELx405™ involves three activities: qualification of installation and setup, qualification of routine capability, and qualification of long-term stability. This chapter refers to these activities as Installation Qualification (**IQ**), Operational Qualification (**OQ**), and Performance Qualification (**PQ**), respectively.

Verification testing of the washer includes the **System Self Test** and **Checksum Test**, and liquid testing for **Evacuation Efficiency** and **Dispense Precision**. For washers equipped with the optional valve module, instrument verification includes Dispense Precision tests for the valve module.

- The **System Self Test** verifies system components, such as the vacuum, manifold, and carrier positioning. The **Checksum Test** verifies the basecode software against internal checksum values to ensure that no corruption has occurred. If the Checksum Test is run manually, part number and version information is displayed for the software on the instrument.
- **Evacuation Efficiency.** This test measures the residual volume per well after the aspiration aspect of plate washing. The lower the residuals per well, the better the evacuation efficiency of the washer.
- **Dispense Precision.** This test measures the variability of volumes dispensed from tube to tube across the manifold.
- **Dispense Precision, Valve Module.** The Dispense Precision Test for the external valve module measures the variability of volumes dispensed from tube to tube across the manifold, when the washer is used with the valve module.

❖ The Ultrasonic Advantage™ (ultrasonic cleaner) does not require qualification testing.

Verification Schedule

The following schedule defines the factory-recommended intervals for verification tests for a washer used two to five days a week. The schedule assumes that the washer is properly maintained as outlined in **Chapter 4, Preventative Maintenance**.

Recommended Instrument Verification Schedule

Tests	IQ	OQ		PQ
	Initially	Initially	Annually	Monthly
System Self Test and Checksum Test	✓	✓	✓	✓
Evacuation Efficiency		✓	✓	✓
Dispense Precision (without valve module)		✓	✓	✓
Dispense Precision (with valve module)			✓	
Note: Refer to page 147 to determine which tests to perform.				



Important! The risk factors associated with your assays may require that the Operational and Performance Qualification procedures be performed more or less frequently than shown above.

❖ **Note:** An **instrument qualification package** (PN 7100567) for the washer is available for purchase. The package contains thorough procedures for performing Installation Qualification, Operational Qualification and Performance Qualification (IQ-OQ-PQ) and preventative maintenance (PM). Extensive Checklists and Logbooks are included for recording results. Contact your local dealer for more information.

Installation Qualification (IQ)

Installation Qualification confirms that the washer and its components have been supplied as ordered and ensures that they are assembled and configured properly for your lab environment.

- The recommended IQ procedure consists of setting up the instrument as described in **Chapter 2, Installation** and then performing the System Self-Test and the Checksum test.
- The IQ procedure should be performed *initially* (before the washer is used for the first time).
- The successful completion of the IQ procedure verifies that the instrument is installed correctly. The Operational Qualification procedure should be performed immediately following the successful IQ (see below).

Operational Qualification (OQ)

Operational Qualification confirms that the washer operates according to specification initially and over time.

- The recommended OQ procedure consists of performing the System Self-Test and the Checksum, Evacuation Efficiency, and Dispense Precision tests.
- Your facility's operating policies may also require that you perform an actual assay prior to accepting the washer for routine use. You should not use the data obtained from the first assay that utilizes the washer until you have confirmed that the package insert criteria have been met.
- The OQ procedure should be performed *initially* (before first use) and then routinely; the recommended interval is *annually*. It should also be performed after any major repair or upgrade to the hardware or software.
- Although out-of-tolerance failures will be detected by the OQ tests, results should be compared with those from the monthly Performance Qualification tests and previous OQ tests to monitor for trends.
- The successful completion of the OQ procedure, in combination with results that are comparable to previous PQ and OQ tests, confirms that the washer is performing consistently over time.

Performance Qualification (PQ)

Performance Qualification confirms that the washer consistently meets the requirements of the tests performed at your laboratory.

- The recommended PQ procedure consists of performing the System Self-Test and the Checksum, Evacuation Efficiency, and Dispense Precision tests.
- Your facility's operating policies may also require that you routinely perform an actual assay, to confirm that the washer will consistently give adequate results for the assays to be run with it.
- These tests should be performed routinely; the recommended interval is *monthly*. This frequency may be adjusted depending on the trends observed over time.
- The successful completion of the PQ procedure confirms that the washer is performing consistently under normal operating conditions.

System and Checksum Tests



The information from the System and Checksum Tests is important if you need to contact Bio-Tek.

The **System Self Test** and **Checksum Test** are performed automatically whenever the washer is powered on. They can also be run manually via the washer's keypad.

System Self Test

The System Self Test checks the vacuum (when run manually), manifold, and manifold-to-carrier positioning.

For the **Magna**, a magnetic carrier test is also performed. This test moves the magnet holder to the extreme left and most vertical position and then back to home where a "position verify" command is executed. If the magnet holder loses steps when making these moves, the "position verify" will generate an error code, failing the test.

To run the System Self Test:

At the Main Menu, select UTIL → TESTS → **SELFCHK**.

The following screen will appear while the test is running:

```
SYSTEM TEST RUNNING. . .  
PLEASE WAIT. . . .
```

If the test passes, the Main Menu will be displayed.

If the test fails, the washer will beep repeatedly and the display will show an error code. If this happens, write down the error code and then press the **Stop** key on the keypad to stop the beeping. Look up the error code in **Appendix B, Error Codes**, to determine its cause. If the problem is something you can fix, turn off the washer, fix the problem, and then turn the washer back on. If the cause is not something you can fix, contact Bio-Tek's Technical Assistance Center.

Checksum Test

The Checksum Test compares the on-board software with an internally recorded checksum value to ensure the program has not become corrupted.

To run the Checksum Test:

At the Main Menu, select UTIL → TESTS → **CHKSUM**.

The first screen will display the **onboard (basecode) software** part number, version number, and checksum:

```
7100xxx Version x.xx  
CODE CHECKSUM: (xxxx)
```

After a few seconds, a second screen will display the **assay software** part number and version number:

```
7100xxx Version x.xx
```

The Main Menu will be displayed after the test is finished.

❖ **If you need to provide the Checksum information to TAC:** Since the above screens are displayed only briefly, you may have to run the Checksum Test a few times to record all of the required information.

Liquid Tests



HT models with the accessory 96-tube manifold: Ensure that the washer is configured for operation with the correct manifold (**96** or **192**) (refer to **Manifold Selection** in **Chapter 3, Operation**). Failure to set the correct manifold type in the software *before* operating the washer may damage the manifold and **void your warranty**.

Evacuation Efficiency Test

The Evacuation Efficiency test measures the **residual volume** (mean residual weight) per well after the aspiration aspect of plate washing. The lower the residual per well, the better the evacuation efficiency of the washer.

A known solution is dispensed into all wells of a previously weighed microplate. The aspiration program is run and the plate is reweighed in order to calculate the total residual fluid based on the weight difference. The total residual fluid weight is divided by 96 or 384 as appropriate to obtain the **mean residual weight**.

If further testing is necessary (to identify “problem” wells), the supplemental test is performed. A concentrated dye solution is dispensed to/evacuated from the wells, and the plate is weighed. Buffer is then pipetted to all wells to bring the volume of fluid to a consistent measurement level. The optical density of each well is measured at 630 nm and the background at 450 nm is subtracted to account for scratches on the plate or particulates in a well. Each well’s residual volume is calculated using its optical density and a calibration factor derived from the mean residual weight and the mean optical density of all wells on the plate. It is assumed that 1 mg = 1 μ l of fluid for this calculation.

Dispense Precision Test

The Dispense Precision Test measures the **variability of the volumes dispensed** from tube to tube across the manifold. In this test, a blue dye solution is dispensed into a microplate. The optical density of each well is measured at 630 nm and the background at 450 nm is subtracted to account for scratches on the plate or particulates in the well. The average error percentage is calculated and the amount dispensed to each well is calculated.

Acceptance is based on the **%CV** (%Coefficient of Variation), or the ratio of the standard deviation of the distribution of fluid volumes in the wells to the mean value of volume per well. The lower the %CV, the better the uniformity across the manifold.

Valve Module Test

The Dispense Precision test is conducted for the external valve module to ensure that each valve (A, B, C, D) in the module is calibrated to deliver the same volume of fluid.

Which Tests to Perform?

Which tests you will perform depend on the **washer model**, which **manifold type** is installed on it, and whether or not the washer is equipped with the external **valve module**. Please refer to the chart below to determine which tests to perform.

Washer Model	Manifold Type	Valve Module?	Liquid Tests to Perform	Page
405, Magna	Single/96	No	Evacuation Efficiency Test Dispense Precision Test, without Valve Module	150 153
		Yes	Evacuation Efficiency Test Dispense Precision Test, with Valve Module	150 154
Select, Select CW	Dual/96	No	Evacuation Efficiency Test Dispense Precision Test, without Valve Module	150 153
		Yes	Evacuation Efficiency Test Dispense Precision Test, with Valve Module	150 154
HT	Dual/192	No	Evacuation Efficiency Test (192) Dispense Precision Test (192), without Valve Module	157 160
		Yes	Evacuation Efficiency Test (192) Dispense Precision Test (192), with Valve Module	157 161
	Dual/96 (HT2/HTV2 only)	No	Evacuation Efficiency Test Dispense Precision Test, without Valve Module	150 153
		Yes	Evacuation Efficiency Test Dispense Precision Test, with Valve Module	150 154

Materials

- One clean, dry microplate per test to be performed:

Microplate Type	Liquid Tests
Corning® Costar #3590 96-well plates	Evacuation Efficiency Test
	Dispense Precision Test
	Dispense Precision Test, with Valve Module
Corning Costar flat-bottom 384-well plates	Evacuation Efficiency Test (192)
	Dispense Precision Test (192)
	Dispense Precision Test (192), with Valve Module

- Precision balance with minimum capacity of 100 g and readability of 0.01 g resolution
- Pipettes and graduated beakers
- Microplate absorbance reader capable of dual wavelength reading at 630/450 nm
- Liquid Test Worksheets at the end of this chapter for recording data and results
- Deionized water
- Test solutions:

If this manifold is installed:	Prepare these solutions, using the recipes on the next page:			
	Sol. #1	Sol. #2	Sol. #3	Sol. #4
Single/96 or Dual/96	1 batch (1000 ml)	1 batch (100 ml)	1 batch (1200 ml)	n/a
Dual/192	1 batch (1000 ml)	1 batch (100 ml)	n/a	1 batch (1440 ml)

- ❖ These volumes are sufficient for performing the standard and supplemental Evacuation Efficiency tests, plus the Dispense Precision test. In most cases, enough fluid will be left over to re-run a test, if necessary.
- ❖ If you will be performing the **annual OQ** with the **external valve module**, you will need several additional liters of deionized water.

Test Solutions

SOLUTION #1: Buffer Solution

Pipette 1 ml Tween 20[®] into 1 liter (1000 ml) of deionized water and mix well. **or** Pipette 10 ml of Bio-Tek Wetting Agent (PN 7773002) into 1 liter of deionized water and mix well.

SOLUTION #2: Evacuation Efficiency (Residual) Test Solution

Mix 100 ml of **Solution #1** with 0.050 grams of FD&C #1 blue dye. **or** Mix 90 ml of **Solution #1** with 10 ml of Bio-Tek Blue Test Dye (PN 7773001).

SOLUTION #3: Dispense Precision Test Solution (Single/Dual 96 manifolds)

Mix 1180 ml of deionized water with 20 ml of **Solution #2**.

SOLUTION #4: Dispense Precision Test Solution (Dual 192 manifold)

Mix 1420 ml of deionized water with 20 ml of **Solution #2**.

- ❖ You may use your own buffer solution in place of **Solution #1**. If any tests fail using your own buffer, however, retry the tests using the suggested solutions. Using pure DI water in place of Solution #1 is *not* recommended and will likely result in the failure of the unit to meet specifications.
 - ❖ **Important:** The factory determined the pass/fail specifications for the following tests using the test solutions described above.
 - ❖ **Bio-Tek PN 7773002** (Solution #1 100X Concentrate Wetting Agent 125 ml) contains 10% Tween 20 in deionized water and 0.01% Sodium Azide as a preservative.
- Bio-Tek PN 7773001** (Solution #2 10X Concentrate Blue Test Dye 125 ml) contains 5 g per liter FD&C Blue #1, 0.1% Tween 20 in deionized water, and 0.01% Sodium Azide as a preservative.

Evacuation Efficiency Test (96)

- ❖ This test is designed for **Single/96** or **Dual/96** manifolds. See page 157 if you're looking for the Evacuation Efficiency Test for the Dual/192 manifold.
- ❖ See page 148 for a list of required materials.

1. Fill a supply bottle with two liters of deionized water. Run the Maintenance program **DAY_RINSE** two or three times to prime the fluid lines and manifold.
2. Place a clean, dry 96-well microplate on the balance and zero the balance.
3. Pipette or dispense 150 μ l of **Solution #1** into each well of the microplate.
4. Place the plate on the washer and run the Aspirate program **residual_qc_test**. This program evacuates all of the wells, leaving a small amount of residual fluid.
5. When the program is finished, remove the plate and weigh it immediately, because evaporation will affect the results. This is the **Total Residual Weight**, in grams.
6. Visually inspect the plate and note if any wells appear to have considerably more liquid in them than others.
7. Using the **Evacuation Efficiency Test Worksheet** on page 164, perform initial data reduction:
 - a. Divide the Total Residual Weight by **96** to find the **Mean Residual Weight**.
 - b. The Mean Residual Weight should be \leq **0.005 g**.

If the Mean Residual Weight is *greater than* 0.005 g, or if one or more wells appear to have much more liquid than the others, the washer failed the test.

Troubleshoot as follows:

- If the test fails once: Failure of this test is commonly caused by improper aspiration tube placement within the wells, usually because a microplate other than the recommended Corning Costar® 96 was used.

- If you prefer to use a plate *other than* the Corning Costar 96, modifying the ASPIRATE HEIGHT or HORIZONTAL ASPIRATE POSITION parameters in a copy of the **residual_qc_test** program should correct this error (residual_qc_test is locked for editing, but you can copy the program and edit its parameters in the newly created copy). See **Chapter 3, Operation**, for instructions on copying and editing programs and modifying the abovementioned parameters. After making this change, retry the test using a clean, dry microplate.
- If you *are* using the Corning Costar 96 microplate, run **AUTOCLEAN** (Ultrasonic Advantage™ models only), and/or remove the manifold and clean the aspiration tubes with the stylus (all models). See **Chapter 4, Preventive Maintenance** for complete instructions. When finished, retry the test using a clean, dry microplate.
- If the test fails a second time: Perform the **Supplemental Test** below.

Supplemental Test

Conduct this test if the Standard Evacuation Efficiency Test fails twice. This test will confirm which aspirate tube(s) may be clogged, or if the plate's alignment or position is the problem.

1. Repeat steps 2 through 7 of the previous test, using **Solution #2** for the dispense fluid. Be sure to recalculate the **Mean Residual Weight**.
2. Pipette 300 µl of **Solution #1** into each well, on top of the residual solution.
3. Shake the plate to get uniform distribution of the remaining dye in each well.

❖ If you are using one of Bio-Tek's keypad-based readers, such as the ELx800™ or ELx808™, ensure that the reader is **not** running in **Rapid mode**. To check the setting, select UTIL → READ and cycle through the options until READ IN RAPID MODE? appears. Set it to **NO**.

4. Read the plate in an optical reader (blank on air), using the dual-wavelength method (630 nm - 450 nm), then print or export the results.
5. Using the **Evacuation Efficiency Test Worksheet** on page 164, perform data reduction:
 - a. Calculate the sum of the OD values for all 96 wells, then divide by **96** to determine the **Mean OD** for the plate.
 - b. Divide the Mean OD by the **Mean Residual Weight** (from step 1), to find the **Residual Factor**.

- c. For each well, divide its OD value by the Residual Factor to find its **Residual Weight**.

Each well's Residual Weight should be **≤ 0.005 g**.

If one or more wells has a Residual Weight *greater than* 0.005 g, review the data to determine which well, or wells, is causing the problem.

- If the problem appears to be related to particular wells, clean the associated aspiration tubes: run **AUTOCLEAN** (Ultrasonic Advantage™ models only), and/or remove the manifold and thoroughly clean the tubes with the stylus (all models). See **Chapter 4, Preventive Maintenance** for complete instructions. When finished, retry the test.
- If the problem appears to be related to a particular region, edge, or corner of the plate, review the alignment and flatness of the plate on the carrier.

❖ **Please do not adjust** the carrier adjustment screws! Contact your Bio-Tek dealer if you suspect an alignment problem.

- For additional suggestions, see **Appendix A, Troubleshooting**.
- If the test continues to fail, contact Bio-Tek Instruments.

Dispense Precision Test (96)

- ❖ This test is designed for **Single/96** and **Dual/96** manifolds. See page 160 if you're looking for the Dispense Precision Test for the Dual/192 manifold.
- ❖ See page 148 for a list of required materials.

Without the Valve Module

1. Fill a supply bottle with two liters of deionized water. Run the Prime program **P_DAY_RINSE** two or three times to prime the fluid lines and manifold.
2. Fill a supply bottle with 1200 ml of **Solution #3**.
3. Run **P_DAY_RINSE** to prime the washer with the solution.
4. Place a clean, dry 96-well microplate on the washer and run the Dispense program **accuracy_qc_test**. This program dispenses 300 µl of solution to each well of the plate. It does not evacuate the solution.
5. When the program is finished, carefully remove the plate.

- ❖ If you are using one of Bio-Tek's keypad-based readers, such as the ELx800™ or ELx808™, ensure that the reader is **not** running in Rapid mode. To check the setting, select UTIL → READ and cycle through the options until READ IN RAPID MODE? appears. Set it to **NO**.

6. Read the plate in an optical reader (blank on air), using the dual-wavelength method (630 nm - 450 nm), then print or export the results.
7. Using the **Dispense Precision Test Worksheet** on page 165, perform data reduction:
 - a. Calculate the **Standard Deviation**.
Tip: If you have a spreadsheet software program, enter/export all 96 values into a spreadsheet and apply your program's Standard Deviation function (e.g., Microsoft Excel's STDEV).
 - b. Calculate the sum of the OD values for all 96 wells, then divide by **96** to determine the **Mean OD** for the plate.
 - c. Calculate the **%CV**: (Standard Deviation / Mean OD) * 100.
 The %CV should be **<= 4.0**.

If the %CV is *greater than 4.0*, one or more dispense tubes may need to be cleaned. Run **AUTOCLEAN** (Ultrasonic Advantage™ models only), and/or remove the manifold and use the stylus to clean the dispense tube(s) giving lower-than-average absorbance readings (all models). When finished, re-prime the washer and retry the test.

8. When finished, prime with deionized water to flush out the dye solution.

With the Valve Module

Routine Procedure for Valve A

❖ Perform this test during the **initial/annual OQ**, and the **monthly PQ**.

1. Fill the supply bottle for **Valve A** with two liters of deionized water. Run the Maintenance program **DAY_RINSE** two or three times to prime the fluid lines and the manifold.
2. Fill the supply bottle for Valve A with 1200 ml of **Solution #3**.
3. Run **DAY_RINSE** to prime **Valve A** with the solution.
4. Place a clean, dry 96-well microplate on the washer and run the Dispense program **accuracy_qc_test**. This program dispenses 300 µl of solution to each well of the plate. It does not evacuate the solution.
5. When the program is finished, carefully remove the plate.

❖ If you are using one of Bio-Tek's keypad-based readers, such as the ELx800™ or ELx808™, ensure that the reader is **not** running in Rapid mode. To check the setting, select UTIL → READ and cycle through the options until READ IN RAPID MODE? appears. Set it to **NO**.

6. Read the plate in an optical reader (blank on air), using the dual-wavelength method (630 nm – 450 nm), then print or export the results.
7. Using the **Dispense Precision Test Worksheet** on page 166, perform data reduction:

- a. Calculate the **Standard Deviation**.

Tip: If you have a spreadsheet program, enter/export all 96 values into a spreadsheet and apply your program's Standard Deviation function (e.g., Microsoft Excel's STDEV).

- b. Calculate the sum of the OD values for all 96 wells, then divide by **96** to determine the **Mean OD** for the plate.
- c. Calculate the **%CV**: (Standard Deviation / Mean OD) * 100.

The %CV should be **<=4.0**.

If the %CV is *greater than* 4.0, one or more dispense tubes may need to be cleaned. Run the **AUTOCLEAN** (Ultrasonic Advantage™ models only), and/or remove the manifold and use the stylus to clean the dispense tube(s) giving lower-than-average absorbance readings (all models). When finished, re-prime the washer and retry the test.

8. When finished, prime with deionized water to flush out the dye solution.

Annual Procedure for All Valves

- ❖ Perform this test during the **annual OQ** only.
- ❖ The **routine** test for Valve A (see previous page) must pass before the **annual** test for Valves A-D can be performed.

1. Empty the waste bottle now, and then as needed throughout this procedure.
2. Fill each of the supply bottles connected to **Valves A, B, C, and D** with three liters (3000 ml) of deionized water. Place the bottles on a surface level with the washer, i.e., the adjacent (lab bench) area.

Repeat the following steps for each valve:

3. Run the Maintenance program **DAY_RINSE** two or three times to prime the fluid lines, manifold, and the valve being tested.

- ❖ ELx405 **standard** models (Single/96 manifold): See the note on the next page before performing step #4.

4. Edit the Dispense program **accuracy_qc_test** to use the Valve currently being tested (**DEFINE** → **EDIT** → **DISP** → **accuracy_qc_test**).
5. Place a clean, dry 96-well microplate on the balance and zero the balance.
6. Place the microplate on the carrier and run the Dispense program **accuracy_qc_test**. This program dispenses 300 µl of water to each well of the plate. It does not evacuate the wells.
7. When the program is finished, carefully remove the plate and weigh it. This is the **Total Dispense Weight** in grams.
 - The weight should be **28.8 grams, ± 10%** (between 25.92 g and 31.68 g).
 - If the weight falls outside this range, contact Bio-Tek.

- If the weight falls below this range, the fluid inlet filter could be clogged, or the valve may be contaminated with fungi or proteins. See ***Cleaning the Fluid Inlet Filter*** in **Chapter 4, Preventive Maintenance**, for recommendations on cleaning the filter. The valve should be cleaned using an appropriate enzyme, alcohol, or a diluted bleach solution, depending on the contaminant. See ***Removing Protein Residuals and Fungi Growth*** and ***Decontamination*** in **Chapter 4** for suggestions.

After cleaning the fluid inlet filter or valve and tubing, retry the test. If the test continues to fail, contact Bio-Tek.

8. Record the results in the ***Dispense Precision Test Worksheet*** on page 166.

❖ For the ELx405™ standard model only, the accuracy_qc_test program is locked for editing; it can only be used to test Valve A. In order to test all four valves, you'll need to create a copy of this program. You will then edit the copy when performing step #4.

To copy the test program:

- Select **DEFINE → COPY → DISP.**
- When **accuracy_qc_test** appears, press the **Enter** key.
- When **NAME:** appears, use the keypad to enter an identifying name, such as **ACC_QC_TEST**.

Tip: Press **Shift** + a **number key** to type a letter. When the cursor is positioned under a letter, via the ► (forward) or ◀ (reverse) arrows, press the **Options** key to advance through the alphabet.

- When finished entering the name, press the **Enter** key.
- When **OK TO COPY?** appears, select **YES**.

Evacuation Efficiency Test (192)

- ❖ This test is designed for the **Dual/192** manifold. See page 150 if you're looking for the Evacuation Efficiency Test for Single/96 and Dual/96 manifolds.
- ❖ See page 148 for a list of required materials.

1. Fill a supply bottle with two liters of deionized water. Run the Maintenance program DAY_RINSE two or three times to prime the fluid lines and manifold.
2. Place a clean, dry 384-well microplate on the balance and zero the balance.
3. Pipette or dispense 80 µl of **Solution #1** into each well of the microplate.
4. Place the plate on the washer and run the Aspirate program **192resid_qc_test**. This program evacuates all of the wells, leaving a small amount of residual fluid.
5. When the program is finished, remove the plate and weigh it immediately, because evaporation will affect the results. This is the **Total Residual Weight**, in grams.
6. Visually inspect the plate and note if any wells appear to have considerably more liquid in them than others.
7. Using the **Evacuation Efficiency Test Worksheet** on page 167, perform initial data reduction:
 - a. Divide the Total Residual Weight by **384** to find the **Mean Residual Weight**.
 - b. The Mean Residual Weight should be **<= 0.002 g**.

If the Mean Residual Weight is *greater than* 0.002 g, or if one or more wells appear to have much more liquid than the others, the washer failed the test.

Troubleshoot as follows:

- If the test fails once: Failure of this test is most commonly caused by improper aspiration tube placement within the well, usually because a microplate other than the recommended Corning Costar® 384 was used.
 - If you prefer to use a plate *other than* the Corning Costar 384, modifying the ASPIRATE HEIGHT or HORIZONTAL ASPIRATE POSITION parameters in a copy of the **192resid_qc_test** program should correct this error. (192resid_qc_test is locked for editing, but you can copy the program and edit its parameters in the newly created copy.) See **Chapter 3, Operation**, for instructions on copying and editing programs and modifying the abovementioned parameters. After making this change, retry the test using a clean, dry microplate.

- If you *are* using the Corning Costar 384 microplate, run **AUTOCLEAN** (Ultrasonic Advantage™ models only), and/or remove the manifold and clean the aspiration tubes with the stylus (all models). See **Chapter 4, Preventive Maintenance** for complete instructions. When finished, retry the test using a clean, dry microplate.
- If the test fails a second time: Perform the **Supplemental Test** below.

Supplemental Test

Conduct this test if the Standard Evacuation Efficiency Test (192) fails twice. This test will confirm which aspirate tube(s) may be clogged, or if the plate's alignment or position is the problem.

1. Repeat steps 2 through 7 of the previous test, using **Solution #2** for the dispense fluid. Be sure to recalculate the **Mean Residual Weight**.
2. Pipette 80 µl of **Solution #1** into each well, on top of the residual solution.
3. Shake the plate to get uniform distribution of the remaining dye in each well.

❖ **Note:** If you are using one of Bio-Tek's keypad-based readers, such as the ELx800NB™, ensure that the reader is **not** running in **Rapid Mode**. To check the setting, select UTIL → READ and cycle through the options until READ IN RAPID MODE? appears. Set it to **NO**.

4. Read the plate in an optical reader (blank on air), using the dual-wavelength method (630 nm - 450 nm), then print or export the results.
5. Using the **Evacuation Efficiency Test Worksheet** on page 167, perform data reduction:
 - a. Calculate the sum of the OD values for all 384 wells, then divide by **384** to determine the **Mean OD** for the plate.
 - b. Divide the Mean OD by the **Mean Residual Weight** (from step 1) to find the **Residual Factor**.
 - c. For each well, divide its OD value by the Residual Factor to find its **Residual Weight**.

Each well's Residual Weight should be **<= 0.002 g**.

If one or more wells has a Residual Weight *greater than* 0.002 g, review the data to determine which well, or wells, is causing the problem.

- If the problem appears to be related to particular wells, clean the associated aspiration tubes: run **AUTOCLEAN** (Ultrasonic Advantage™ models only), and/or remove the manifold and thoroughly clean the tubes with the stylus (all models). See **Chapter 4, Preventive Maintenance** for complete instructions. When finished, retry the test.
- If the problem appears to be related to a particular region, edge, or corner of the plate, review the alignment and flatness of the plate on the carrier.

❖ **Please do not adjust** the carrier adjustment screws! Contact your Bio-Tek dealer if you suspect an alignment problem.

- For additional suggestions, refer to **Appendix A, Troubleshooting**.
- If the test continues to fail, contact Bio-Tek Instruments.

Dispense Precision Test (192)

- ❖ This test is designed for the **Dual/192** manifold. See page 153 if you're looking for the Dispense Precision Test for Single/96 and Dual/96 manifolds.
- ❖ See page 148 for a list of required materials.

Without Valve Module

1. Fill a supply bottle with two liters of deionized water. Run the Prime program **P_DAY_RINSE** two or three times to prime the fluid lines and manifold.
2. Fill a supply bottle with 1440 ml of **Solution #4**.
3. Run **P_DAY_RINSE** to prime the washer with the solution.
4. Place a clean, dry 384-well microplate on the washer and run the Dispense program **192accuracy_qc**. This program dispenses 80 µl of solution to each well of the plate. It does not evacuate the solution.
5. When the program is finished, carefully remove the plate.

- ❖ **Note:** If you are using one of Bio-Tek's keypad-based readers, such as the ELx800NB™, ensure that the reader is **not** running in **Rapid Mode**. To check the setting, select UTIL → READ and cycle through the options until READ IN RAPID MODE? appears. Set it to **NO**.

6. Read the plate in an optical reader (blank on air), using the dual-wavelength method (630 nm - 450 nm), then print or export the results.
7. Using the appropriate **Dispense Precision Test Worksheet** on page 168, perform data reduction:
 - a. Calculate the **Standard Deviation**.
Tip: If you have a spreadsheet software program, enter/export all 384 values into a spreadsheet and apply your program's Standard Deviation function (e.g., Microsoft Excel's STDEV).
 - b. Calculate the sum of the OD values for all 384 wells, then divide by 384 to determine the **Mean OD** for the plate.
 - c. Calculate the **%CV**: (Standard Deviation / Mean OD) * 100.
 The %CV should be **<= 4.0**.

If the %CV is *greater than 4.0*, one or more dispense tubes may need to be cleaned. Run **AUTOCLEAN** (Ultrasonic Advantage™ models only), and/or remove the manifold and use the stylus to clean the dispense tube(s) giving lower-than-average absorbance readings (all models). When finished, re-prime the washer and retry the test.

8. When finished, prime with deionized water to flush out the dye solution.

With the Valve Module

Routine Procedure for Valve A

❖ Perform this test during the **initial/annual OQ**, and the **monthly PQ**.

1. Fill the supply bottle for **Valve A** with two liters of deionized water. Run the Maintenance program **DAY_RINSE** two or three times to prime the fluid lines and the manifold.
2. Fill the supply bottle for Valve A with 1440 ml of **Solution #4**.
3. Run **DAY_RINSE** to prime **Valve A** with the solution.
4. Place a clean, dry 384-well microplate on the washer and run the Dispense program **192accuracy_qc**. This program dispenses 80 µl of solution to each well of the plate. It does not evacuate the solution.
5. When the program is finished, carefully remove the plate.

❖ **Note:** If you are using one of Bio-Tek's keypad-based readers, such as the ELx800NB™, ensure that the reader is **not** running in **Rapid Mode**. To check the setting, select UTIL → READ and cycle through the options until READ IN RAPID MODE? appears. Set it to **NO**.

6. Read the plate in an optical reader (blank on air), using the dual-wavelength method (630 nm - 450 nm), then print or export the results.
7. Using the **Dispense Precision Test Worksheet** on page 169, perform data reduction:
 - a. Calculate the **Standard Deviation**.
Tip: If you have a spreadsheet software program, enter/export all 384 values into a spreadsheet and apply your program's Standard Deviation function (e.g., Microsoft Excel's STDEV).
 - b. Calculate the sum of the OD values for all 384 wells, then divide by **384** to determine the **Mean OD** for the plate.

c. Calculate the **%CV**: (Standard Deviation / Mean OD) * 100.

The %CV should be **<= 4.0**.

8. If the %CV is *greater than* 4.0, one or more dispense tubes may need to be cleaned. Run **AUTOCLEAN** (Ultrasonic Advantage™ models only), and/or remove the manifold and use the stylus to clean the dispense tube(s) giving lower-than-average absorbance readings (all models). When finished, re-prime the washer and retry the test.
9. When finished, prime with deionized water to flush out the dye solution.

Annual Procedure for All Valves

- ❖ Perform this test during the **annual OQ** only.
- ❖ The **routine** test for Valve A must pass before the **annual** test for Valves A-D can be performed.

1. Empty the waste bottle now, and then as needed throughout this procedure.
2. Fill each of the supply bottles connected to **Valves A, B, C, and D** with three liters (3000 ml) of deionized water.

Repeat the following steps for each valve:

3. Run the Maintenance program **DAY_RINSE** two or three times to prime the fluid lines, manifold, and the valve being tested.
4. Edit the Dispense program **192accuracy_qc** to use the Valve currently being tested (**DEFINE → EDIT → DISP → 192accuracy_qc**).
5. Place a clean, dry 384-well microplate on the balance and zero the balance.
6. Place the microplate on the washer and run the Dispense program **192accuracy_qc**. This program dispenses 80 µl of water to each well of the plate. It does not evacuate the wells.
7. When the program is finished, carefully remove the plate and weigh it. This is the **Total Dispense Weight** in grams.
 - The weight should be **30.72 grams, ± 10%** (between 27.65 g and 33.79 g).
 - If the weight falls outside this range, contact Bio-Tek.

- If the weight falls below this range, the fluid inlet filter could be clogged, or the valve may be contaminated with fungi or proteins. See ***Cleaning the Fluid Inlet Filter*** in ***Chapter 4, Preventive Maintenance***, for recommendations on cleaning the filter. The valve should be cleaned using an appropriate enzyme, alcohol, or a diluted bleach solution, depending on the contaminant. See ***Removing Protein Residuals and Fungi Growth*** and ***Decontamination*** in ***Chapter 4*** for suggestions.

After cleaning the fluid inlet filter or valve and tubing, retry the test. If the test continues to fail, contact Bio-Tek.

8. Record results in the ***Dispense Precision Test Worksheet*** on page 169.

Evacuation Efficiency Test Worksheet

for Single/96 and Dual/96 Manifolds

Washer Model:	<input type="checkbox"/> ELx405™ <input type="checkbox"/> Select CW <input type="checkbox"/> Magna <input type="checkbox"/> HT2 (with Dual/96 manifold) <input type="checkbox"/> Select <input type="checkbox"/> HTV2 (with Dual/96 manifold)
Serial Number:	

Standard Test	
Total Residual Weight:	g
Verification that wells are consistent in appearance:	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Mean Residual Weight (Total Residual Weight ÷ 96):	g
Mean Residual Weight ≤ 0.005 g?	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Supplemental Test (check here <input type="checkbox"/> if not performed)	
Mean OD for the plate (Sum of all wells ÷ 96):	
Residual Factor (Mean OD ÷ Mean Residual Weight):	
<i>Calculate the Residual Weight for each well: well OD ÷ Residual Factor</i>	
Every Residual Weight per well ≤ 0.005 g?	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Date:	
Test Performed By:	

Dispense Precision Test Worksheet

*for Single/96 and Dual/96 Manifolds
without the External Valve Module*

Washer Model:	<input type="checkbox"/> ELx405™ <input type="checkbox"/> Select CW <input type="checkbox"/> Magna <input type="checkbox"/> HT2 (with Dual/96 manifold) <input type="checkbox"/> Select
Serial Number:	

Calculations	
Standard Deviation: (calculate using spreadsheet program)	
Mean OD: (sum of all wells ÷ number of wells)	
% Coefficient of Variation: ((Standard Deviation ÷ Mean OD) x 100)	
% CV <= 4.0?	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Date:	
Test Performed By:	

Dispense Precision Test Worksheet

*for Single/96 and Dual/96 Manifolds
with the External Valve Module*

Washer Model:	<input type="checkbox"/> ELx405™ <input type="checkbox"/> Select CW <input type="checkbox"/> Magna <input type="checkbox"/> HTV2 (with Dual/96 manifold) <input type="checkbox"/> Select
Serial Number:	

Calculations for Valve A	
Standard Deviation:	
Mean OD (Sum of all wells ÷ Number of wells):	
% CV (Standard Deviation ÷ Mean OD x 100):	
% CV <= 4.0?	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Calculations for Valves A-D (Annual OQ only, check here <input type="checkbox"/> if not performed)		
	Total Dispense Weight	28.8 g ±10%? (25.92 g - 31.68 g)
Valve A	grams	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Valve B	grams	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Valve C	grams	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Valve D	grams	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Date:	
Test Performed By:	

Evacuation Efficiency Test Worksheet

for the Dual/192-Tube Manifold

Washer Model:	<input type="checkbox"/> HT <input type="checkbox"/> HT2/HTV2 (with Dual/192 manifold)
Serial Number:	

Standard Test	
Total Residual Weight:	g
Verification that wells are consistent in appearance:	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Mean Residual Weight (Total Residual Weight ÷ 384):	g
Mean Residual Weight <= 0.002 g?	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Supplemental Test (check here <input type="checkbox"/> if not performed)	
Mean OD for the plate (sum of all wells ÷ 384):	
Residual Factor (Mean OD ÷ Mean Residual Weight):	
<i>Calculate the Residual Weight for each well: well OD ÷ Residual Factor</i>	
Every Residual Weight per well <= 0.002 g?	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Date:	
Test Performed By:	

Dispense Precision Test Worksheet

*for the Dual/192 Manifold
without the External Valve Module*

Washer Model:	<input type="checkbox"/> HT <input type="checkbox"/> HT2 (with Dual/192 manifold)
Serial Number:	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

Calculations	
Standard Deviation: (calculate using spreadsheet program)	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>
Mean OD: (sum of all wells ÷ number of wells)	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>
% Coefficient of Variation: ((Standard Deviation ÷ Mean OD) x 100)	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>
% CV <= 4.0?	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Date:	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>
Test Performed By:	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

Dispense Precision Test Worksheet

*for the Dual/192 Manifold
with the External Valve Module*

Washer Model:	<input type="checkbox"/> HT <input type="checkbox"/> HTV2 (with Dual/192 manifold)
Serial Number:	

Calculations for Valve A	
Standard Deviation:	
Mean OD (Sum of all wells ÷ Number of wells):	
% CV (Standard Deviation ÷ Mean OD x 100):	
% CV <= 4.0?	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Calculations for Valves A-D (Annual OQ only, check here <input type="checkbox"/> if not performed)		
	Total Dispense Weight	30.72 g ±10%? (27.65 g – 33.79 g)
Valve A	grams	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Valve B	grams	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Valve C	grams	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Valve D	grams	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Date:	
Test Performed By:	

Appendix A

Troubleshooting

This appendix lists problems that you may experience with the washer, and suggests possible solutions for these problems.

Overview	172
Troubleshooting Charts.....	173

Overview

Every effort has been made to ensure that the ELx405™ Microplate Washer is extremely reliable and easy to use. Nevertheless, you could experience problems with the washer hardware, software, and/or accessories. This appendix offers the following information to help resolve these problems.

The **Troubleshooting Checklist** below is a concise summary of possible causes for many of the problems that may occur during operation of the washer.

The **Troubleshooting Charts** on the following pages provide detailed lists of problems, their possible causes, and possible solutions.

Troubleshooting Checklist

Periodic inspection of the washer, tubing, and bottles for the possible causes listed below may help to eliminate many of the problems listed on the following pages.

Check for the following:	
✓	Loose or disconnected power cord, vacuum pump accessory cable, waste/supply tubing and fittings
✓	Incomplete or incorrect installation of manifold, carrier, High Flow vacuum pump, external valve module; incorrect attachment of mist shield or placement of microplates/ strips in carrier
✓	Loose covers on waste or supply bottles
✓	Accumulation of residue on microplate carrier, carrier transport rails and carrier glide strips, or inside aspirate/dispense tubes, waste/supply bottles and tubing, manifold, inlet/outlet fittings, or fluid inlet filter
✓	Worn or defective tubing, o-rings, inlet/outlet fittings, manifold or vacuum seals
✓	Kinked or bent aspirate/dispense tubes or waste/supply tubing
✓	Program settings not optimized or incorrect: aspiration/dispense height too high/low, dispense flow rate too fast/slow for volume selected, horizontal aspirate position programmed too wide for a movement, system not primed or not adequately primed, insufficient vacuum dissipation delay, incorrect manifold selected (HT models with the accessory 96-tube manifold, including Select models upgraded to HT models)

Troubleshooting Charts

See **Figures 12 to 15** in **Chapter 2, Installation**, and **Figure 28** in **Chapter 4, Preventative Maintenance**, for illustrations of the components referenced in the Troubleshooting Charts:

- **Figure 12** - Rear Panel
- **Figure 13** - Washer With Vacuum Pump and Waste Tubing Connections
- **Figure 14** - Washer With Supply Tubing Connections (Without Optional External Valve Module)
- **Figure 15** - Washer With Optional External Valve Module
- **Figure 28** - Cleaning the Fluid Inlet Filter

❖ **Note:** If you are operating the washer with the **Bio-Stack™**, and encounter problems during plate transfers between the Stacker and the washer, or during communication between the two instruments, refer to the **Troubleshooting and Error Codes** section of the Bio-Stack Operator's Manual.

Washer Start-Up

Problem	Possible Cause	Possible Solution
Display (LCD) not on.	Power cord not plugged in.	Check power connection.
Vacuum pump does not start, or shakes when turned on.	Vacuum pump is not turned on.	Flip the switch on the side of the vacuum pump to turn it on.
	Vacuum pump accessory cable not installed correctly.	The vacuum pump accessory cable should be plugged into the back of the washer.
	Too much residual vacuum force for pump.	Release the vacuum by loosening the waste bottle stopper. Reconnect and start again.

Washer Start-Up, Cont'd

Problem	Possible Cause	Possible Solution
Vacuum pump does not start, cont'd.	Blown fuse in accessory outlet.	<p>Replace fuse (PN 46055). Increase vacuum dissipation delay (refer to the section on Vacuum Dissipation Delay in Ch. 3, Operation).</p> <p>Ensure that the vacuum pump accessory cable is plugged into the vacuum pump accessory outlet on the back of the washer, and not into a wall outlet. See Ch. 2, Installation.</p>
Carrier/manifold position error.	Manifold or carrier is being obstructed.	Remove obstruction.
	Motor, sensor, or electrical problem.	Turn washer off, wait at least 15 seconds, then turn back on. If washer does not pass its self-test, contact Bio-Tek TAC.
	Misaligned carrier or manifold.	Contact Bio-Tek TAC.
	Incorrect manifold selected.	HT models with the accessory 96-tube dual manifold (including Select models upgraded to HT models): Ensure that the washer is configured for the installed manifold (96-tube or 192-tube). See Manifold Selection in Ch. 3 .

Fluid Aspiration

Problem	Possible Cause	Possible Solution
<p>Poor or uneven aspiration.</p>	<p>Insufficient or no vacuum.</p>	<p>Firmly seat the waste bottle covers. Ensure tubing is connected properly.</p> <p>Check all external tubing for kinks or clogs.</p> <p>If you are using an in-line vacuum filter, the filter may need to be replaced.</p> <p>If the vacuum pump is on, remove the vacuum pump tubing from the back of the washer while the pump is on. Put your finger over the port; if there is no vacuum, contact Bio-Tek TAC.</p>
	<p>Clogged aspiration tubes on the washer manifold.</p>	<p>Remove and clean the manifold (see <i>Cleaning the Manifold</i> in <i>Ch. 4, Preventative Maintenance</i>).</p>
	<p>Microplate aspiration height adjustment too high or too low.</p>	<p>Change the Aspiration Height in the program (see <i>Define Wash ASPIRATION Program Options</i> in <i>Ch. 3</i>).</p>
	<p>Vacuum pump failure.</p>	<p>Contact Bio-Tek TAC.</p>
<p>Uneven aspiration of water buffer. Some wells might be left full.</p>	<p>No surfactant in the buffer such as Tween[®] 20.</p>	<p>Add surfactant to the buffer such as Tween 20. If this is not possible, continue below.</p>
	<p>Insufficient vacuum.</p>	<p>Bio-Tek offers a high flow pump for those 96- and 384-well assays using only water for the wash fluid. Contact Bio-Tek for more information.</p>

Fluid Aspiration, *Cont'd*

Problem	Possible Cause	Possible Solution
Uneven aspiration of water buffer, <i>cont'd</i>.	Check fluid aspiration problem section.	<p>Check aspiration height, waste system for leaks, waste bottle caps, tubing for kinks, and in-line filter for clogs.</p> <p>Check to see if the microplate is not level or if the waste valve of the valve module is touching the bench.</p> <p>Clean the aspiration tubes with a stylus.</p>
	Program settings not optimized.	<p>Try these changes in this order and in combination if necessary:</p> <ol style="list-style-type: none"> 1. Enable crosswise aspiration. 2. Increase aspiration time to 800 ms. 3. Slow aspiration speed to 1 or 2.
	Aspiration tubes not properly positioned horizontally in wells.	<p>If none of the tubes are bent, try adjusting the Horizontal Aspirate Position in the program (see <i>Define Wash ASPIRATION Program Parameters</i> in Ch. 3).</p>
	Microplate not level in carrier, or strips not level in holder.	<p>Reseat microplate in carrier or strips in holder.</p> <p>Make sure the carrier is clean (see <i>Cleaning the Plate Carrier System</i> in Ch. 4).</p> <p>Try a different microplate or strip holder. If the problem is unresolved, the carrier may have to be realigned. Contact Bio-Tek TAC.</p>

Fluid Aspiration, *Cont'd*

Problem	Possible Cause	Possible Solution
Too much residual left in microwells after aspiration.	Clogged vacuum filter.	If you are using an in-line vacuum filter, the filter may need to be replaced.
	Waste bottle cover not properly sealed or fittings not properly connected.	Firmly seat the waste bottle stopper. Make sure tubing is connected properly.
	Manifold out of alignment or not moving freely.	Check for obstructions. If none are found, contact Bio-Tek TAC.
	Microplate not level in carrier or strips not level in holder.	Reseat microplate in carrier or strips in holder. Make sure the carrier is clean (see <i>Cleaning the Plate Carrier System</i> in <i>Ch. 4</i>). Try a different microplate or strip holder. If the problem is unresolved, the carrier may have to be realigned. Contact Bio-Tek TAC.
	Washer program requires optimization.	To minimize the residuals, program a second or crosswise aspiration (see <i>Define Wash ASPIRATION Program Options</i> in <i>Ch. 3</i>). Other options include decreasing the aspiration rate or adding a delay on the final aspiration.
	Aspirate tubes are bent.	Contact Bio-Tek TAC.

❖ **Note:** Monthly performance of the Evacuation Efficiency test is recommended to verify that the residual volume per well after evacuation (aspiration) meets the specified criteria. See ***Evacuation Efficiency Test Procedure*** in ***Ch. 5, Performance Verification/Qualification Tests***.

Fluid Delivery

Problem	Possible Cause	Possible Solution
<p>Unable to dispense fluid:</p> <p>ELx405 models without the external valve module.</p>	Clogged fluid inlet filter.	Clean the fluid inlet filter. See <i>Cleaning the Fluid Inlet Filter</i> , in Ch. 4 ; note orientation of the filter in Figure 28 .
	Supply tube inside the supply bottle is kinked or disconnected.	Straighten or connect supply tube. Make sure the end is cut; see <i>General Usage Guidelines, Ch. 3</i> .
	Inlet tube not connected.	Check all tubing (see <i>Connecting the Tubes and Bottles</i> in Ch. 2).
	Clogged dispense tubes on the washer manifold.	Remove and clean the manifold (see <i>Cleaning the Manifold</i> in Ch. 4).
	No wash or rinse fluid.	Fill bottles with appropriate fluid. Ensure bottles are clean and do not contain particles or organic material.
	System not primed. Large air pockets in tubing.	Run a Prime program using the following volumes; do not use the AutoPrime program for the initial prime: All models except Select CW: 200 ml Prime Volume when all the lines are empty or when changing fluids. Select CW models: 200 ml Prime Volume and 150 ml Low Flow Prime Volume when all the lines are empty; 300 ml Prime Volume and 200 ml Low Flow Prime Volume when changing fluids.
	Insufficient suction force, clogged tubing, or faulty valve.	Perform Periodic Maintenance as described in Ch. 4 . If problem persists, contact Bio-Tek TAC.
<p>Unable to dispense fluid:</p> <p>ELx405 models with the external valve module.</p>	System not primed. Large air pockets in tubing.	Run a Prime program using the following volumes: All models except Select CW: 400 ml Prime Volume when all the lines are empty or when changing fluids. Select CW models: 400 ml Prime Volume and 300 ml Low Flow Prime Volume when all the lines are empty; 600 ml Prime Volume and 400 ml Low Flow Prime Volume when changing fluids.

Fluid Delivery, *Cont'd*

Problem	Possible Cause	Possible Solution
Unable to dispense fluid: ELx405 models with the external valve module, <i>cont'd</i>.	External valve module not connected to washer, or supply tubing set up incorrectly.	Check valve module cable and tubing.
	Solenoid valve not opening.	Make sure valve module cable is plugged into the valve control port on the back of the washer. If it is plugged in, contact Bio-Tek TAC.
Plate overfills (floods).	Dispense height too high. The aspirate tubes are too many steps above the microwells to prevent overflow.	Change the Dispense Height in the program (see <i>Define Wash DISPENSE Program Options</i> in <i>Ch. 3</i>).
	Dispense flow rate too low. Select CW model's low flow rate 10 or 11 used with 384-well plates.	Select a higher flow rate (see <i>Define Wash DISPENSE Program Options</i> in <i>Ch. 3</i>).
	Aspiration tubes hit bottom of trough during Prime or Maintenance.	Manifold may not be properly seated or mounted. Contact Bio-Tek TAC.
	In-line vacuum filter plugged.	If you are using an in-line vacuum filter, replace or remove the filter.
	Loose covers on waste bottles.	Firmly tighten waste bottle covers.
	Dispense rate too fast for volume selected.	Use slower dispense rate or lower volume (see <i>Define Wash DISPENSE Program Options</i> , in <i>Ch. 3</i>).
	Faulty vacuum pump.	Contact Bio-Tek TAC.

❖ **Note:** Monthly performance of the Dispense Precision test is recommended to measure the variability of volumes dispensed from tube to tube across the manifold. See ***Dispense Precision Test Procedure*** in ***Ch. 5, Performance Verification/Qualification Tests***.

Fluid Delivery, Cont'd

Problem	Possible Cause	Possible Solution
Plate overfills (floods), cont'd.	Insufficient or no vacuum.	<p>Firmly seat the waste bottle covers; ensure tubing is connected properly.</p> <p>Check all external tubing for kinks or clogs.</p> <p>An in-line vacuum filter may need to be replaced.</p> <p>When the program begins, you should be able to hear the vacuum pump turn on. If it is not turning on, contact Bio-Tek TAC.</p> <p>If the vacuum pump turns on, remove the vacuum tubing from the back of the washer while the pump is on and put your finger over the port. If there is no vacuum, contact Bio-Tek TAC.</p>
Uneven dispensing of fluid; wells not filled.	Clogged dispense tubes on the washer manifold.	Remove and clean the manifold (see <i>Cleaning the Manifold</i> in Ch. 4).
	Manifold or tubing not adequately primed.	<p>Run a prime program using the following <u>minimum</u> Prime Volumes; do not use the AutoPrime program for the initial prime:</p> <p>All models except Select CW, Without the valve module, 200 ml Prime Volume when all the lines are empty or when changing fluids. <u>With the valve module</u>, 400 ml Prime Volume when all the lines are empty or when changing fluids.</p> <p>Select CW: Without the valve module, 200 ml Prime Volume/150 ml Low Flow Prime Volume when all the lines are empty; 300 ml Prime Volume/200 ml Low Flow Volume when changing fluids. <u>With the valve module</u> - 400 ml Prime Volume/300 ml Low Flow Prime Volume when all the lines are empty; 600 ml Prime Volume/400 ml Low Flow Volume when changing fluids.</p>
	<p>Dispense flow rate too low.</p> <p>Select CW model's low flow rate 10 or 11 used with 384-well plates.</p>	Select a higher flow rate (see <i>Define Wash DISPENSE Program Options</i> in Ch. 3).
	Microplate aspiration height adjustment too high or too low.	Change the Aspiration Height in the program (see <i>Define Wash ASPIRATE Program Options</i> , Ch. 3).

Fluid Leakage

Problem	Possible Cause	Possible Solution
Fluid leaking from manifold.	Defective seals.	<p>Replace individual seals at the front of the manifold, or o-rings at the rear of the manifold (see <i>Cleaning the Manifold</i> in Ch. 4).</p> <p>Replace o-rings on washer manifold inlet fittings.</p> <p>Contact Bio-Tek TAC.</p>
	Aspiration tubes only: vacuum too low.	<p>Check waste connector tubes; make sure they are properly connected to the manifold.</p> <p>If you are using an in-line vacuum filter, check the filter for clogging, and replace if necessary.</p> <p>Check seal of waste bottle covers.</p> <p>Check for air leaks in the waste tubing and bottles.</p> <p>Use a slower Aspiration Rate in the program (see <i>Define Wash ASPIRATION Program Options</i> in Ch. 3).</p>
Fluid leaking from underneath the washer.	Defective tubing connector or inlet tubing.	Contact Bio-Tek TAC.
	Leaking valve.	Contact Bio-Tek TAC.
Fluid leaking from external tubing connector.	Defective connector.	Replace connector.
	Worn tubing.	Replace tubing, or cut back tubing one inch (to remove worn section).
	Worn seal (inlet or vacuum fitting).	Replace filter or seal (see <i>Connecting the Tubes and Bottles</i> in Ch. 2).

Microplate Carrier Movement

Problem	Possible Cause	Possible Solution
Aspiration tubes not entering well correctly.	Microplate not properly seated or strips not level.	Reseat microplate in carrier or strips in holder. Make sure the carrier is clean (see <i>Cleaning the Plate Carrier System</i> in <i>Ch. 4</i>). Try a different microplate or strip holder. If the problem is unresolved, the carrier may have to be realigned. Contact Bio-Tek TAC.
	Horizontal Aspirate Position is programmed too wide for a movement.	Change the Horizontal Aspir Pos value in the program (see <i>Define Wash ASPIRATION Program Options</i> in <i>Ch. 3</i>).
	Aspirate tubes bent.	Contact Bio-Tek TAC.

Washer Manifold Movement

Problem	Possible Cause	Possible Solution
Manifold position error.	Manifold movement is blocked.	Check orientation of microplate; A1 should be in the left rear corner of the plate carrier as you face the front of the instrument. Check for and remove any obstructions. Ensure that the manifold is installed properly (see <i>Setting Up the ELx405: Installing the Microplate Carrier</i> in <i>Ch. 2</i>).
	Incorrect manifold selected.	HT models with the accessory 96-tube manifold (including Select models upgraded to HT models): Ensure that the washer is configured for the installed manifold (96-tube or 192-tube). See <i>Manifold Selection</i> in <i>Ch. 3</i> .

Microplate Scratches

Problem	Possible Cause	Possible Solution
<p>Scratches on microplate bottom.</p>	<p>Microplate dispense or aspiration height adjustment too low.</p>	<p>Change the Dispense or Aspiration Height in the program (see <i>Define Wash DISPENSE or ASPIRATION Program Options</i> in <i>Ch. 3</i>).</p>
	<p>Microplate not properly seated or strips not level.</p>	<p>Reseat microplate in carrier or strips in holder.</p> <p>Make sure the carrier is clean (see <i>Cleaning the Plate Carrier System</i> in <i>Ch. 4</i>).</p> <p>Try a different microplate or strip holder. If the problem is unresolved, the carrier may have to be realigned. Contact Bio-Tek TAC.</p>

Appendix B

Error Codes

This appendix lists error codes that may appear on the ELx405™ Microplate Washer. If an error is displayed, refer to Appendix A, Troubleshooting. Contact Bio-Tek's Technical Assistance Center if further instructions are necessary.

Error Codes	186
General Errors.....	187
Fatal Errors.....	200
Bio-Stack Errors	203

Error Codes

An error code is displayed on the ELx405™ as a four-digit identifier. The first digit will be **0**, **1**, **2**, **3**, or **A**.

- **0**, **1**, **2**, **3**, or **4** denote a noncritical (**General**) error, which means that the instrument will still respond to keypad input. See **General Errors**, page 187.
- **A** denotes a more serious (**Fatal**) error, which requires that the ELx405 be turned off and then powered up. Upon restarting the washer, you should be able to enter commands into the keypad. See **Fatal Errors**, page 200.

If an error is displayed, refer to **Appendix A, Troubleshooting**. Contact Bio-Tek's Technical Assistance Center if further instructions are necessary.

Bio-Stack Errors

Error codes displayed on the washer during operation with the **Bio-Stack™ Microplate Stacker**, that are prefixed with a **B-**, indicate either errors generated by the Bio-Stack or problems with communication between the two instruments.

Page 203 contains a partial listing of errors that may appear on the display of the ELx405 during operation with the Bio-Stack. Refer to the **Troubleshooting and Error Codes** section of your Bio-Stack Operator's Manual for a more complete listing of these types of error codes and their descriptions.

General Errors

For the codes that represent **motor** errors, the fourth digit of the code represents the affected motor:

0 = manifold motor

1 = carrier motor (x-direction)

2 = magnet motor (Magna models)

3 = carrier motor (y-direction) (dual-manifold models)

For example, error code **0201** means that the microplate carrier motor (x-axis) could not find its optical sensor.

❖ **Note: Calibration errors** (AUTOCAL_JIG_ERR; MANIFOLD_AUTOCAL_ERR; etc.) will normally be displayed only during calibration or repair of the instrument by Bio-Tek TAC.

❖ **Motor errors:** n = motor; **Program errors:** n = program #.

Code	Cause
0100 ABORT_ERR	Washer function was aborted due to operator-initiated abort, or following some other error.
0200 NO_SENSOR_ERR	<p>Manifold motor couldn't find the optical sensor – occurs in a homing sequence during self-test, prior to running a program, or following a program.</p> <p>If auto-calibration jigs are out of calibration or incorrectly installed, the error may occur during a Dispense, Wash, or Aspirate Protocol, if plate clearance is less than priming trough clearance.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Linear way is dirty, losing steps due to lack of grease, or an object is blocking its path. • Motor is defective. • Optical sensor is defective. • Shipping block is still installed. • Lead screw has become unglued from the motor shaft.

General Errors, Cont'd

Code	Cause
0201 NO_SENSOR_ERR	Carrier x-axis motor couldn't find optical sensor – occurs in a homing sequence during self-test, prior to running a program, or following a program. Probable Causes: <ul style="list-style-type: none"> • Carrier x-axis motor is unable to move due to contamination of the carrier transport rail. • Carrier x-axis motor failed, belt is slipping, or drive or idler pulley is defective. • Optical sensor is defective.
0202 NO_SENSOR_ERR	Magna models only: Carrier x-axis motor couldn't find optical sensor – occurs in a homing sequence during self-test, prior to running a program, or following a program. Probable Causes: <ul style="list-style-type: none"> • Carrier x-axis motor is unable to move due to contamination of the carrier transport rail. • Carrier x-axis motor failed, belt is slipping, or drive or idler pulley is defective. • Optical sensor is defective.
0203 NO_SENSOR_ERR	Dual-manifold models only: Carrier y-axis motor couldn't find optical sensor – occurs in a homing sequence during self-test, prior to running a program, or following a program. Probable Causes: <ul style="list-style-type: none"> • Carrier y-axis motor is unable to move due to contamination. • Optical sensor is defective. • Carrier y-axis motor is defective.
0300 AUTOCAL_JIG_ERR	Manifold motor couldn't find edge of autocal jig during autocal routine. Probable Causes: <ul style="list-style-type: none"> • Distance from optical sensor to autocal jig is too short. • Autocal jig contacts are contaminated. • Autocal jig is not installed properly or a connection is not made.

General Errors, Cont'd

Code	Cause
0301 AUTOCAL_JIG_ERR	Carrier x-axis motor couldn't find edge of autocal jig. Probable Causes: <ul style="list-style-type: none"> • Autocal jig contacts are contaminated. • Autocal jig is not properly installed or a connection is not made.
0302 AUTOCAL_JIG_ERR	Magna models only: Carrier x-axis motor couldn't find edge of autocal jig. Probable Causes: <ul style="list-style-type: none"> • Autocal jig contacts are contaminated. • Autocal jig is not properly installed or a connection is not made.
0303 AUTOCAL_JIG_ERR	Dual-manifold models only: Carrier y-axis motor couldn't find edge of autocal jig. Probable Causes: <ul style="list-style-type: none"> • Autocal jig contacts are contaminated. • Autocal jig is not properly installed or a connection is not made.
0400 MOTOR_VERIFY_ERR	Manifold motor failed positional verify – occurs when verifying the current motor position during self-test, prior to running a program, or following a program. Probable Causes: <ul style="list-style-type: none"> • Linear way is dirty, losing steps due to lack of grease, or an object is blocking its path. • Motor is defective. • Optical sensor is defective. • Shipping block is still installed. • Lead screw has become unglued from the motor shaft. • Incorrect manifold selected (HT2/HTV2 models).

General Errors, Cont'd

Code	Cause
<p>0401</p> <p>MOTOR_VERIFY_ERR</p>	<p>Carrier x-axis motor failed positional verify – occurs when verifying the current motor position during self-test, prior to running a program, or following a program.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Carrier x-axis motor is unable to move due to contamination of the carrier transport rail. • Carrier x-axis motor failed, belt is slipping, or drive or idler pulley is defective. • Optical sensor is defective. • Incorrect manifold selected (HT2/HTV2 models).
<p>0402</p> <p>MOTOR_VERIFY_ERR</p>	<p>Magna models only: Carrier x-axis motor failed positional verify – occurs when verifying the current motor position during self-test, prior to running a program, or following a program.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Carrier x-axis motor is unable to move due to contamination of the carrier transport rail. • Carrier x-axis motor failed, belt is slipping, or drive or idler pulley is defective. • Optical sensor is defective.
<p>0403</p> <p>MOTOR_VERIFY_ERR</p>	<p>Dual-manifold models only: Carrier y-axis motor failed positional verify – occurs when verifying the current motor position during self-test, prior to running a program, or following a program.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Contamination on the y-axis rail of the carrier. • Y-axis motor is not able to move due to contamination. • Optical sensor is defective. • Y-axis motor is defective. • Incorrect manifold selected (HT2/HTV2 models).

General Errors, Cont'd

Code	Cause
0500 UNDEF_PROG_TYPE_ERR	Undefined program type - occurs when trying to define or run a program type that is invalid (usually initiated from washer keypad operations). Probable Causes: <ul style="list-style-type: none"> • Memory is corrupt.
060n PROGRAM_NUM_ERR	Invalid program number (n = program number) - occurs when trying to return information for a program that is not found in the list of programs in the flash memory. Probable Causes: <ul style="list-style-type: none"> • Corrupt memory. • Program not loaded when requested by the controlling software.
0700 PROGRAM_SET_ERR	Invalid write attempt - occurs when trying to store a program in flash memory (e.g., when saving a program via the washer keypad, or when downloading programs from a controlling PC), and there are no empty locations. Probable Causes: <ul style="list-style-type: none"> • Processor failure.
0800 PROGRAM_DEL_ERR	Invalid delete attempt (n = program number) - occurs when trying to delete a program from flash memory via the washer keypad or a controlling PC, and it is not found in the memory. Probable Causes: <ul style="list-style-type: none"> • Program is not available or listed. • Memory corruption.
0A0n PROGRAM_CHECKSUM_ERR	Program checksum failure (n = program number) - occurs when trying to return information for a program. At that time, a checksum test is run when validating a program name, or when loading a program from flash memory to RAM. If it fails, then the software assumes the program is corrupt in flash memory. Probable Causes: <ul style="list-style-type: none"> • Memory corruption.

General Errors, Cont'd

Code	Cause
0B00 MANIFOLD_AUTOCAL_ERR	Invalid manifold for calibration – occurs when the value stored in flash memory for the manifold type is invalid. This is checked at powerup, during self-test, and during and after autocal is run. Probable Causes: <ul style="list-style-type: none"> • Memory corruption.
0C00 INVALID_BUFFER_ERR	An invalid buffer is selected – occurs when a program first starts, when fluid is going to be dispensed, or when a linked program is going to the next link. Probable Causes: <ul style="list-style-type: none"> • Memory corruption.
0E00 DISPENSE_RATE_ERR	Dispense rate is invalid for manifold type – occurs when verifying validity of a program, e.g., during run-time, or when saving a program. Probable Causes: <ul style="list-style-type: none"> • Incorrect rate/volume entered for manifold selected.
0F00 DISPENSE_VOLUME_ERR	Dispense volume invalid for manifold type – occurs when verifying the validity of a program, e.g., during run-time, or when saving a program. Also occurs when attempting to dispense fluid, and the transition volume for that rate is larger than the volume to be dispensed. (Transition volume = the non-linear volume dispensed when the dispense motor is turned on and off.) Probable Causes: <ul style="list-style-type: none"> • Incorrect rate/volume entered for manifold selected.
1000 CNFG_DATA_ERR	Necessary configuration data is missing because flash memory configuration data has not been properly initialized, or flash memory is corrupted. Probable Causes: <ul style="list-style-type: none"> • New basecode overwrites configuration values. • Unit has not been calibrated or lost calibration values. • Main PCB has been replaced. • Memory corruption.

General Errors, Cont'd

Code	Cause
1100 CNFG_CHECKSUM_ERR	Failed configuration checksum test because flash memory configuration data is corrupt. Occurs during powerup, or after running a program. Probable Causes: <ul style="list-style-type: none"> • New basecode overwrites configuration values. • Main PCB has been replaced. • Memory corruption.
1300 MOTOR_NOT_HOMED_ERR	Manifold motor not homed successfully – occurs anytime a motor is requested to be moved before it has been homed. Probable Causes: <ul style="list-style-type: none"> • Errors 0200 or 0400 initially occurred and were not resolved; see the Probable Causes for 0200.
1301 MOTOR_NOT_HOMED_ERR	Carrier x-axis motor not homed successfully – occurs anytime a motor is requested to be moved before it has been homed. Probable Causes: <ul style="list-style-type: none"> • Errors 0201 or 0401 initially occurred and were not resolved; see the Probable Causes for 0201.
1302 MOTOR_NOT_HOMED_ERR	Magna models only: Carrier x-axis motor not homed successfully – occurs anytime a motor is requested to be moved before it has been homed. Probable Causes: <ul style="list-style-type: none"> • Errors 0202 or 0402 initially occurred and were not resolved; see the Probable Causes for 0202.
1303 MOTOR_NOT_HOMED_ERR	Dual-manifold models only: Carrier y-axis motor not homed successfully – occurs anytime a motor is requested to be moved before it has been homed. Probable Causes: <ul style="list-style-type: none"> • Errors 0203 or 0403 initially occurred and were not resolved; see the Probable Causes for 0203.
1400 AUTOCAL_ABORT_ERR	Autocal of washer is aborted – occurs whenever the operator requests an abort of the autocal procedure.

General Errors, Cont'd

Code	Cause
1900 MALLOC_ERR	<p>Memory allocation failure - occurs when trying to store a large block of configuration data in flash memory, such as downloaded configuration data, or autocal configuration data.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • The memory is corrupt. Contact Bio-Tek TAC. • If the error persists, the processor PCB needs to be replaced.
1A00 ASPIRATE_POS_ERR	<p>Horizontal aspirate position is out of range – occurs when verifying the validity of a program prior to running the program, or prior to saving the program to flash memory.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • The horizontal aspirate position requested is out of range. See Wash ASPIRATE Defaults and Ranges in Chapter 3, Operation for a list of acceptable ranges.
1B00 DISPENSE_POS_ERR	<p>Horizontal dispense position is out of range – occurs when verifying the validity of a program prior to running the program, or prior to saving the program to flash memory.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • The horizontal dispense position requested is out of range. See Wash DISPENSE Defaults and Ranges in Chapter 3, Operation for a list of acceptable ranges.
1E00 AUTOCAL_CHECKSUM_ERR	<p>Failed autocal checksum during the powerup sequence; autocal data is missing.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Basecode is loaded, but autocalibration has not been performed. • Memory corruptions. • Autocalibration has not been performed. • Main PCB was replaced.

General Errors, Cont'd

Code	Cause
<p>1F00 VACUUM_ON_ERR</p>	<p>Vacuum switch failed to close in time – occurs whenever the vacuum pump fails to turn on properly, usually at the start of a program, but also during a full self-test sequence.</p> <p>The switch is normally open. When the switch senses the vacuum, it will close. Whenever the software turns on the vacuum pump, the software will monitor the vacuum switch until it closes, or until the vacuum startup delay expires.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Q-cups are defective or not properly connected. • No vacuum source, external pump fuse has blown, or external pump is defective and unable to reach minimum vacuum requirements of 1.6" HG. • Vacuum source has not reached 1.6" HG. • Waste bottle cap or caps are loose. • Vacuum switch has failed in the open state.
<p>2000 WASTE_FULL_ERR</p>	<p>Waste switch detects a full waste bottle – occurs at the start of a program (including AUTOCLEAN programs in Ultrasonic Advantage™ models). The switch is normally closed and when the waste bottle is full, the switch will open.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Waste switch is stuck or always in the open state. • Waste bottle is full. • Foam in the overflow bottle has pushed the switch open. • Waste tubing is not properly connected, and the overflow bottle is the primary bottle, i.e., the first bottle that waste flows into.

General Errors, Cont'd

Code	Cause
2100 FLUID_ERR	<p>No fluid detected during a dispense, prime, or maintenance cycle in a program.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Ball used to block the sensor is missing or stuck below the infrared detector. • Infrared detector or fluid sensor is no longer functioning. • Dispense valve has not closed and fluid is still flowing. • Air bubble present in the detection path.
2200 FLOW_ERR	<p>No flow detected – occurs at the end of a dispense, if no fluid flow was detected during the dispense operation.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Fluid or sensor housing is opaque, not allowing the infrared detector to toggle. • Infrared detector or fluid sensor failed. • Main PCB failed to detect the fluid sensor.
2300 INVALID_PLATE_TYPE	<p>Plate type not valid for hardware – occurs at the start of a program.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Invalid plate type entered. • Protocol is corrupt.
2400 INVALID_LINK_ERR	<p>Failure to get a program to view/run – occurs at program start time, at program validation time (i.e., when programs are saved and/or downloaded), or when one of the programs within a linked program is not found or is invalid.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Memory corruption. • Requested program is corrupt or not available.

General Errors, Cont'd

Code	Cause
<p>2700 YAXIS_POSITION_ERR</p>	<p>Dual manifold models only: Cannot move to requested position/offset – occurs when trying to move the carrier along the y-axis to a position greater than allowed.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Memory corruption.
<p>2800 NO_FLUID_START_ERR</p>	<p>No fluid detected at the start of a wash or dispense program, or at the start of a loop for an AUTOCLEAN program (Ultrasonic Advantage™ models only).</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • The floating ball that blocks the infrared detector is missing. • The floating ball is stuck to the tubing and not able to float. • Infrared detector or fluid sensor has failed. • Main PCB failed to detect the fluid sensor. • Air bubble in the detection path. • No fluid in unit (unit has not been primed). • Stuck or defective dispense valve. <p>Insufficient prime volumes (air bubble).</p>
<p>2900 NO_FLUID_END_ERR</p>	<p>No fluid detected at the end of a wash or dispense program.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Insufficient prime volumes (air bubbles). • Floating ball that blocks the infrared detector is missing. • Floating ball is stuck to the tubing and not able to float. • Infrared detector or fluid sensor has failed. • Main PCB failed to detect fluid sensor. • Air bubble moving ball out of sensor intermittently. • Dispense valve did not close properly, allowing some fluid to flow, causing manifold to drip.

General Errors, Cont'd

Code	Cause
3000 MAGNET_POSITION_ERR	<p>Magna models only: Requested offset position is not valid - the request is to move the magnet to a position greater than allowed; 0 offset only.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • Offset entered other than 0.
3100 SOAK_SHAKE_ERR	<p>Error running shake/soak protocol – one of several potential errors that can occur during a shake or soak operation. A 3100 error is unlikely to occur. An axis or sensor error is more likely to appear before a 3100 error.</p> <p>For example, whenever a motor-related error occurs during activities in the shake/soak cycle, such as moving the manifold, magnet, carrier, and carrier Y motors, or turning the vacuum on and off, the axis or sensor errors would be displayed first before a 3100 error.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • One of the axes failed. • Vacuum switch did not close before vacuum delay expired.
3200 SERIAL_PORT_ERR	Error running serial port test on test station. (EPROM test station error only.)
3300 KEYBOARD_ERR	Error running keyboard test on test station. (EPROM test station error only.)
3400 IO_TEST_ERR	I/O test error – occurs when one part of the I/O test on the test station has failed. (EPROM test station error only.)
3500 DC_PUMP_ERR	DC pump test error on the test station. (EPROM test station error only.)
3700 AUTCLN_NUM_LOOPS_INVALID_ERR	Invalid number of loops selected for the AUTOCLEAN program. This usually occurs when trying to start the AUTOCLEAN feature from a PC, and the parameters downloaded include an out-of-range loop count.

General Errors, Cont'd

Code	Cause
3800 AUTCLN_DURATION_INVALID_ERR	Invalid duration selected for one of the loops of the AUTOCLEAN program. This usually occurs when trying to start the AUTOCLEAN feature from a PC, and the parameters downloaded include an out-of-range loop duration.
3900 AUTCLN_VALVE_INVALID_ERR	Invalid valve index selected for one of the loops of the AUTOCLEAN program (if external valve module is used). This usually occurs when trying to start the AUTOCLEAN feature from a PC, and the parameters downloaded include an out-of-range loop valve index.
3A00 AUTCLN_VOLUME_INVALID_ERR	Invalid fill volume value entered. This occurs when trying to start the AUTOCLEAN feature, and the value stored in the flash memory for the fill volume is out of range.
3B00 AUTCLN_LOOP_IN_PROGRESS_ERR	Error running one of the AUTOCLEAN loops. This usually occurs when trying to start the AUTOCLEAN feature from a PC, and the PC tries to run an AUTOCLEAN loop while the previous loop is already in progress.
4500 INVALID_FEATURE_ERR	During PC control of the washer, the PC is trying to set or run an undefined feature.
<p>AUTCLN errors appear only in Ultrasonic Advantage™ models. These errors may also appear during keypad control of the washer, with the exception of error code 3A00.</p>	

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:

- 0** = manifold motor
- 1** = carrier motor (x-direction)
- 2** = magnet motor (Magna models)
- 3** = carrier motor (y-direction) (dual-manifold models)
- 4** = software timer
- 5** = display
- 6** = quick flash memory
- 7** = memory manager (memory allocation heap)

Code	Cause
A100 TCB_NOT_AVAIL_ERR	Task control block not available – occurs when trying to create a new software task to run “simultaneously” with other tasks, such as when first trying to run a wash program, or when trying to start an AUTOCLEAN program in an Ultrasonic Advantage™ model.
A300 NOT_AVAIL_ERR	Manifold motor not available – occurs when trying to get access to a system resource, such as the manifold motor or a timer. If the requested device is the manifold motor, usually that motor is still running, or the software “thinks” the motor is still running, even if it isn't.
A301 NOT_AVAIL_ERR	Carrier x-axis motor not available – occurs when trying to get access to a system resource, such as the carrier x-axis motor or a timer. If the requested device is the x-axis motor, usually that motor is still running, or the software “thinks” the motor is still running, even if it isn't.

Fatal Errors, Cont'd

Code	Cause
A302 NOT_AVAIL_ERR	Magna models only: Carrier x-axis motor not available – occurs when trying to get access to a system resource, such as the carrier x-axis motor or a timer. If the requested device is the x-axis motor, usually that motor is still running, or the software “thinks” the motor is still running, even if it isn’t.
A303 NOT_AVAIL_ERR	Dual manifold models only: Carrier y-axis motor not available – occurs when trying to get access to a system resource, such as the carrier y-axis motor or a timer. If the requested device is the y-axis motor, usually that motor is still running, or the software “thinks” the motor is still running, even if it isn’t.
A304 NOT_AVAIL_ERR	Software timer not available.
A305 NOT_AVAIL_ERR	Display not available.
A306 NOT_AVAIL_ERR	Quick flash memory not available.
A307 NOT_AVAIL_ERR	Memory manager (memory allocation heap) not available.
A400 CHECKSUM_ERR	Failed code checksum test on powerup – returned by EPROM software when downloading code unsuccessfully, or when it is trying to initialize after a successful download.
A500 POWER_ERR	Power dropped below safe level – occurs at powerup and when trying to perform a write to flash memory, if there is insufficient power to perform the desired operation.
A600 QFLASH_TIMEOUT_ERR	Quick flash memory configuration timed out. Occurs in the interrupt handler routine, which is triggered every 1 msec, if there is a quick flash memory error.

Fatal Errors, Cont'd

Code	Cause
A700 QFLASH_ERR	Quick flash memory read did not match write. Occurs when verifying that configuration data written to flash memory actually matches that intended to be written, in size or content. This could follow configuration downloads, saving of autocal data or program files, etc.
A800 RAM_ERR	RAM error - occurs during failure of the RAM test on the test station. (EPROM test station error only.)
A900 HEAP_CORRUPTED_ERR	Memory manager (memory allocation heap) corruption detected – occurs when writing data to flash memory. This can also be detected during that portion of the software, which runs in the background, while other tasks are simultaneously running.

Bio-Stack Errors

The following error codes may be displayed on the ELx405™ during operation with the Bio-Stack™ Microplate Stacker. Refer to the **Troubleshooting and Error Codes** section of the Bio-Stack Operator's Manual for more information.

Code	Cause
<p>B-xxxx</p> <p>BIOSTACK_ERR</p>	<p>These are errors generated by the Bio-Stack during an operation (plate transfer, re-stacking, etc.) with the ELx405. See your Bio-Stack Operator's Manual.</p> <p>The following three errors are generated by the ELx405 during communication with the Bio-Stack.</p>
<p>B-8304</p> <p>NAK_RECEIVED_ERR</p>	<p>The ELx405 is unable to communicate with the Bio-Stack because the Bio-Stack didn't properly acknowledge a message sent to it. This occurs when a NAK is received from the Bio-Stack. This can happen during any message sent to the Bio-Stack, including those associated with retrieving information, as well as those used for moving motors.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • The ELx405 was turned on before the Bio-Stack finished its startup routine. • The ELx405 was turned on first, then the Bio-Stack was turned on. • The Bio-Stack has an error or is in a bad state and needs to be turned off and then turned back on. • The cable connection is lost, not allowing communications to transfer properly.

Bio-Stack Errors, Cont'd

Code	Cause
<p>B-8305</p> <p>INVALID_RESPONSE_ERR</p>	<p>The ELx405 has received an invalid message response from the Bio-Stack. Occurs when neither a NAK nor an ACK is received from the Bio-Stack. This can happen during any message sent to the Bio-Stack, including those associated with retrieving information, as well as those used for moving motors.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • The ELx405 was turned on before the Bio-Stack finished its startup routine. • The ELx405 was turned on first, then the Bio-Stack was turned on. • The Bio-Stack has an error or is in a bad state and needs to be turned off and then turned back on. • The cable connection is lost, not allowing communications to transfer properly.
<p>B-8306</p> <p>TIMEOUT_ERR</p>	<p>The ELx405 failed to communicate with the Bio-Stack because the serial communications timed out. This can happen during any message sent to the Bio-Stack, including those associated with retrieving information, as well as those used for moving motors.</p> <p>Probable Causes:</p> <ul style="list-style-type: none"> • The ELx405 was turned on before the Bio-Stack finished its startup routine. • The ELx405 was turned on first, then the Bio-Stack was turned on. • The Bio-Stack has an error or is in a bad state and needs to be turned off and then turned back on. • The cable connection is lost, not allowing communications to transfer properly.

Appendix C

Chemical Compatibility

This appendix lists the name and material(s) of each washer component that will come into contact with chemicals during operation or maintenance. If there are questions about compatibility of chemicals with the washer, contact Bio-Tek.

Components and Materials Composition	206
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Components and Materials Composition

Continuous contact with harsh chemicals is not recommended. It is best if the washer is rinsed with deionized water after contact with any strong acid, base, or solvent.

Components	Material Composition
Fluid inlet filter, inlet valve, manifold, waste sensor, fluid sensor ball retainer, Select CW low flow tubing	PVC
Fluid inlet filter, feeder tube to manifold, vacuum switch, fluid pump	304 SS
Dispense and aspirate tubes, feeder tubes to manifold, spring in bottle fittings	316 SS
Flow sensor	Polystyrene
Outlet fitting, fittings in bottles, inline fittings, ball	Polypropylene
Inlet fitting, vacuum switch adjustment screw	Nylon
Inlet tubing, outlet tubing, o-rings	Silicon
Channel-end seals	Neoprene
Outlet valve, fluid pump, Select CW inlet valve	Ryton
Inlet valve, vacuum switch	EP (ethylene propylene)
Outlet valve, Select CW inlet valve	Viton
Vacuum switch	Polycarbonate
Fluid pump	Santoprene*
Buffer bottle	Polyethylene
* Teflon® (if the washer is upgraded with PN 68098 Teflon valves, for use with acetic acid).	

Appendix D

Default Programs

This appendix lists all default wash, prime, dispense, aspirate, and maintenance programs available on the washer.

Default Programs.....	208
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Default Programs

	ELx405	Select	Select CW	Magna	HT
Wash					
COSTAR_FLAT	X	X	X	X	X*
COSTAR_ROUND	X	X	X	X	X*
NUNC_FLAT	X	X	X	X	X*
NUNC_ROUND	X	X	X	X	X*
NUNC_384		X	X		X*
192NUNC_384					X
Prime					
Autoprime	X	X	X	X	X
Prime_200	X	X	X	X	X
Prime_CW			X		
P_DAY_RINSE	X	X	X	X	X
P_RINSE_LOOP	X	X	X	X	X
P_RINSE_AND_SOAK	X	X	X	X	X
P_DECON1	X	X	X	X	X
P_DECON2	X	X	X	X	X
Dispense					
accuracy_qc_test	X	X	X	X	X*
192accuracy_qc					X
Aspirate					
residual_qc_test	X	X	X	X	X*
192resid_qc_test					X
Maintenance					
DAY_RINSE	X	X	X	X	X
OVERNIGHT_LOOP	X	X	X	X	X
RINSE_AND_SOAK	X	X	X	X	X
LONG_SHUTDOWN	X	X	X	X	X
DECONTAMINATION	X	X	X	X	X
AUTOCLEAN**	X	X	X		X
<p>*These programs are available in HT models when the accessory 96-tube manifold is installed. ** AUTOCLEAN appears only in models with the Ultrasonic Advantage™ (ultrasonic cleaner).</p>					

Appendix E

Changing the Manifolds

This appendix contains instructions for changing manifolds in ELx405 HT models with the accessory 96-tube manifold.

Changing Manifolds in HT Models With the 96-Tube Manifold.....	210
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Changing Manifolds in HT Models With the 96-Tube Manifold

HT models (HT2 and HTV2) that include the accessory 96-tube dual manifold are shipped with the 192-tube manifold installed, and the 96-tube manifold packaged in a special case (PN 7102136). This shipping case can be used to store whichever manifold is not being used (see **Figure 30** on page 212).

Before removing the installed manifold, it is recommended that you first run a Maintenance program (such as DAY_RINSE) to flush remaining residue from the manifold tubes, if the washer has been in operation.

❖ **Tip:** It will be easier to clean the manifold now, before removing and storing it, rather than after residuals in the manifold tubing and fluid paths have been allowed to dry or crystallize during storage.

1. Run DAY_RINSE, using deionized water in the supply bottle.
2. Run the system “dry”:
 - From the main menu, select UTIL → SETUP → SENSOR and set VACUUM DETECTION, FLUID DETECTION, AND FLOW DETECTION to NO.
 - Connect an empty supply bottle and run DAY_RINSE.
 - **Important!** Set the vacuum, fluid, and flow detection sensors back to YES.

❖ **HT models with the Ultrasonic Advantage™ (ultrasonic cleaner):** Run an AUTOCLEAN program instead of DAY_RINSE.

3. Turn off the washer and disconnect the power cord.
4. Remove the mist shield (if it is attached): using your fingers, loosen the two thumbscrews that fasten the shield to the front base of the washer, and set them aside, with the shield.
5. Using the 9/64” (3.57 mm) hex wrench supplied with the instrument, remove the screws, washers, and springs that hold the manifold in place, and set them aside.
6. Carefully remove the manifold and end plates, holding the upper and lower manifolds together as a single unit, and place the manifold into the shipping case for safe storage. If you ran DAY_RINSE or an AUTOCLEAN program as instructed in step 1 above, ensure that the manifold is thoroughly dry before storing it.

7. Install the alternate manifold and end plates, carefully holding the upper and lower manifolds together as a single unit, and making sure that the two o-rings do not fall out of their grooves during installation. **Do not overtighten the manifold mounting screws.**



Important! When reinstalling the manifold, only tighten the screw-washer-spring assembly that holds it in place until you feel the mechanical stop. You will damage the instrument if you continue tightening past this point, and will **void your warranty.**

8. Reinstall the mist shield:
 - Align the mist shield with the washer so it rests on top of the two posts and the two thumbscrew holes in the shield are lined up with the two holes in the base of the washer.
 - Insert the two thumbscrews and **finger-tighten only.**
9. Configure the washer for operation with the correct manifold by using the **Manifold Selection** feature in the Utility (**UTIL**) menu. Follow the menu path shown below, and select **96** or **192**, as appropriate.

UTIL → **SETUP** → MORE → MORE → MORE → **MANIFOLD** →
MANIFOLD SELECTION **96** or **192**

10. Re-prime the washer.



Important! The correct manifold (**96** or **192**) must be chosen in the **Manifold Selection** feature **before** operating the washer. Failure to set the manifold type before operating the washer may damage the manifold and void your warranty.

Refer to **Manifold Selection** in **Chapter 3, Operation**, for more information.

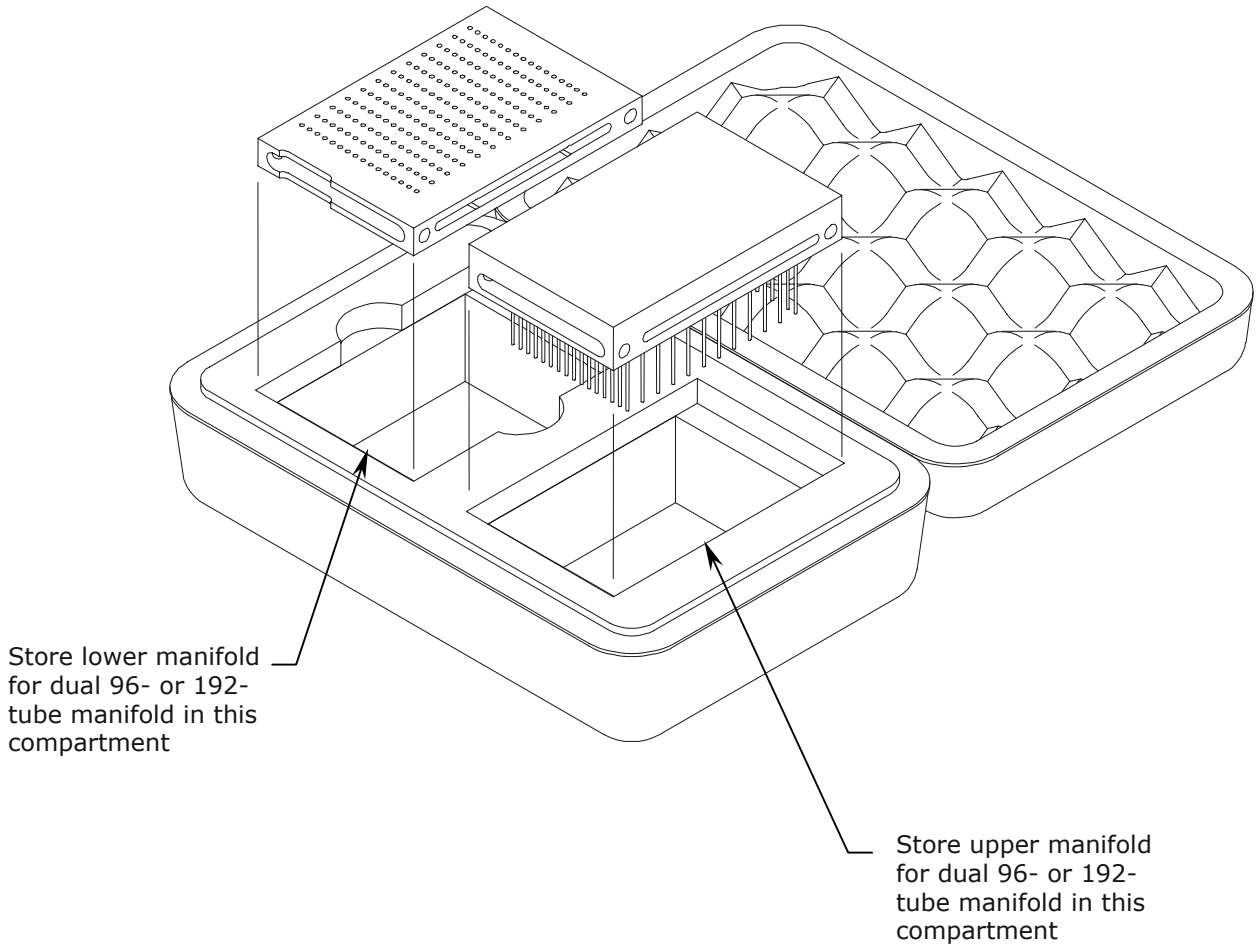


Figure 30: Storing the 96- or 192-Tube Dual Manifold in the Shipping Case

Index

A

Accessories
 Optional, 9

Accessory 96-tube manifold, 3
 Repackaging, 37

accuracy_qc_test, 153, 154, 155

Air bubbles in tubing, 50

Aspirate height, 62

Aspiration delay, 63, 66

Aspiration height, 62, 65

Aspiration program, 83
 Copy aspiration program, 85
 Define aspiration program, 84
 Delete aspiration program, 85
 Edit aspiration program, 84
 Run aspiration program, 83

Aspiration rate, 63, 66

Assays
 Cellular, 2
 ELISA, 2

AUTOCLEAN
 Creating and running programs, 124, 125
 Error codes, 198, 199
 Warning, xix

AUTOPRIME, 110

B

Biohazards, xix

Bio-Stack
 Compatibility with washer, 2, 4
 Installation with washer, 36
 Operation with washer, 48

Bottles
 Cleaning, 115
 Connection, 26

Bottom wash options, 58, 60

Bovine serum albumin, xxi, 112

C

Carrier
 Cleaning, 115
 Cleaning the transport arm, 116
 Installation, 22
 Magnetic plate carrier, 22

Cell washer, 3

Channel-end seals
 Cleaning and replacing, 136
 Part number, 104

Checksum Test, 145

Chemical compatibility
 Components and materials composition,
 206

Chemical Compatibility

Caution, xx

Chemiluminescence, 2

Clean components, 114

Cleaning

Bottles, 115

Manifold, 118

Plate carrier, 115

Contact information, xiii

Application support, 14

Technical support, 12

Copyright information, iii

Crosswise aspiration options, 64, 66

D

Daily maintenance tasks, 109

DAY_RINSE, 109

Decontamination, 128

Alternate decontamination procedure,
132

Before shipping, 38

Bottles, 115

Decontamination of external surfaces, 129

DECONTAMINATION program, 130

US Department of Transportation
requirements, 38, 128

Default programs, 208

Dispense flow rate, 56, 59

Dispense height, 56, 59

Dispense Precision Test

Defined, 146

For 192-tube, 160

For 96 tube, 153

Valve module, 154, 161

Dispense program, 79

Copy dispense program, 81

Define dispense program, 80

Delete dispense program, 82

Edit dispense program, 81

Run dispense program, 79

Dispense volume, 56, 59

DNA Probes, 2

Dual Action manifold, 3

E

Electrical grounding, xix

ELISA, 2

ELx405

ELx405 model, 3

HT model, 3

Key features, 2

Magna model, 3

Select CW model, 3

Select model, 3

Variations, 3

ELx405 model, 3

Environmental conditions, xx

Error codes, 185

AUTOCLEAN, 198, 199

Bio-Stack, 186, 203

Fatal, 200

General (noncritical), 187

Evacuation Efficiency Test

Defined, 146

For 192-tube, 157

For 96-tube, 150

F

Fluid inlet filter
 Cleaning, 126

Front panel, 42

G

General usage guidelines, 49
 Before running any program, 49
 Maintenance, 50
 Programming considerations, 51

Grounding, xix

H

Hardware features, 6

Hazardous material, 38

High Flow vacuum pump
 Caution, xxi
 Installation, 28

Horizontal aspiration position, 62, 66

Horizontal dispense position, 57, 60

Horizontal Y aspiration position, 63, 66

Horizontal Y dispense position, 57, 60

HT model, 3
 Changing the manifolds, 209
 HT2 and HTV2 models, 3

Humidity warning, xix, 22

I

Installation Qualification (IQ), 142

Installation qualification package, 35

Intended use
 Clinical, xviii
 Research and development, xviii

Internal voltage, xix

K

Keypad
 Description, 43
 Entering program names, 44

L

Leaking
 From external tubing connector, 181
 From manifold, 181
 From underneath washer, 181

Link programs, 88
 Define link program, 89
 Delete link program, 90
 Run link program, 88

Liquid testing, 146
 Dispense Precision Test, 153, 160
 Evacuation Efficiency Test, 150, 157
 Materials, 148
 Solutions, 149
 Which tests to perform, 147

Low vacuum, 175

M

Magna model, 3
Magnet aspiration height, 62, 66
Main Menu, 46
Maintenance
 Daily, 109
 Overnight/multi-day, 111
 Periodic, 114
 RINSE_AND_SOAK program, 112
Maintenance programs, 106
 DAY_RINSE, 109
 OVERNIGHT_LOOP, 111
 RINSE_AND_SOAK, 112
Manifold
 Cleaning, 118
 Shipping bracket, 21
Mist shield
 Cleaning, 118
 Installation, 33

O

Operating environment
 Humidity, 22
 Temperatures, 22
Operational qualification (OQ), 142
O-rings
 Part number, 104
 Replacing, 136
Overnight/multi-day maintenance tasks, 111
OVERNIGHT_LOOP, 111

P

Package contents, 8
Performance Qualification (PQ), 143
Performance specifications, 11
Performance verification
 After installation, 35
Periodic maintenance tasks, 114
Plate carrier
 Cleaning, 115
Plate type, 53
Plate type prompt, 84
Power Cord
 Installation, 34
Prepare washer for storage/shipment, 134
 Storage temperatures, 135
Preventive maintenance, 102
 Defined, 102
 Tasks and frequency, 103
 Tools and supplies, 104
 Warnings and precautions, 105
Prime after soak, 55
Prime flow rate, 55, 59, 61
Prime program, 73
 Copy prime program, 77
 Define prime program, 74
 Delete prime program, 77
 Edit prime program, 76
 Prime_200, 78
 Prime_CW, 78
 Recommended prime and low flow prime volumes, 76
 Run prime program, 73
Prime programs, 107
 AUTOPRIME, 110

Prime volume, 55, 59, 61

Problems

Aspiration tubes not entering well correctly, 182

Carrier/manifold position, 174

Display (LCD) not on, 173

Leaking, 181

Manifold position error, 182

Plate overfills, 179

Poor/uneven aspiration, 175

Scratches on microplate bottom, 183

Too much residual in wells, 177

Unable to dispense fluid, 178

Uneven dispensing, 180

Vacuum pump, 173

Programs

Aspiration, 83

AUTOCLEAN, 123

DECONTAMINATION, 130

Dispense, 79

Link, 88

LONG_SHUTDOWN, 134

Prime, 73

RINSE_AND_SOAK, 112

Soak, 86

Wash, 52

Protein residuals

BSA caution, xxi

Removing, 112

R

Registration

Card, xxviii

Online, xxviii

Regulations, 38

Remove magnet (during shake), 55

Repackaging and shipping
Washer, 37

Replace components, 136

Replace channel-end seals, 136

Replace o-rings, 136

residual_qc_test, 150

Restrictions and liabilities, iii

Return Materials Authorization (RMA),
xviii, 12, 38

RIA, 2

Rinse/soak the fluid path, 109

RINSE_AND_SOAK program, 112

RS-232

Port, 34

S

Safety symbols, xxv

Select CW model, 3

Select model, 3

Select reagent bottle prompt, 80

Self Test

At system startup, 45

Serial

Communications, 34

Setup utilities, 91

Adjust utility, 92

Bio-Stack utilities, 93

Delay after dispense, 94

Manifold selection, 95

Park utility, 93

Plate clearance height, 94

RS-232 settings, 91

Sensor system, 91
Vacuum dissipation delay, 94

Shipping
Address for Bio-Tek, 13
Bracket removal/installation, xxi, 18, 21, 38
Preparing instrument for, 38
RMA, 38

Soak program, 86
Copy soak program, 87
Define soak program, 86
Delete soak program, 87
Edit soak program, 86

Soak/shake options, 54, 55

Software features, 7

Specifications, 10
Electrical, 10
Environmental, 10
Manifold type, 10
Microplates, 10
Physical, 10

Spilled fluids, xx

Storing the washer, 135

Supply system
Installation, 30

Symbols, using in program name, 44

System Self Test, 144

T

TAC, 12

Technical assistance center, 12

Tests
Checksum Test, 145
Dispense Precision, 192-tube, 160

Dispense Precision, 96-tube, 153

Evacuation Efficiency, 192-tube, 157

Evacuation Efficiency, 96-tube, 150

System Self Test, 144

Troubleshooting, 171
Charts, 173
Checklist, 172
Fluid aspiration, 175
Fluid delivery, 178
Fluid leakage, 181
Microplate carrier movement, 182
Microplate scratches, 183
Washer manifold movement, 182
Washer Start-Up, 173

Tubes
Installation of, 26

Tubing
Air bubbles, 50
Cleaning, 118

Typographic conventions, xiv

U

Ultrasonic Advantage, 2, 123
Models, 3

Unpacking
Valve module, 19
Washer, 16

V

Vacuum
Low, 175

Vacuum on volume, 56, 59

Valve module, external

- Attaching to washer, 30
- Compatibility with washer models, 2, 3
- Dispense Precision Test, 154, 161
- Repackaging and shipping, 39
- Unpacking, 19

Verification schedule, 141

Voltage, xix

W

Warranty, xxvii

- Conditions for voiding, 16, 21

Wash format, 54, 55

Wash program, 52

- Copy wash program, 71
- Define wash aspirate program options, 62
- Define wash dispense program options, 56
- Define wash method program options, 54
- Define wash program, 53
- Delete wash program, 72
- Edit wash program, 71
- Run wash program, 52

Washer menu maps, 96

Waste sensor port

- Caution, xxi

Waste system

- Installation, 28

