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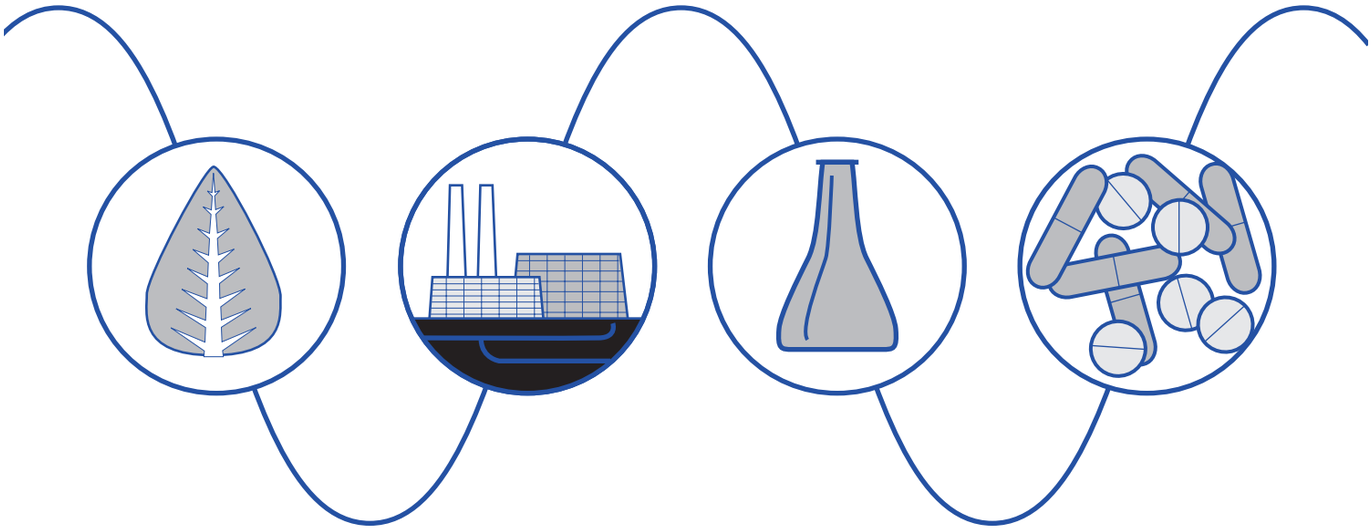
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Waters 717plus Autosampler

Operator's Manual



Waters

34 Maple Street
Milford, MA 01757

173-02TP, Revision 2

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Attention: *The Waters 717plus Autosampler may be used for IN VITRO diagnostic applications. This is a highly sensitive instrument. Read the accompanying operator's manual before using.*

When using the instrument, follow generally accepted procedures for quality control and methods development.

If you observe a change in the retention of a particular compound, in the resolution between two compounds, or in peak shape, immediately take steps to determine the reason for the changes. Until you determine the cause of a change, do not rely upon the results of the separations.



Attention: *Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.*



Attention: *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. 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 harmful interference, in which case you must correct the interference at your own expense.*

Shielded cables must be used with this unit to ensure compliance with the Class A FCC limits.



Caution: *For continued protection against fire hazard, replace fuses with those of the same type and rating.*



Caution: *To avoid the possibility of electric shock, do not remove the power supply covers. The power supply does not contain user-serviceable components.*



Attention: *To meet the regulatory requirements of immunity from external electrical disturbances that may affect the performance of this instrument, do not use cables longer than 9.8 feet (3 meters) when you make connections to the screw-type barrier terminal strips. In addition, ensure you always connect the shield of the cable to chassis ground at one instrument only.*

The Installation Category (Overvoltage Category) for this instrument is Level II. The Level II category pertains to equipment that receives its electrical power from a local level, such as an electrical wall outlet.

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Canadian Emissions Notice

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

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans les règlements sur le brouillage radioélectrique édictés par le Ministère des Communications du Canada.

Symbols Used on 717plus Autosampler

	Direct current
	Alternating current
	Protective conductor terminal
	Frame or chassis terminal
	Caution, risk of electric shock (high voltage)
	Caution or refer to manual

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How to Use This Manual

Purpose of This Manual

The *Waters 717plus Operator's Manual* describes the features and use of the Waters™ 717plus Autosampler. It also includes installation, maintenance, and troubleshooting procedures.

Audience

The audience for this operator's manual includes chemists and technicians who will use the autosampler to make injections for chromatographic analysis.

Structure of This Manual

This manual is divided into chapters. Each chapter page is marked with a tab and a footer facilitating access to information within the chapter.

The table below describes the material covered in each chapter.

Chapter 1, Introduction	Describes the Waters 717plus Autosampler.
Chapter 2, Installation	Provides procedures for installing the Waters 717plus and making fluidic and electrical connections.
Chapter 3, Startup and Configuration	Provides procedures for starting up, calibrating, configuring, verifying, and powering down.
Chapter 4, Operating the Autosampler	Provides procedures for preparing and loading samples, programming and using the automatic features, and making a stat run.
Chapter 5, Maintenance	Provides procedures for defrosting the heater/cooler and for replacing the syringe, seal pak, and in-line filters.

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Chapter 6, Troubleshooting	Provides troubleshooting tables to aid in problem diagnosis and information about error messages.
Appendix A, Specifications	Lists Waters 717plus specifications.
Appendix B, Spare Parts	Lists spare parts.
Appendix C, Warranty Information	Contains the warranty and a key to serial number interpretation.
Appendix D, Reproducibility and Solvent Degassing	Provides information about the factors affecting reproducibility and the theory and methods of solvent degassing.
Appendix E, Selecting Sample Vials	Provides information about selecting sample vials.

Related Adobe™ Acrobat Reader Documentation

For detailed information about using the Adobe Acrobat Reader, refer to the *Adobe Acrobat Reader Online Guide*. This Online Guide covers procedures such as viewing, navigating and printing electronic documentation from Adobe Acrobat Reader.

Printing From This Electronic Document

Adobe Acrobat Reader lets you easily print pages, pages ranges, or the entire electronic document by selecting **Print** from the File menu. For optimum print quantity, Waters recommends that you specify a Postscript printer driver for your printer. Ideally, use a printer that supports 600 dpi print resolution.

Conventions Used in This Guide

This guide uses the following conventions to make text easier to understand.

- **Purple Text** indicates user action. For example:

  Press **0**, then press **Enter** for the remaining fields.

- *Italic* text denotes new or important words, and is also used for emphasis. For example:

  An *instrument method* tells the software how to acquire data.

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- Underlined, Blue Color text indicates hypertext cross-references to a specific chapter, section, subsection, or sidehead. Clicking this topic using the hand symbol automatically brings you to this topic within the electronic document. Right-clicking and selecting **Go Back** from the popup context menu brings you back to the originating topic. For example:

  For details on selecting a needle wash solution for a specific sample, refer to Section 4.3, Selecting a Needle Wash Solvent.

Notes, Attentions, and Cautions

- Notes call out information that is important to the operator. For example:

  Note: *Record your results before you proceed to the next step.*

- Attentions provide information about preventing possible damage to the system or equipment. For example:



Attention: *To avoid damaging the detector flow cell, do not touch the flow cell window.*

- Cautions provide information essential to the safety of the operator. For example:



Caution: *To avoid chemical or electrical hazards, always observe safe laboratory practices when operating the system.*



Caution: *To avoid the possibility of electrical shock and possible injury, always turn off the detector and unplug the power cord before performing maintenance procedures.*

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1 Introduction

This chapter introduces you to the Waters™ 717plus Autosampler. The autosampler's operational features are summarized and its components described.

1.1 Description

The Waters 717plus Autosampler injects samples into a high performance liquid chromatography (HPLC) system. The Waters 717plus automates sampling by storing up to 96 sampling methods or "steps". Each method controls all injection parameters for a sequence of vials.

The Waters 717plus (Figure 1-1) may be used as either a stand-alone unit or as a component in a Waters IEEE-488 based HPLC system. As part of an IEEE-488 based system, the autosampler may be controlled by Waters PowerLine™ System Controllers or Waters Data Workstations.

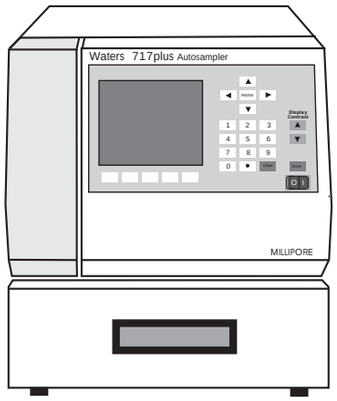


Figure 1-1 Waters 717plus Autosampler

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1.2 Features

Sample Carousels and Vials

The Waters 717plus autosampler features:

Two carousel sizes:

- **48-vial carousel** - Holds 4 mL sample vials
- **96-vial carousel** - Holds 1 mL sample vials

A variety of sample vials are available. For details, refer to Appendix E, Selecting Sample Vials.

Multi-method Automatic Sampling

An auto sampling multi-method may contain:

- Up to 96 steps, with each step containing a different sampling method
- Random access to any single or series of vials

Priority (Stat) Sampling

The Stat function:

- Interrupts a programmed sampling method.
- Performs injections from a single vial or a series of vials.
- Returns to the interrupted sampling method, and continues auto sampling from the interruption point.

Automated Options

The 717plus allows you to program the following options:

- **Auto Addition** - Allows you to inject a common solution with each sample.
- **Auto Standards** - Allows you to run standards automatically during a run.
- **Auto Transfer** - Allows you to program the 717plus to transfer solutions from specified vials to your sample vial; to mix the solution; and to inject.

Interaction with Other LC Modules

The Waters 717plus sends and receives signals from other LC modules, including:

- **Inject Start** - Occurs when the sample is injected into the mobile phase stream. Initiates data acquisition, fraction collection, and detector autozero. Contact closure is initiated by the autosampler.

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- **Inject Stop** - Occurs when the programmed run time expires. Signals data integrators that the chromatography run is complete. Contact closure is initiated by the autosampler.
- **Hold** - Halts the autosampler until the signal changes. Can be used to prevent sample injections if an LC system module fails or while a data acquisition system is preparing for the next run. Signal is received from external devices.
- **Report Delay** - Delays the next injection until a data integrator can complete a report for the previous run. The delay is a programmable interval that occurs after the Inject Stop signal.
- **Programmable Event** - The 717plus includes a programmable event output that can control external devices during a run.

IEEE-488 Bus Communication

As part of a Waters IEEE-488 system, the Waters 717plus autosampler accepts programming and control signals from an LC system controller.

RS-232 Communications

The Waters 717plus autosampler sends data over an RS-232 communication line. The data is in ASCII format and contains:

```
VIAL # nn  INJ # n OF n

INJ VOL nnnn  RUN TIME nnnnn
```

Purge and Compression

Purge and compression testing capability includes:

- **Purge** - Fills the sample loop and injection syringe with fresh mobile phase.
- **Compression** - Tests the sample loop for gas content (compressibility). Compressibility limits may be set for specific mobile phases. Testing may be automatic or operator initiated.

Needle Wash System

The needle wash system:

- Prevents cross-contamination of samples
- Extends seal life by removing the mobile phase and the sample from the sampling needle

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Semiprep Chromatography

For semiprep chromatography (up to 2 mL injections), the 717plus autosampler may be configured with optional:

- **2000 µL sample loop** - Required for injections greater than 200 µL
- **2500 µL syringe** - Speeds pre-injection sequence for samples greater than 150 µL

Microbore (< 1 µL) Chromatography

For microbore chromatography, the 717plus autosampler may be configured with:

- 25 µL syringe for improved injection volume precision below 1.0 µL
- Low volume sample vials

Syringe Speed

The autosampler syringe speed is adjustable for each syringe size and allows you to adjust for sample viscosity.

Heater/Cooler

The Waters 717plus Autosampler may be configured with a heater/cooler to maintain constant sample compartment temperature from 4 to 40°C.

1.3 Components and Subsystems

717plus Components

This section describes the components and subsystems of the Waters 717plus Autosampler (Figure 1-2):

- **Front Panel** - Contains a display screen, keypad, and function keys, and provides access to the control system.
- **Autosampler Controller** - Contains a microprocessor and memory for controlling all autosampler components.
- **Sample Transport System** - Positions sample vials under the injector.
- **Fluid Pack** - Contains all components involved in directing mobile phase and sample to the column. Performs purges and mobile phase compression tests.
- **Injector** - Withdraws the sample (aliquot) from the sample vial, and performs an injection into the mobile phase.
- **Syringe** - Draws samples and compresses the mobile phase during testing.
- **Needle Wash System** - Cleans the outside of the needle to prevent cross-contamination of samples.

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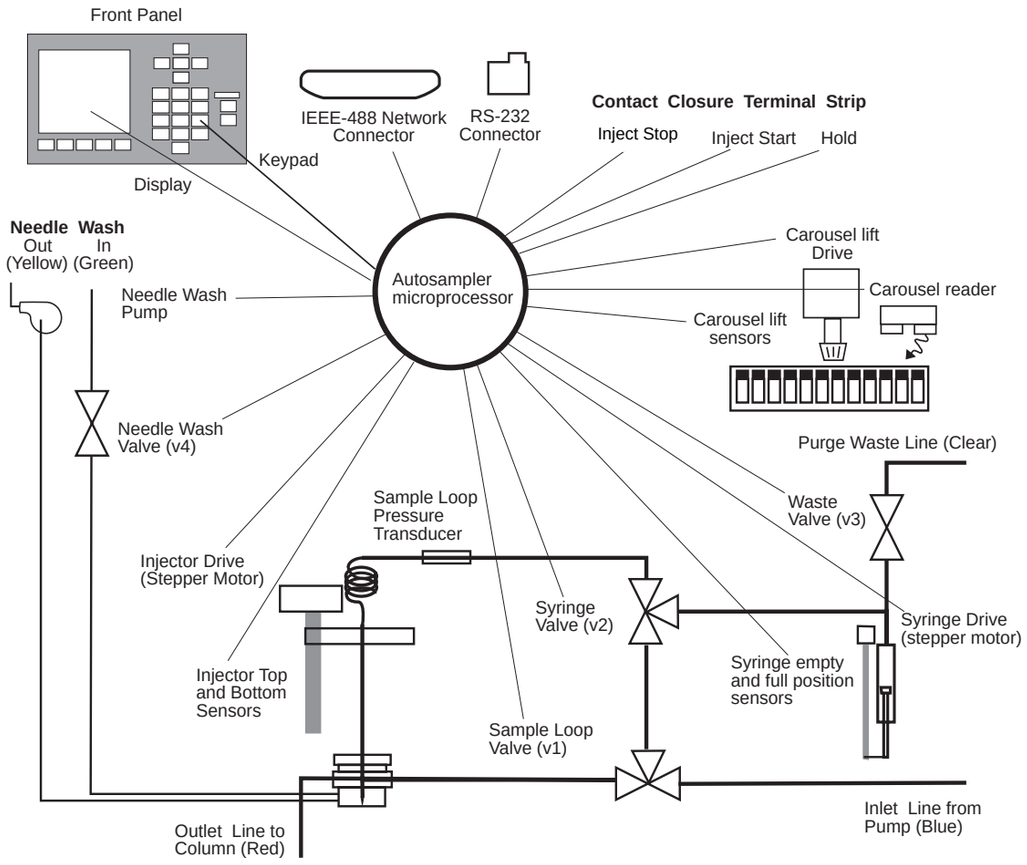


Figure 1-2 Waters 717plus Autosampler Subsystems

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2 Installation

This chapter describes 717plus installation and setup. It includes procedures for making connections, voltage selection, and configuring optional hardware.

2.1 Site Requirements

Required Space

Before beginning the installation procedure, note the following autosampler site and utility requirements (Figure 2-1):

Note: *The autosampler site requires room for a waste bottle and a needle wash solvent reservoir.*

- **Bench space** - Allow 21 x 23.5 inches (53 x 72 cm) for the autosampler. This space includes ventilation sides 2.5 inches (6.3 cm) and back 3.5 inches (8.75 cm).

  Note: *Ensure the bench top must be level to ensure proper drainage of the solvent spill lines.*

- **Bench space with heater/cooler installed** - Allow an additional three inches on the back and on each side next to the air vents.

  Note: *To avoid heater/cooler performance degradation, do not place the rear of the unit in an enclosed space, under a shelf, or near a heat source.*

- **Column location** - Ensure the red fluid line reaches the column. Lengthening this line may result in peak broadening.
- **Waste and solvent container location** - Place the needle wash reservoir at bench level to prevent siphoning.

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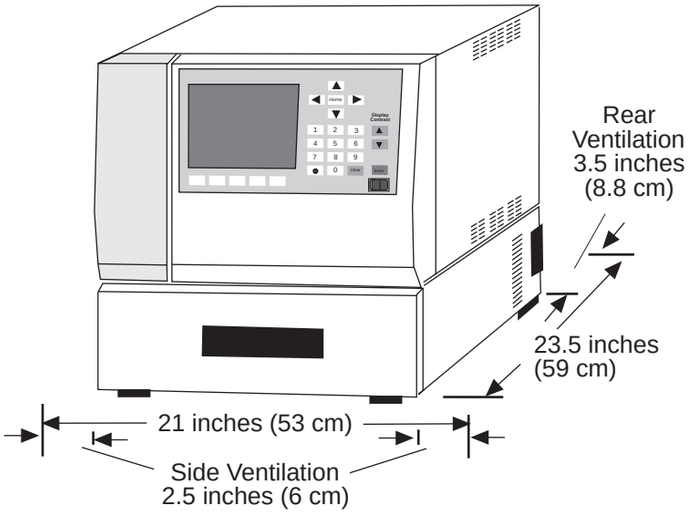


Figure 2-1 Waters 717plus Autosampler Site Requirements

Operating Conditions

Locate the Waters 717plus in a clean area free from extremes in temperature, humidity, strong radio frequency radiation, appreciable shock or vibration. The Waters 717plus operates within the following ranges:

Temperature	4 to 40 °C Note that cooler performance is derated above 27 °C
Humidity	80% maximum relative humidity, non-condensing

Do not locate the Waters 717plus in direct sunlight, near heat registers, or under air conditioning vents.

Weight

Requires a bench capable of supporting at least 75 lbs.

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Power Requirements

Requires 5 Amps at 110 Vac (nominal) or 4 Amps at 220 Vac (nominal) from a grounded outlet.

2.2 Unpacking and Inspection

Unpacking

To unpack your unit:

1. Remove the straps and open the top of the shipping carton.
2. Remove the Startup Kit.
3. Remove the packing material from the carton.
4. Lift the carton sides from the base of the carton to expose the autosampler.



Caution: *The autosampler weighs approximately 63 pounds (28.6 kg). Two people are required to safely lift the autosampler; use care when lifting.*

5. Grasp the autosampler from the bottom to lift. Do not lift by holding the front panel.
6. Place the 717plus securely on the bench top. Allow clearance for the power cord and ventilation.

List of Components

The autosampler shipping carton contains:

- Waters 717plus autosampler
- Startup Kit

Reporting Damage

Check the packing list against the contents as you unpack, and confirm that all items are included. If you find any damage or discrepancy, immediately report any damage to both the shipping carrier and to your Technical Service representative. You can contact Waters Technical Service at (800) 252-4752, *U.S. and Canadian customers only*. Other customers, call your local Waters subsidiary or your local Waters Technical Service Representative, or call Waters corporate headquarters for assistance at (508) 478-2000 (U.S.).

If any items are damaged, use the shipping container for subsequent claim purposes.

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2.3 Changing Voltage Configuration

The Waters 717plus autosampler is shipped in a 120 V/60 Hz configuration. If you require a different voltage setting, change the configuration.

Tools required:

- One small-blade screwdriver
- One Phillips-head screwdriver
- One pair of needlenose pliers

Caution: *Disconnect the autosampler power cord before continuing this procedure.*

For continued protection, use only fuses of the approved type and rating, as indicated by the label on the rear panel near the power cord connector

Selecting Voltage

To select the voltage configuration:

1. Disconnect the power cord from the back of the Waters 717plus Autosampler.
2. Insert a small-blade screwdriver into the notch just to the right of the power cord connector and pry off the fuse block cover (Figure 2-2).

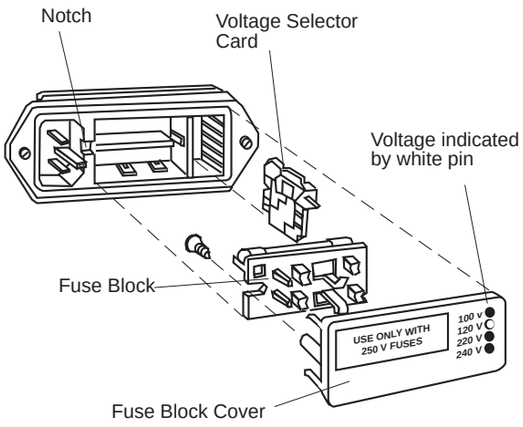


Figure 2-2 Fuse Block and Voltage Selector Card

3. Grasp the voltage selector card and pull it straight out of the housing.

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Attention: *Do not use the voltage selector card to compensate for low line voltage. Always use a selection that equals the nominal line voltage, or power surges may damage the instrument.*

4. The edge of the voltage card is labeled with four voltages (Figure 2-3). Position the voltage indicator pin on the opposite side of the card from the required voltage. Seat the indicator in the notch on the edge of the card.

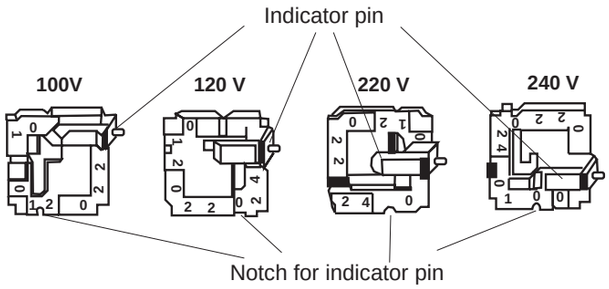


Figure 2-3 Voltage Selector Card

5. Insert the voltage selector card into the housing until it is firmly seated.

Changing Fuses

Change the fuse block arrangement if the fuse requirements change from single 1/4-inch x 1 1/4-inch to dual 5 mm x 20 mm.

To change the fuse configuration:

1. Loosen the Phillips screw two turns and remove the fuse block by tilting it up and sliding it away from the screw (Figure 2-4).

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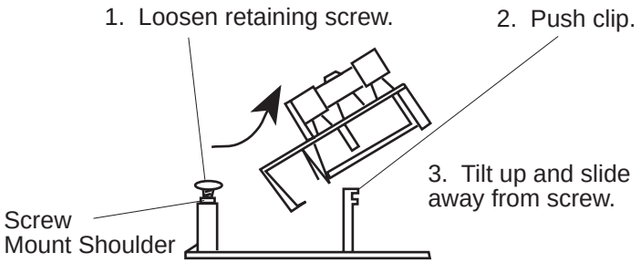


Figure 2-4 Removing the Fuse Block

2. Orient the fuse block for the desired voltage (Figure 2-5) as follows:
   - For single 1/4-inch x 1 1/4-inch fuse arrangements, install the fuse block with the fuse and jumper bar facing away from the cover.
   - For dual 5 mm x 20 mm fuse arrangements, install the fuse block with the two fuses facing away from the cover.

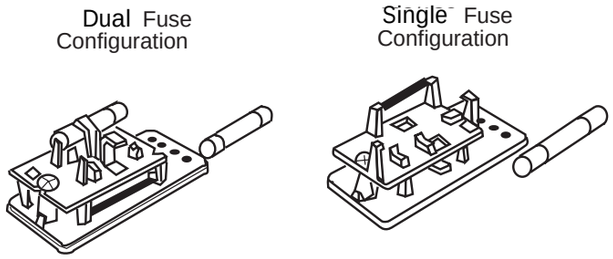


Figure 2-5 Fuse Installation

3. Install the appropriate fuse or fuses as labeled on the rear panel near the power cord connector.
4. Ensure that the assembly is seated against the shoulder of the screw mount and tighten the Phillips screw.
5. Install the fuse block and cover in the rear panel of the autosampler. Make sure that the indicator pin fits through the appropriate opening on the left end of the cover.

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2.4 Connecting Fluid and Drain Lines



Caution: *Observe safe laboratory practices when handling solvents. Refer to the Material Safety Data sheets for the solvents in use.*

The Waters 717plus Autosampler fluid lines are:

- **Green** - Plastic tubing for needle wash inlet
- **Yellow** - Plastic tubing for needle wash waste
- **Clear** - Plastic tubing for purging the sample loop waste
- **Blue** - High pressure steel tubing, 0.04-inch (1 mm) I.D., connects the autosampler to the pump
- **Red** - High pressure steel tubing, 0.009-inch (0.2 mm) I.D., connects the autosampler to the column
- **Drain** - Two 1/4-inch clear lines attached to the drip trays on bottom of the autosampler. One line drains solvent and sample spills. The other line drains water when the heater/cooler is defrosted.

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Connecting Fluid Lines

To connect the fluid lines (Figure 2-6):

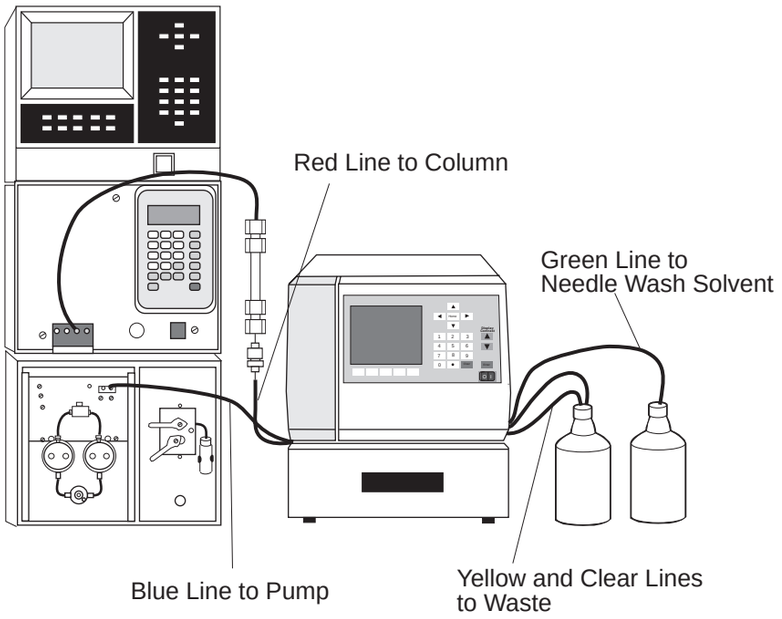


Figure 2-6 Fluid Line Connections

1. Cut the plastic tie securing the coil of tubing located at the rear of the autosampler. The coil consists of yellow, clear, and green tubing.
2. Fill a flask with a filtered solution of 90 percent methanol/10 percent water. Use this solution for the needle wash during installation. Place the flask at bench level, and put the end of the green line in the solution.

   Note: *For details on selecting a needle wash solution for a specific sample, refer to Section 4.3, Selecting a Needle Wash Solvent.*

3. Place the ends of the yellow (needle wash waste), and clear (purge waste) lines in appropriate containers.
4. Connect the blue line to the pump. Do not connect the red line to the column inlet until you flush the system (see Section 3.3, Flushing the Autosampler).

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Attention: *Ensure that the red and blue fluid lines are in the side panel slots and not pinched between the cover and side panels.*

Installing Drain Lines

Using parts from the 717plus Startup Kit, connect the two drain lines to the drain pans located on the bottom of the autosampler (Figure 2-7) as follows:

1. Place an appropriate waste container for solvent and sample leaks below bench level.
2. Cut a length of 1/4-inch tubing long enough to reach the waste container from the autosampler.
3. Slip the tubing strain relief onto the tubing and push it onto the fitting for the solvent drain pan (located on left side).
4. Use the elbows to facilitate bends in the tubing.
5. If you have a heater/cooler, connect a drain line for condensation/defrosting following steps 1 through 4.

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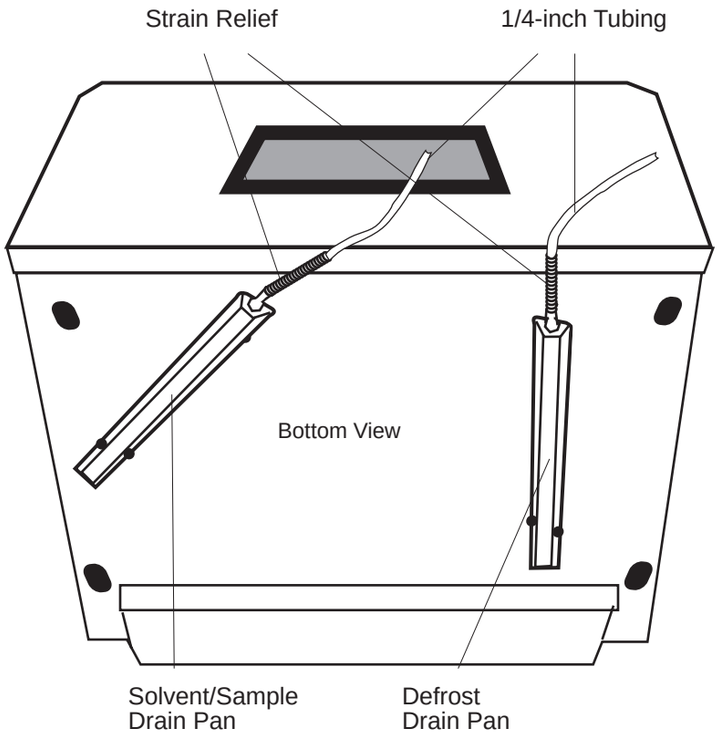


Figure 2-7 Drain Line Connections

2.5 Connecting Communication Cables

The 717plus autosampler communicates with other LC system components via the following connections on the rear panel of the autosampler (Figure 2-8):

- **Terminal Strip** - Contact closure signals from the terminal on the back panel provide communication with non-IEEE-488 LC components.
- **IEEE-488** - Communicates with a system controller over the IEEE network.
- **RS-232** - Provides information to RS-232 based data systems such as the Waters 746 Data Integrator.

This section describes the communication connections listed above.

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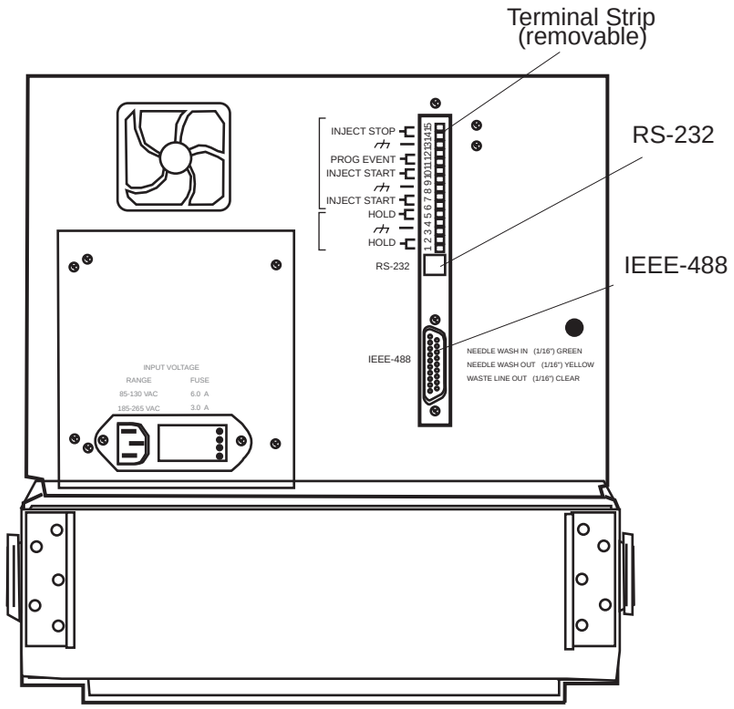


Figure 2-8 Autosampler Rear Panel

2.5.1 Making Terminal Strip Connections

This section covers:

- Terminal strip signals
- Electrical specifications
- Making cable connections
- Making system controller connections
- Making detector connections
- Making pump connections
- Making programmable event output connections

Refer to Figure 2-8 while performing the following procedures.

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Terminal Strip Signals

The signals available on the back panel terminal strip include:

Table 2-1 Terminal Strip Signals

Terminal Numbers	Signal Name	Description
1, 2	Hold	Input signals the autosampler to hold (pause) the injection sequence
4, 5	Hold	Input signals the autosampler to hold (pause) the injection sequence
6, 7	Inject Start	Output signals the start of an injection
9, 10	Inject Start	Output signals the start of an injection
11, 12	Prog Event	Programmable event output signal
14, 15	Inject Stop	Output signals the end of the programmed run time
3, 8, 13	Ground	Signal ground for cable shields

For specific information on signal use with other Waters equipment, refer to the appropriate manual.

Electrical Specifications

Input (Hold) terminal specifications are:

- TTL or switch closure
- Low trigger < 1.8 V
- High trigger > 3.0 V
- Protected to ±30 V
- Minimum pulse width: 30 milliseconds
- Maximum current: 5 milliamps

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Output (Inject Start/Inject Stop) specifications are:

- Contact closure
- Maximum power 10 watts
- Maximum current: 0.5 amps at 20 V
- Maximum voltage: 40 Vdc at 0.25 amps



Attention: *Do not connect two cables to the same autosampler terminal on the terminal strip.*



Attention: *To meet the regulatory requirements of immunity from external electrical disturbances that may affect the performance of this instrument, do not use cables longer than 9.8 feet (3 meters) when you make connections to the screw-type barrier terminal strips. In addition, ensure you always connect the shield of the cable to chassis ground at one instrument only.*

Making Cable Connections

Tools required:

- One small-blade screwdriver
- One electrical insulation stripping tool
- Signal cable from 717plus Startup Kit

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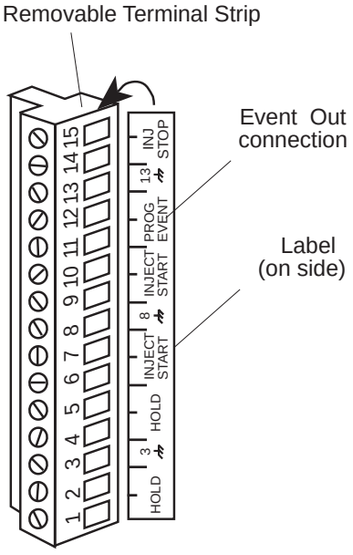


Figure 2-9 Terminal Strip

To connect cables from other LC devices to the terminal strip on the back panel (Figure 2-9):

1. To facilitate making connections, remove the terminal strip from the rear panel (see Figure 2-8).
2. Strip 1/4 inch (5 mm) of insulation from each wire at one end of the signal cable.
3. Insert the bare wire into the appropriate connector, and secure it by screwing down the connector.

Note: *If multiple components require an injection start signal, use separate INJECT START terminals for each component. Do not exceed the 0.5 A and 20 V maximum open circuit limit for a terminal.*

System Controller Connections

Note: *Some system controllers do not allow injections of less than 1 µL. To make injections of less than 1 µL, do not operate the Waters 717plus autosampler over the IEEE bus.*

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Using a signal (contact closure) from the Waters 717plus autosampler, a Waters system controller can coordinate the start of detectors, pumps, and computers. For specific details on programming a system controller, refer to the system controller operator's manual.

To connect a system controller, connect the Inject Start terminal on the autosampler as outlined in Table 2-2.

Table 2-2 System Controller Connections

Autosampler Terminal	Controller	Controller Terminal
Inject Start	Millennium™ Chromatography Manager	Event In for channel 1 or 2
Inject Start	ExpertEase SAT/IN™	Event In for channel 1 or 2
Inject Start	ExpertEase SIM	Start Inject and COM
Inject Start	600 Series	INJ and GND
Inject Start	Maxima™ Watch Dog Event Box	IN 1 or IN 2

Making LAC/E Connections

Use the Inject Start signal from the Waters 717plus:

- If the LAC/E system contains components such as detectors that are not connected to the IEEE-488 bus.
- If the ExpertEase™ multi-method is set to "Start by Injector."

Making Detector Connections

Waters detectors use the start of the injection for:

- Auto zeroing
- Start of data transfer
- Detector chart marking

For specific details on programming a detector for an auto zero, refer to the detector operator's manual.

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Auto Zero

To enable an auto zero, connect the Inject Start terminal on the autosampler as outlined in Table 2-3.

Table 2-3 Auto Zero Connections

Autosampler Terminal	Detector	Detector Terminal
Inject Start	490E	Event In 1
Inject Start	996	Event In 1
Inject Start	Other Waters detectors	Auto Zero

Detector Data Transfer and Chart marking

Using the Inject Start signal from the Waters 717plus autosampler, a Waters detector can:

- Start data transfer over the IEEE-488 bus when the autosampler initiates an injection

  Note: *If you specify start by LAC/E, you do not need the Inject Start signal.*

- Indicate the start of an injection on a chart recorder

For specific details on connecting a chart recorder to the detector, refer to the detector operator's manual.

To enable a detector to mark a chart recorder, connect the Inject Start terminal on the autosampler as outlined in Table 2-4.

Table 2-4 Chart Mark Connections

Autosampler Terminal	Detector	Detector Terminal
Inject Start	490E	Event In 1
Inject Start	996	Event In 1

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Table 2-4 Chart Mark Connections (Continued)

Autosampler Terminal	Detector	Detector Terminal
Inject Start	Other Waters detectors	Chart Mark

Making Pump Connections

Waters 600 series gradient controllers provide a Hold signal to stop the next injection. Connect the Waters 717plus autosampler to the 600 series pump as follows:

Autosampler	600 Series
HOLD	HOLD and GRN

Making Event Output Connections

Connect a signal cable to the Prog Event terminals (pins 11 and 12, pin 13 for ground) on the 717plus autosampler terminal strip (Figure 2-9).

2.5.2 Making IEEE-488 Network Connections

The IEEE-488 bus provides a communication link between the Waters 717plus autosampler and system controllers such as the Millennium Chromatography Manager, ExpertEase data systems (through a LAC/E module), and 600 series system controllers.

Making IEEE-488 Bus Connections

With all instruments powered down, make the following cable connections (Figure 2-10):



Attention: *Power down all instruments on the IEEE-488 bus before making connections.*

1. Connect one end of the IEEE-488 cable to the IEEE connector of the 717plus autosampler.
2. Connect the other end of the IEEE-488 cable to a system controller or to any one of your IEEE-488 components.

   Ensure that all IEEE cable screws are fastened securely.

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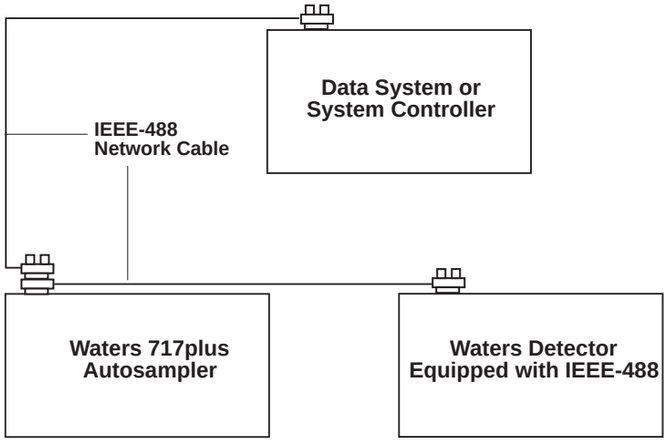


Figure 2-10 IEEE-488 Connections

Setting IEEE-488 Addresses

In order to interact with the PowerLine system controller or LAC/E, each device on the IEEE-488 communications bus must have a unique individual address.

Note: *To use the autosampler on the IEEE-488 network, change the autosamplers IEEE-488 address (refer to Section 3.6.2, Setting Parameters for LC System Operation).*

2.5.3 Connecting RS-232 Output to Data Module

The RS-232 connector on the rear panel allows the autosampler to transfer injection parameters to a data integrator such as the Waters™ 746 Data Integrator.

You may use the RS-232 port with any device that can read ASCII code.

To connect to the RS-232 port, plug the cable into the modified phone jack connector on the rear panel of the Waters 717plus autosampler.

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RS-232 Parameters

Note: *RS-232 parameters are not user-configurable.*

Table 2-5 RS-232 Parameters

Parameter	Value
Baud rate	1200
Number of bits	8
Number of stop bits	1
Parity	none

2.6 Changing the Hardware Configuration

This section covers:

- Removing the autosampler cover
- Installing the heater/cooler
- Installing the auxiliary sample loop

2.6.1 Removing/Replacing the 717plus Cover



Caution: *To avoid the possibility of electric shock, disconnect the autosampler power cord before continuing this procedure.*

Removing the Cover

To remove the autosampler cover (Figure 2-11):

1. Turn off the autosampler and disconnect the power cord.
2. Remove the syringe cover, and unscrew the cover retaining screw located to the right of the magnetic latch.
3. Slide back the cover until it clears the posts on the rear panel.
4. Ensure that the red and blue fluid lines are free of the side cover slots.
5. Lift the cover up and back.

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Attention: *Always replace the 717plus autosampler cover to maintain RFI and EMI shielding integrity.*



Caution: *To avoid the possibility of electric shock, do not remove the power supply cover. The power supply does not contain user-serviceable components.*

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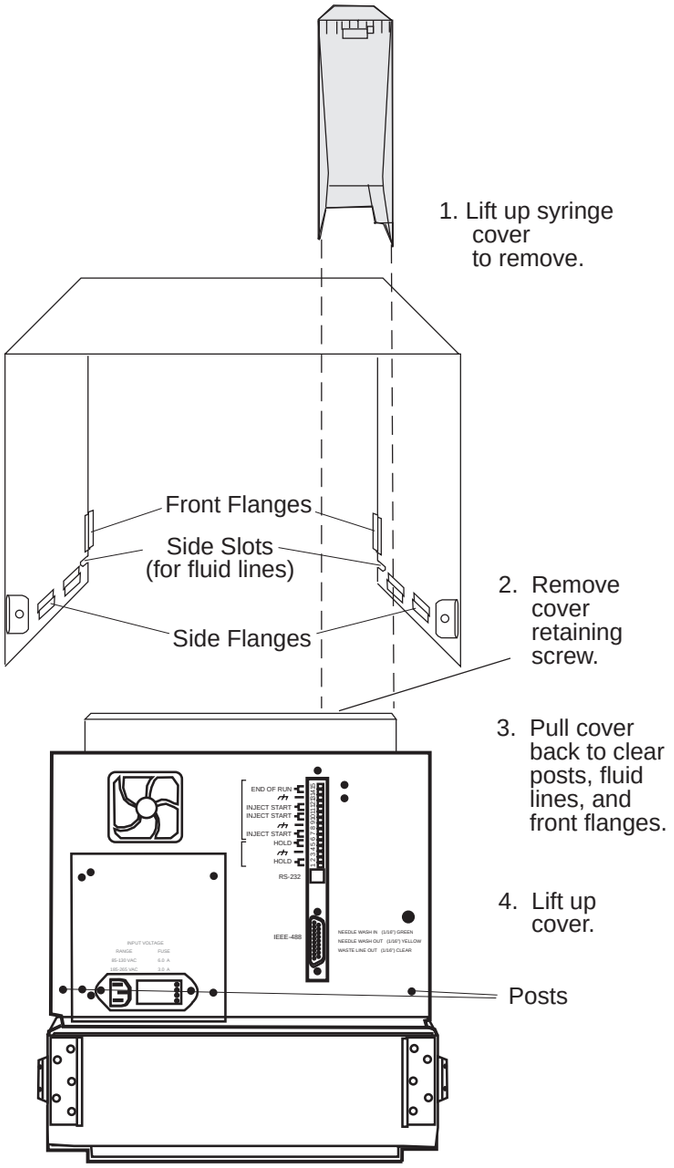


Figure 2-11 Removing the Autosampler Cover

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Replacing the Cover

To replace the autosampler cover:

1. Lower the cover onto the autosampler leaving a 2-inch space between the cover and the front panel.
2. Before sliding the cover forward, ensure that the red and blue fluid lines are in the side slots and that the flanges fit over the sides of the base.
3. Slide the cover forward until it seats on the rear panel posts.
4. Secure the cover retaining screw on the right of the magnetic latch, and replace the syringe cover.
5. Reconnect the power cord.

2.6.2 Installing the Heater/Cooler



Caution: *To avoid the possibility of electric shock, disconnect the autosampler power cord before continuing this procedure.*

This section describes the following procedures:

- Remove the rear chamber assembly
- Install the heater/cooler
- Connect the heat/cooler power cord
- Install the temperature probe

To install the heater/cooler:

1. Disconnect the power cord and remove the autosampler cover (see Section 2.6.1, Removing/Replacing the 717plus Cover).
2. Remove the rear chamber assembly by unlatching the side clips, and pulling the assembly back.
3. Slide the heater/cooler into the autosampler until the side clip latches are in position to close. Take care not to damage the insulation.
4. Clamp the heater/cooler to the autosampler using the two side clips (Figure 2-12).

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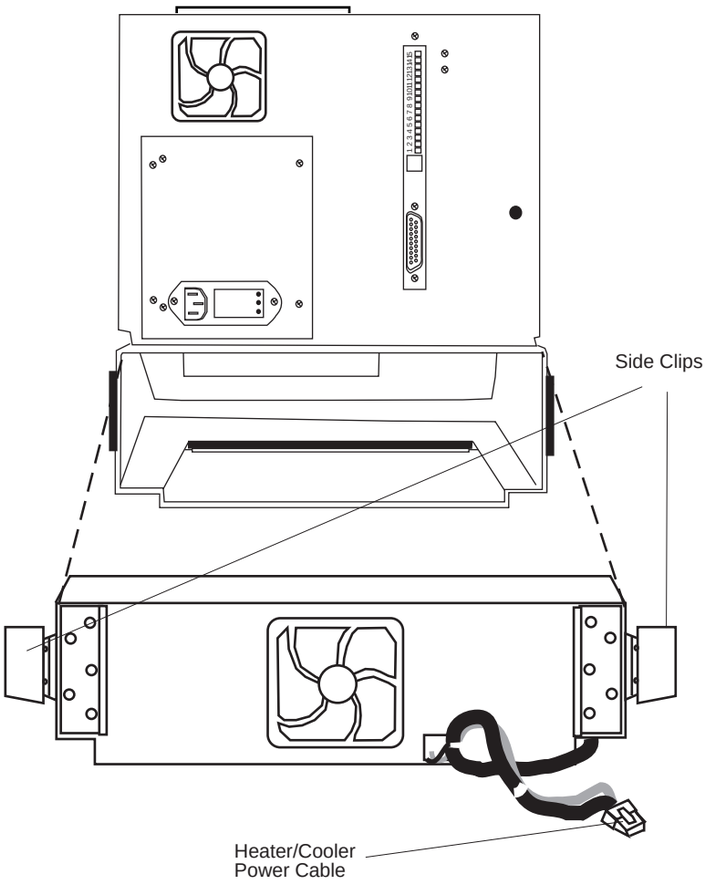


Figure 2-12 Installing Heater/Cooler

5. Feed the power cable up through the opening in the chassis and attach it to the J20 connector on the main circuit board (Figure 2-13).

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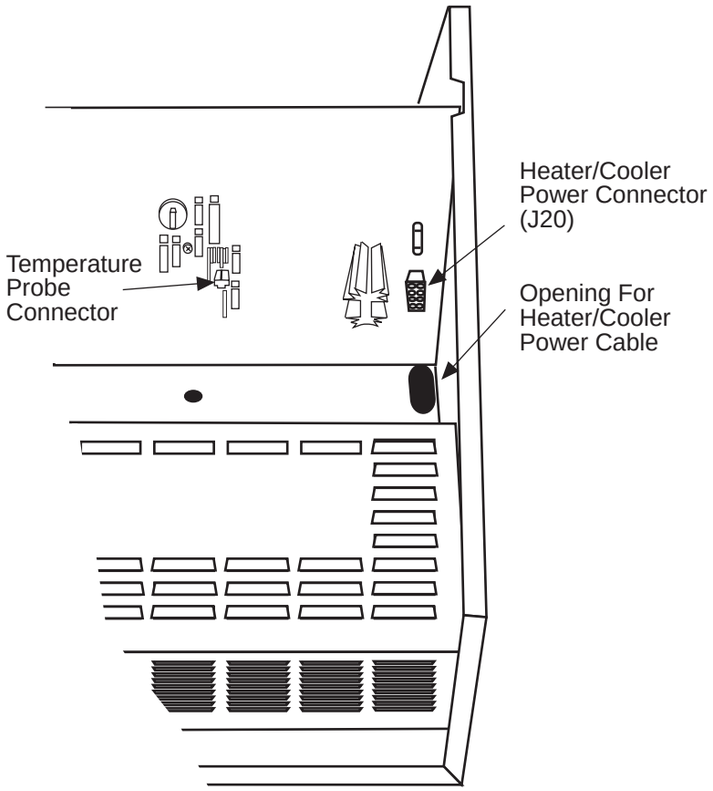


Figure 2-13 Connecting the Heater/Cooler Power Cord and Temperature Probe

6. Push the temperature probe through the grommet located on the floor of the unit behind the carousel drive (Figure 2-14). Push the probe down until it reaches the stop.

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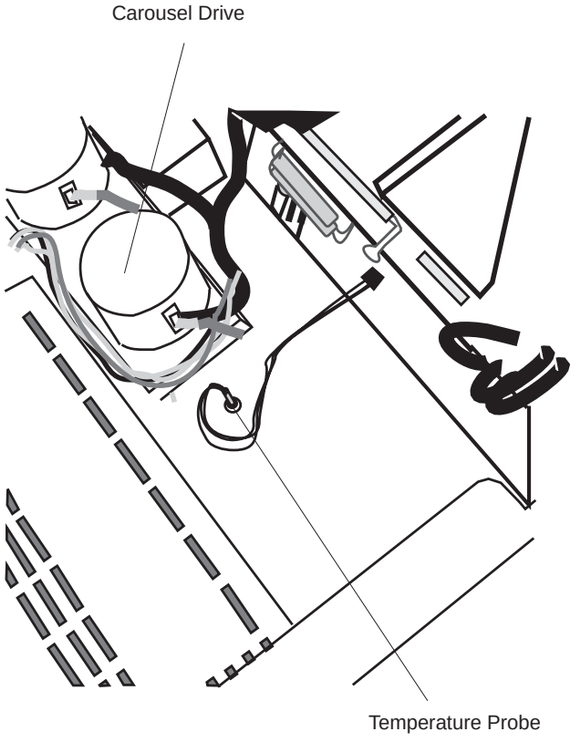


Figure 2-14 Installing the Temperature Probe

7. Attach the temperature probe connector to the main circuit board. The temperature probe connects to the main circuit board at J18, located to the lower right of the battery (see Figure 2-13).
8. Replace the autosampler cover (see Section 2.6.1, Removing/Replacing the 717plus Cover) and reconnect the power cord.

2.6.3 Installing the Large Sample Loop

To inject sample volumes greater than 200 µL, you must install the auxiliary loop.

Caution: *To avoid the possibility of electric shock, disconnect the autosampler power cord before continuing this procedure.*

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Required tools:

- One 5/16-inch wrench
- One adjustable wrench
- Auxiliary loop from 717plus Startup Kit
- Union from 717plus Startup Kit

To install the loop:

1. From the 717plus front panel, set system flow to 0 mL/min.
2. Turn off the autosampler, disconnect the power cord, and remove the autosampler cover (see Section 2.6.1, Removing/Replacing the 717plus Cover).
3. Disconnect the sample loop at the filter using the 5/16-inch wrench (Figure 2-15).

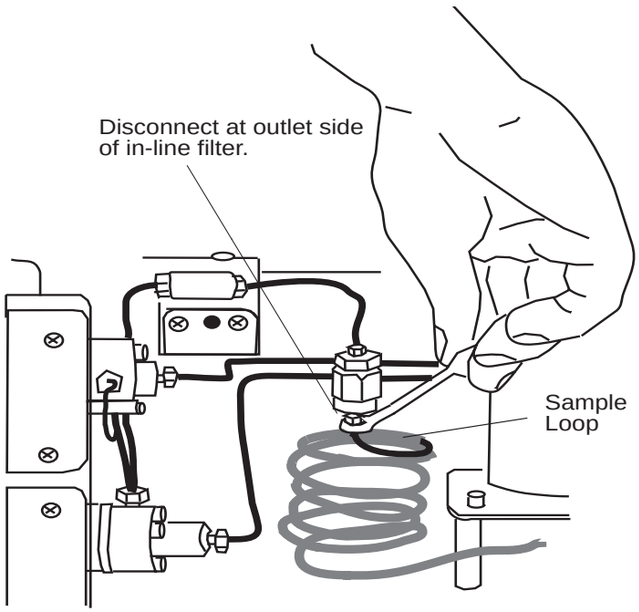


Figure 2-15 Disconnecting the Sample Loop

4. Connect the auxiliary loop to the filter.
5. Using a union from the Startup Kit, connect the auxiliary loop to the sample loop.
6. Replace the cover, reconnect the power cord, and turn on the autosampler.

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7. Complete the configuration procedures discussed in Section 3.6.3, Entering Hardware Changes.

If the auxiliary loop was added to a previously configured autosampler, perform the procedures in:

- Section 3.3, Flushing the Autosampler
- Section 3.7, System Verification
- Section 4.5.2, Performing a Purge

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3
Startup and Configuration

This chapter provides procedures for starting up, calibrating, configuring, verifying, and powering down the Waters 717plus autosampler.

3.1 Powering Up the Autosampler

Note: *If the 717plus autosampler is part of an IEEE-488 system, power up the 717plus autosampler before powering up the system controller.*

Powerup

To power up the 717plus autosampler:

1. Press the 1/0 (on/off) switch (Figure 3-1) on the front panel.

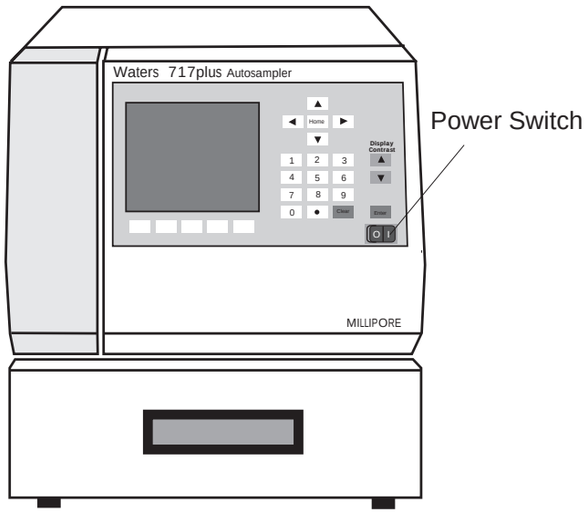


Figure 3-1 Power Switch Location

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2. Wait for the initializing sequence to complete and the IDLE message to appear in the upper left corner (Figure 3-2).

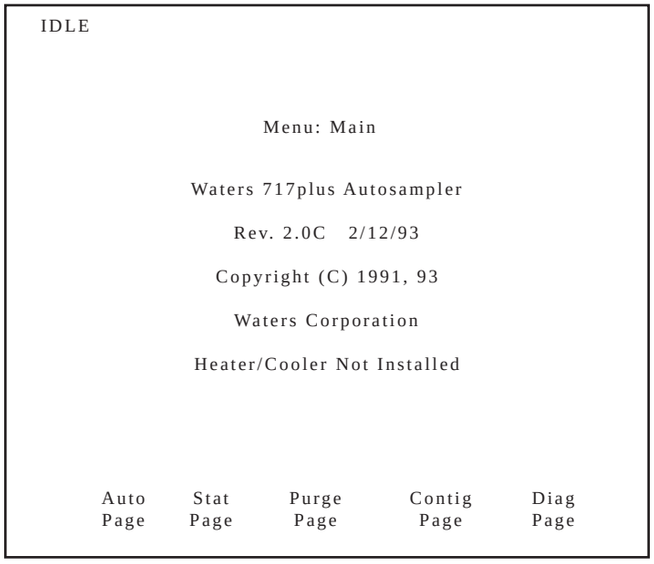


Figure 3-2 Main Menu

Adjusting Display Contrast

If you do not see the Main menu, or need to improve readability, adjust the screen display contrast as follows:

- If the screen appears blue in color, press the Display Contrast **Up arrow** (see Figure 3-3) until the screen text is in focus.
- If the screen appears white in color, press the Display Contrast **Down arrow** (see Figure 3-3) until the screen text is in focus.

3.2 Using the Front Panel

Use the front panel (Figure 3-3) to configure the 717plus system and perform injection programming.

This section describes:

- Accessing menus using menu function keys
- Entering operating parameters using the keypad

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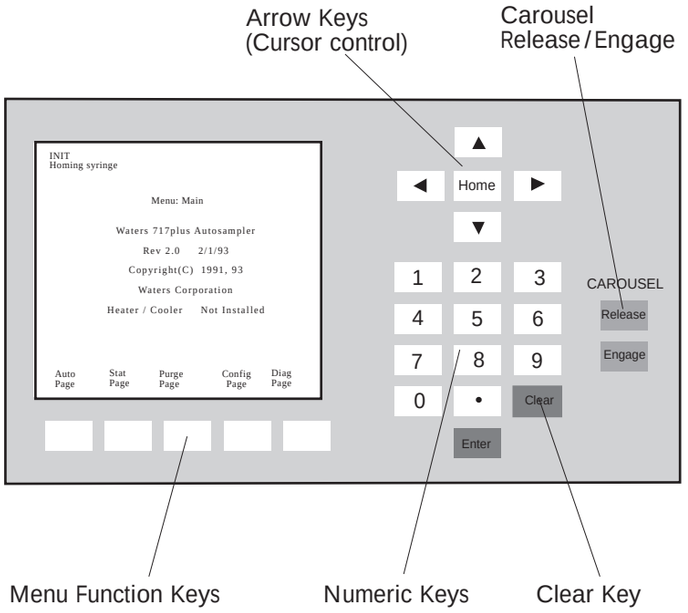


Figure 3-3 Front Panel

3.2.1 Accessing Menus

The Main Menu (see Figure 3-2) provides access to the main system operations:

Table 3-1 Menu Functions

Function Key	Menu	Function
Auto Page	Auto run	Program and run sampling methods
Stat Page	Stat run	Interrupt a programmed run for priority samples
Purge Page	Purge and compressibility	Purge sample loop and test compressibility of mobile phase

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Table 3-1 Menu Functions (Continued)

Function Key	Menu	Function
Config Page	Configuration	Set hardware and LC system configuration parameters
Diag Page	Diagnostics	Calibrate injector, test valves, perform maintenance

Access additional menus using the function keys below the screen. Menus are arranged as shown in the System Menu Flowchart (Figure 3-4).

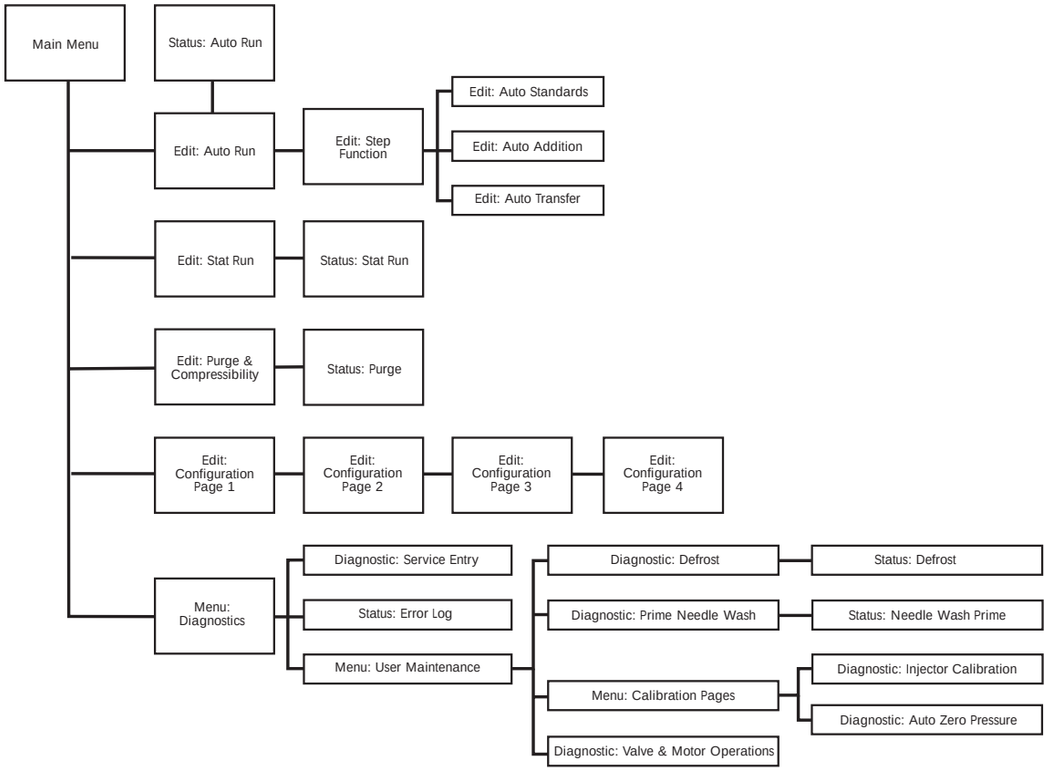


Figure 3-4 717plus Autosampler Menu Flowchart

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3.2.2 Entering Operating Parameters

To enter operating parameters:

1. Access the appropriate menu by pressing the screen function key.
2. Use the arrow keys (see Figure 3-2) to highlight the parameter you want to change.
3. If the parameter has two or more values, highlight the desired value and press **Enter**.
4. If there is one value, use the number keys to type a value and press **Enter** to record the new value.
5. If you make a mistake, press **Clear** to erase the value in the current parameter field.

3.3 Flushing the Autosampler

Solvent Considerations

When flushing or purging your 717plus, make sure the solvent is properly degassed and miscible with the previous mobile phase in the autosampler.

Flushing

To flush the 717plus autosampler:

1. Place the red line in a waste container to catch the solvent.
2. Set the mobile phase pump to deliver 1 mL/min of 100 percent methanol.
3. Continue pumping mobile phase for 10 minutes or until all air is forced out of the autosampler (no bubbles appear in the waste container).

3.4 Calibrating the Seal Pak

The Waters 717plus autosampler seal pak must be calibrated upon startup or after installation or service.

Injector calibration involves:

- Purging the autosampler
- Auto zeroing the transducer
- Calibrating the seal pak

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3.4.1 Purging the Autosampler

Before calibrating the seal pak, run a purge to ensure that there is no air in the autosampler, the mobile phase is fresh, and there are no bubbles in the syringe.

1. Using a degassed solution of 100 percent methanol, set the solvent delivery pump to 1 mL/min.
2. Remove the syringe cover panel to examine the syringe for bubbles.
3. From the Main Menu, press **Edit Purge**. The Purge and Compressibility menu appears (Figure 3-13), listing the default parameter values.
4. Use the arrow keys to set **Compression Check** to **No**, then press **Enter**. Press **Start Purge**.
5. Run at least 2 purges before calibrating the seal pak.
6. If the purging fails to remove bubbles from the syringe, perform a manual purge (Section 6.4.1, Manual Syringe Purge).

3.4.2 Auto Zeroing the Transducer

Auto zeroing the transducer ensures that pressure readings are accurate.

To zero the transducer:

1. Ensure that the system pressure is at 0 psi.
2. Set pump flow to 0 mL/min.
3. To auto zero the transducer, press the keys as outlined in the flowchart below (Figure 3-5).

After pressing Auto zero Pressure, the system requires approximately 2 minutes to auto zero the pressure.

If the system is unable to auto zero, manually adjust the transducer (Section 6.4.3, Manual Transducer Adjustment).

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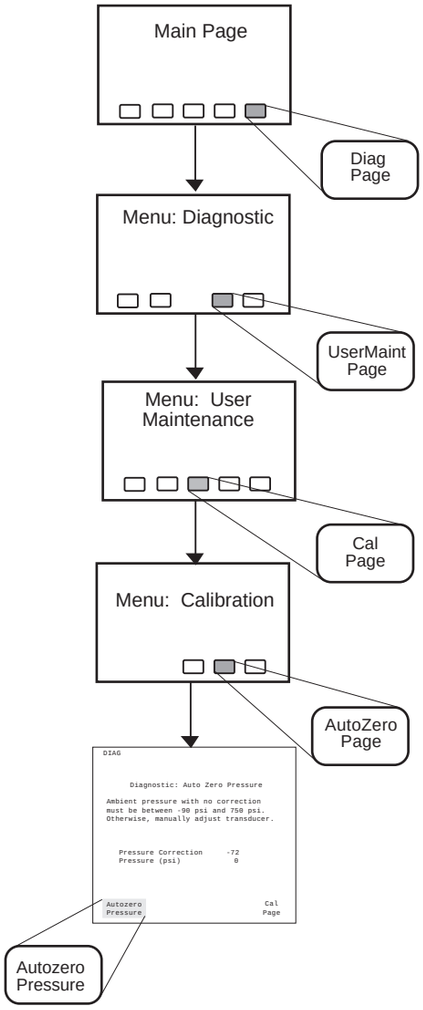


Figure 3-5 Path to Auto Zero Pressure Page

3.4.3 Calibrating the Seal Pak

The autosampler must be calibrated after:

- Initial installation
- Replacing the seal pak and needle

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Before Calibrating

Before running the seal pak calibration, ensure that:

- Two purges have occurred
- Pump pressure is 400 to 600 psi and flow at least 0.5 mL/min
- Solvent is 100 percent degassed methanol
- Mobile phase pump is free of pressure fluctuations
- Remove your column if it is sensitive to sudden pressure changes

To calibrate the seal pak:

1. Adjust the pump flow to achieve a pump pressure of between 400 and 600 psi.

   Note: *To attain sufficient backpressure without a column, it may be necessary to partially cap the red line with the union and fitting plug assembly included in the 717plus Startup Kit.*

2. To access and run the seal pak calibration, press the keys indicated in the flowchart below (Figure 3-6).

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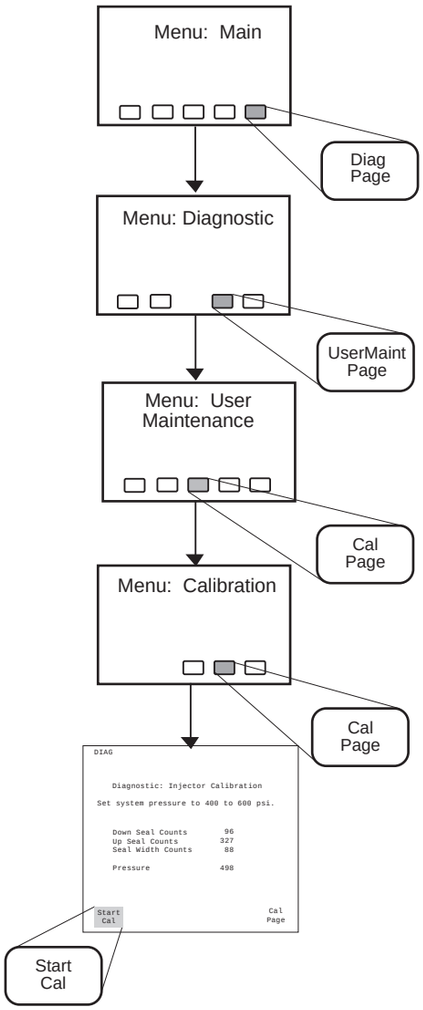


Figure 3-6 Path to Seal Pak Calibration Page

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3.5 Priming the Needle Wash Pump

To prime the needle wash pump:

1. Ensure that the needle wash supply line (green) is in the solvent bottle and the waste line (yellow) is in an appropriate container.
2. To prime the needle wash, press the keys outlined in the flowchart below (Figure 3-7).

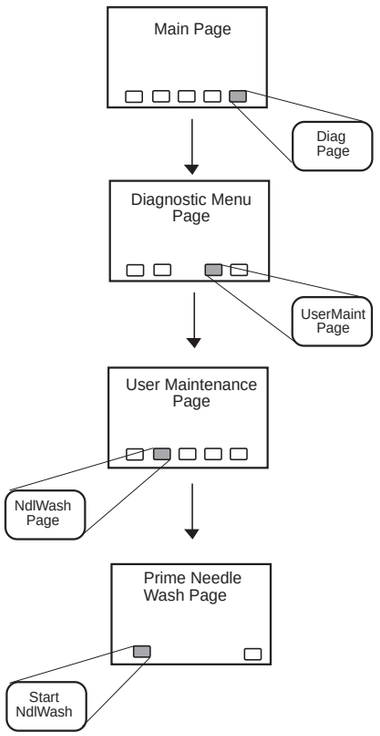


Figure 3-7 Priming the Needle Wash Pump

3. If, after 30 seconds, the solvent does not flow out of the waste line, press **Start NdlWash** again.

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3.6 Configuring the Autosampler

Configuring the Waters 717plus Autosampler requires:

- Setting parameters to enable the autosampler to communicate with other modules in the LC system
- Recording changes to autosampler hardware (syringe size and sample loop volume)

3.6.1 Overview of Configuration

Refer to the Autosampler Configuration flowchart (Figure 3-8) for a 717plus configuration overview.

Table 3-2 provides a summary of parameters from the Configuration Pages.

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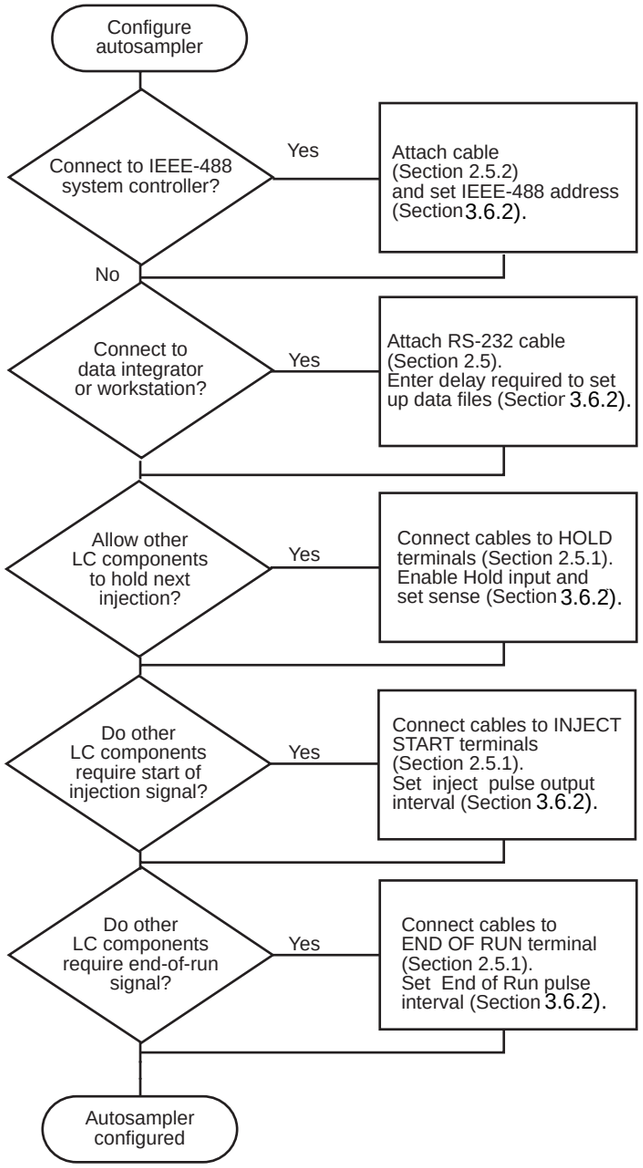


Figure 3-8 Autosampler Configuration Flowchart

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Configuration parameters are shown in Table 3-2.

Table 3-2 Configuration Parameters

Parameter	Configuration Page	Description
Purge In Idle?	1	Enables purging every 60 minutes while the 717plus is idle. See Section 4.8.5, Using Buffered Mobile Phase.
Vials Between Purges	1	Enables automatic purging during an auto run. See Section 4.8.4, Purging During an Auto Run.
Halt Bad Comp Check?	1	Prevents the next injection when a compression check (auto purge) fails. See Section 4.8.4, Purging During an Auto Run.
Report Delay	1	Delays the next injection to allow a data integrator to complete the processing of the previous run. See Section 3.6.2, Setting Parameters for LC System Operation.
Hold Input?	2	Enables other LC components to stop the injector. See Section 3.6.2, Setting Parameters for LC System Operation.
Hold Contact Sense?	2	Sets polarity of signal arriving at the terminal strip. See Section 3.6.2, Setting Parameters for LC System Operation.
Inject Start Pulse	2	Sets length of pulse used to signal other LC components that an injection occurred. See Section 3.6.2, Setting Parameters for LC System Operation.
Inject Stop Pulse	2	Sets length of pulse used to signal other LC components that the run has ended. See Section 3.6.2, Setting Parameters for LC System Operation.

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Table 3-2 Configuration Parameters (Continued)

Parameter	Configuration Page	Description
Temp Setpoint	2	Sets temperature for sample compartment heater/cooler. See Section 4.8.1, Temperature Control.
Temp Control?	2	Enables temperature control for units with heater/cooler. See Section 4.8.1, Temperature Control.
Draw Rate	3	Sets syringe draw rate. See Section 4.8.3, Injecting Viscous Samples.
Syringe Volume?	3	Set equal to installed syringe size. See Section 4.8.2, Microbore/Semiprep Injections.
Loop Volume?	3	Set equal to installed sample loop size. See Section 4.8.2, Microbore/Semiprep Injections.
Installed IEEE Address	4	Displays current address. See Section 3.6.2, Setting Parameters for LC System Operation.
Desired IEEE Address	4	Sets new IEEE address. See Section 3.6.2, Setting Parameters for LC System Operation.

3.6.2 Setting Parameters for LC System Operation

To communicate with other LC system components:

- Set Report Delay for data integrators
- Set terminal strip signal parameters for Hold, Injection Start, and Injection Stop
- Set IEEE-488 address

Setting Report Delay

The Report Delay provides time for the data integrator to process data from a run before a new injection begins.

If a data integrator is attached to the LC system, set the delay as follows:

1. From the 717plus Main Menu, press **Config Page**.

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2. On Configuration Page 1 (Figure 3-9), highlight the Report Delay field and enter the **delay time** in minutes.

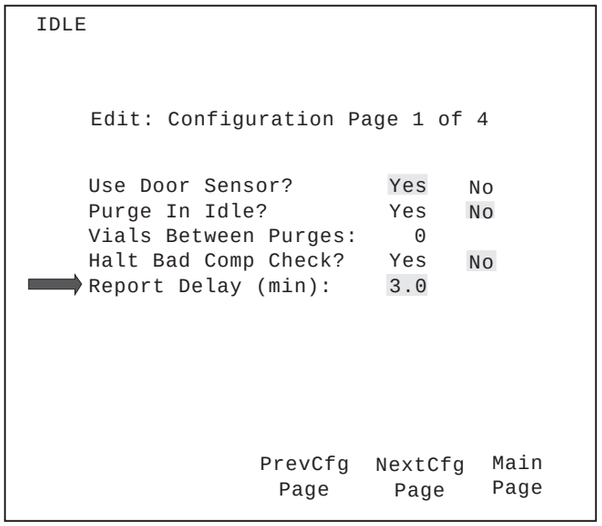


Figure 3-9 Setting the Integrator Report Delay

Setting Terminal Strip Signal Parameters

To set the contact closure parameters for LC components connected through the terminal strip on the rear panel:

1. From the Main Menu, press **Config Page**.
2. Press **NextCfg Page** to access Configuration Page 2 (Figure 3-10).

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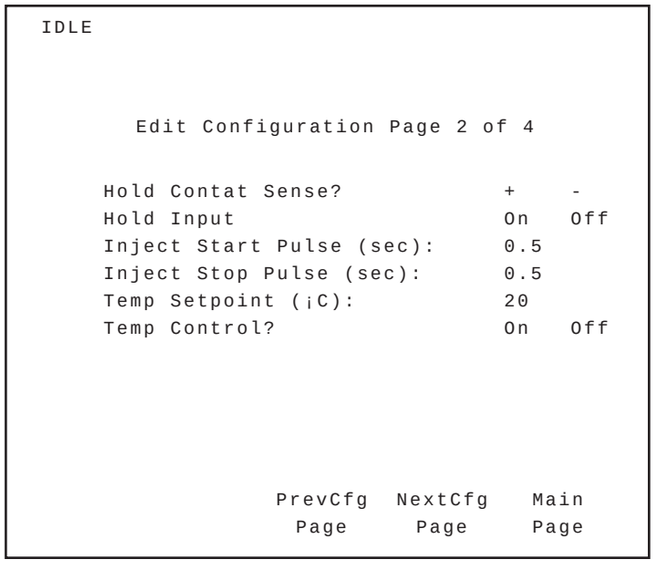


Figure 3-10 Setting Terminal Signal Parameters

Hold Contact Sense and Hold Input

3. To enable other instruments to stop an injection sequence:
   - Set the Hold Contact Sense parameter to the polarity of the incoming hold signal.

Table 3-3 Hold Logic

Hold Inputs	Positive Sense	Negative Sense
LOW LOW	RUN	HOLD
LOW HIGH	HOLD	HOLD
HIGH LOW	HOLD	HOLD
HIGH HIGH	HOLD	RUN

   - Set the Hold Input parameter to **On**.

Note: *Set Hold Input to* ***Off*** *for PowerLine control.*

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Inject Start Pulse

4. The Inject Start default pulse width is 0.5 seconds. Change the pulse width if the instrument connected to the autosampler requires a different setting.

Inject Stop Pulse

5. The Inject Stop Pulse signal default pulse width is 0.5 seconds. Change the pulse width if the instrument connected to the autosampler requires a different setting.

Setting IEEE-488 Address

To ensure that the autosampler is correctly identified when it is part of an IEEE-488 network, verify that the address is a unique number from 2 to 29. The default IEEE-488 address is set to 30.

Note: *To use the Waters 717plus Autosampler in an IEEE-488 network, you must change the address.*

To change the address:

1. From the 717plus Main Menu, press **Config Page**.
2. From Configuration Page 1, press **Next Cfg Page** three times to view Page 4 of the Configuration Pages.
3. On Configuration Page 4 (Figure 3-11), highlight the desired IEEE Address field, type the new address, and press **Enter**.

   Note: *The address must be unique to the system and must be a number between 2 and 29.*

4. Press **Reboot System** to configure and store the new address.

   Note: *If the system controller is powered up, rescan the system to view the new 717plus Autosampler address. Refer to the system controller operator's manual for details.*

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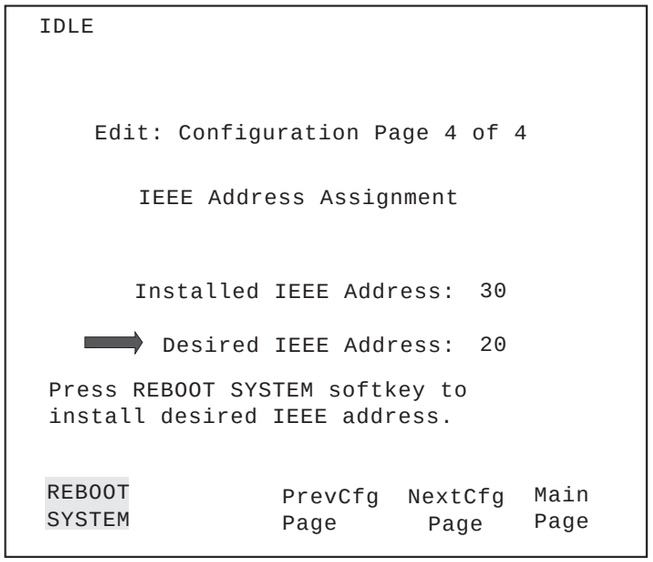


Figure 3-11 Setting IEEE-488 Address

3.6.3 Entering Hardware Changes

To enable the autosampler to adjust to changes in hardware configuration (syringe and sample loop size), you must enter the changes on Configuration Page 3 (Figure 3-12).

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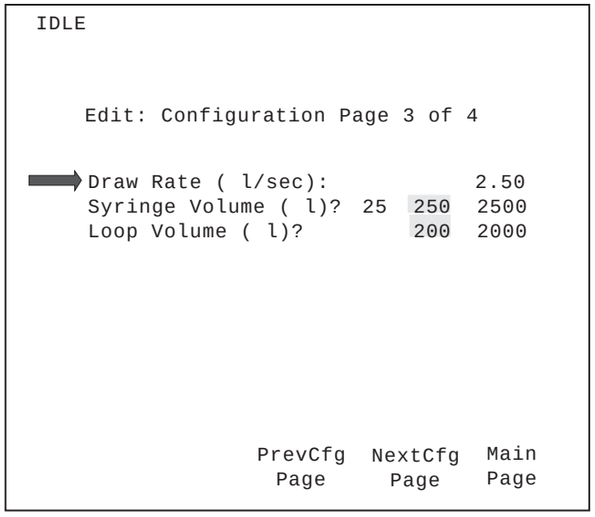


Figure 3-12 Configuration Page 3

Entering Syringe Size

To record a change in the syringe size:

1. From the 717plus Main Menu, press **Config Page**.
2. Press **Next Page** twice to access Configuration Page 3.
3. Select the appropriate Syringe Volume, and press **Enter**.

   The autosampler automatically updates the draw rate to adjust to changes in syringe volume. If you require a different draw rate, change the rate on Configuration Page 3 (see Section 4.8.3, Injecting Viscous Samples).

Entering Sample Loop Size

To record a change in the sample loop volume:

1. From the Main Menu, press **Config Page**.
2. Press **Next Page** twice to access Configuration Page 3.
3. Select the applicable Loop Volume and press **Enter**.

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3.7 System Verification

Perform system verification:

- After installation
- Daily to test the autosampler sample loop

To perform system verification:

1. Using a degassed solution of 100 percent methanol, set the solvent delivery pump to 1 mL/min.

   Note: *For daily verification, use the mobile phase that you normally run.*

2. From the 717plus Main Menu, press **Edit Purge** (Figure 3-13).

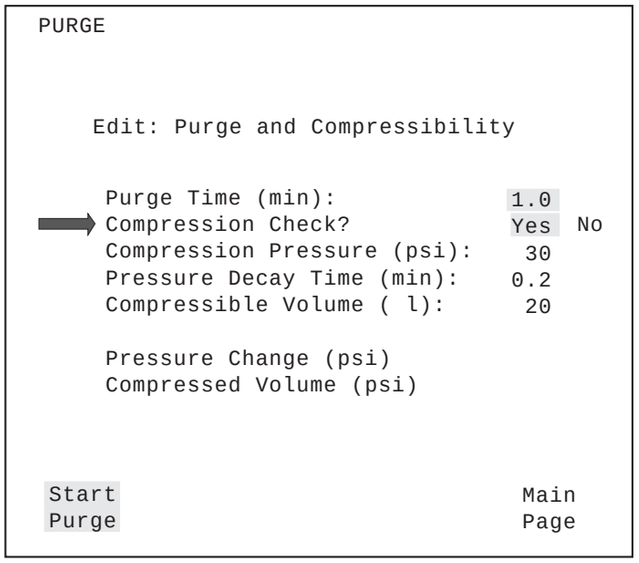


Figure 3-13 Purge Menu

3. Set Compression Check to **Yes** and press **Enter**.
4. Press **Start Purge**.
5. Record the pressure change and compressed volume. Use these values as a basis for evaluating mobile phase degassing and sample loop integrity.

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6. If the compression exceeds the default compressible volume, degas the mobile phase and run the compression check again.
7. If the compression check still fails, perform a leak test (Section 6.4.2, Valve Leak Test).

3.8 Power Down and Storage

If the mobile phase contains buffers, remove the buffers before power down and storage.

This section describes:

- Removing the buffered mobile phase
- Powering down the 717plus Autosampler
- Long-term storage

3.8.1 Removing Buffered Mobile Phase

Remove the mobile phase containing buffer salts as described below:

1. Replace the buffered mobile phase with a solution of 100 percent water, and flush the sampling system for 10 minutes at 1 mL/min.
2. Run three purges to ensure that the syringe is well-purged (see Section 3.4.1, Purging the Autosampler).
3. Replace the needle wash solvent with 90 percent methanol 10 percent water, and perform a needle wash prime (Section 3.5, Priming the Needle Wash Pump).
4. Replace the water with a solution of 90 percent methanol and 10 percent water. Flush the sampling system for 3 minutes at 1 mL/min.
5. Purge the autosampler.

3.8.2 Powering Down

This section covers procedures for powering down the Waters 717plus autosampler for 1 to 14 days.

1. If the current mobile phase is water, replace the water with a solution of 90 percent methanol and 10 percent water. Flush the sampling system for 3 minutes at 1 mL/min.
2. Purge the autosampler (see Section 3.4.1, Purging the Autosampler).
3. To power down the autosampler, press **1/0** (on/off).

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3.8.3 Storage

This section covers procedures for long-term storage of the Waters 717plus autosampler.

If the autosampler will be stored for more than two weeks:

1. Remove buffered mobile phases (see Section 3.8.1, Removing Buffered Mobile Phase).
2. Power down the autosampler (see Section 3.8.2, Powering Down).
3. Remove the waste lines and needle wash line from their containers.
4. Disconnect the red and blue lines.
5. Disconnect the power line.

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4
Operating the Autosampler

This chapter covers 717plus autosampler operation. Provided are procedures for preparing and loading samples, programming and using the automatic features, and making a stat run.

4.1 Overview of Operation

Figure 4-1 provides an overview of autosampling.

Note: *If the Waters 717plus autosampler is part of an IEEE-488 network, power up the autosampler before powering up the system controller.*

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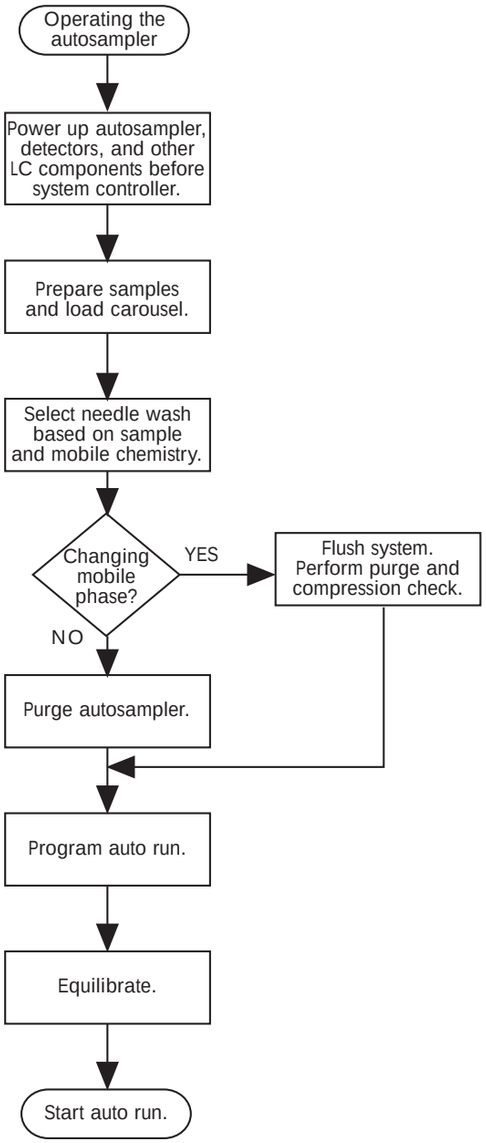


Figure 4-1 Overview of Operations

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4.2 Preparing Samples

To prepare and load samples into the autosampler, you must:

- Prepare the sample
- Select and fill a sample vial

4.2.1 Preparing Samples

Minimum sample preparation consists of dissolving the sample:

- In a solvent that is compatible with the mobile phase and column chemistry
- At a concentration that permits detection of the analyte
- In a solution that is particle-free and homogeneous

Figure 4-2 details the procedure for preparing a sample.

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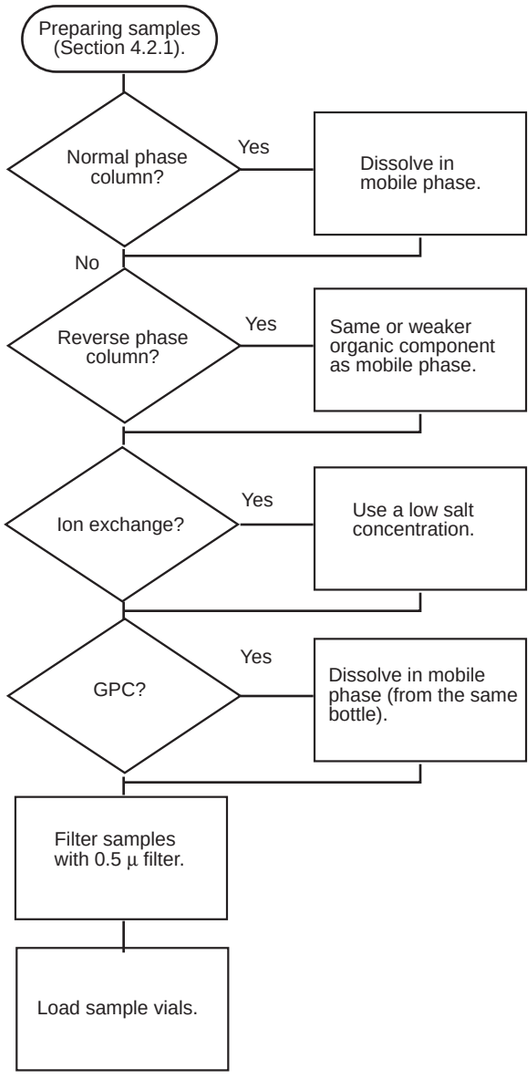


Figure 4-2 Preparing Samples

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Selecting a Solvent

Note: *Prevent precipitation of buffered salts or of sample through careful consideration of solvent concentration and pH. Whenever possible, use mobile phase as the solvent for dissolving samples.*

Observe the following guidelines when selecting a sample solvent:

- **Normal phase column** - Use the same solvent that is used for the mobile phase.
- **Reverse phase column** - Use the same or weaker concentration of the mobile phase organic component.
- **Ion exchange** - Use a low salt concentration.
- **GPC** - Dissolve in the mobile phase (preferably from the same bottle).

Filtering Samples

Unless restricted by sample chemistry, filter prepared samples before placing them in the sample vials. Filtering with a 0.5 µ filter, such as a Millipore Millex™ filter unit, prevents particulate accumulation on internal filters or the column inlet fitting which would result in an increase in backpressure.

4.2.2 Selecting Sample Vials

The Waters 717plus autosampler is compatible with the complete line of Waters chromatography sample vials.



Attention: *Use only sample vials and supplies from Waters. Use of non-Waters sample vials, low-volume inserts, or septa may result in damage to the needle.*

Selecting Sample Vials

Select a sample vial based on:

- Chemistry of the sample
- Volume of sample
- Volume of injection
- Number of injections
- Volatility of sample

For detail on sample vials, see Appendix E, Selecting Sample Vials.

Assembling Sample Vials

Assemble the sample vials as shown in Figure 4-3.

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Attention: Do not overtighten the cap with a self-sealing septum. Overtightening (septum dimples in) may cause the cap to fit incorrectly. Also, the use of self-sealing septa may cause variable injector volumes on multiple injections due to vacuum buildup.

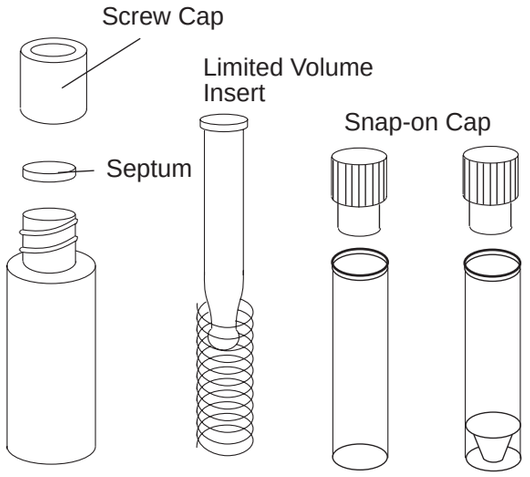


Figure 4-3 Sample Vial Assembly

4.3 Selecting a Needle Wash Solvent

The needle wash prevents cross-contamination of samples by wiping the needle with porous, wetted frits. Select a needle wash solvent based on the sample and mobile phase chemistry. Table 4-1 lists some suggested needle wash solvents. High sample concentrations may require stronger needle wash solvents.

Attention: *Do not use buffers in the needle wash solvent. Buffers decreases seal life.*

Table 4-1 Suggested Needle Wash Solvents

Mobile Phase	Needle Wash
Buffered aqueous, reverse phase	50% H_2O 50% MeOH
Non aqueous, reverse phase	100% MeOH

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Table 4-1 Suggested Needle Wash Solvents (Continued)

Mobile Phase	Needle Wash
Normal phase	Mobile phase
GPC	Mobile phase
Ion exchange	Paired ion reagent in H_2O

To use a needle wash:

1. Select a needle wash solvent based on the chemistry of the mobile phase.
2. Place the green line in the needle wash solvent reservoir and place the reservoir on the same level as the autosampler (Figure 4-4).

Note: *To avoid siphoning, do not place the needle wash reservoir above bench height.*

For extended storage, replace the needle wash solvent with a recommended storage solvent (see Section 3.8, Power Down and Storage).

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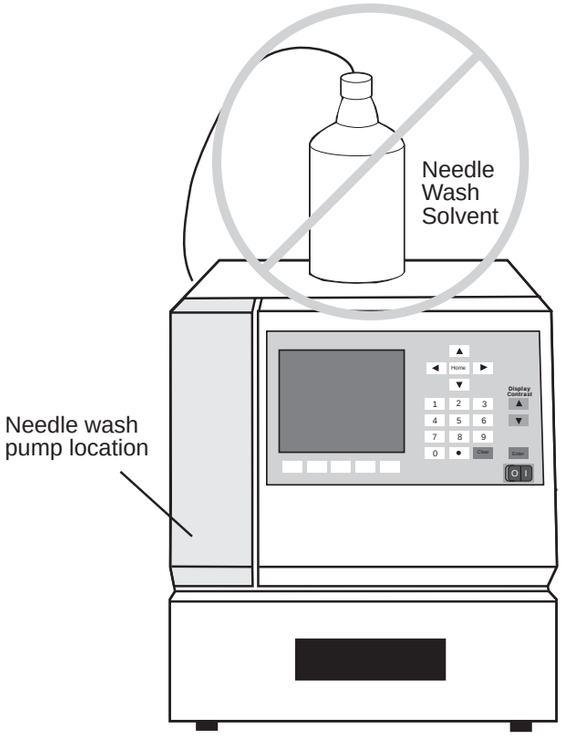


Figure 4-4 Improper Needle Wash Solvent Location

3. With the 717plus autosampler powered on, prime the needle wash pump (see Section 3.5, Priming the Needle Wash Pump).

4.4 Loading the Carousel

Attention: *Use only Waters™ grey carousels. The Waters 717plus autosampler does not work with WISP white or brown carousels.*

To load the carousel:

1. With the power on, open the sample compartment door. If the door sensor is enabled (default condition), the autosampler releases the carousel.

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Note: *The carousel release is not active when the autosampler is performing a purge or a pre-injection sequence.*

2. Before loading the sample vials into the carousel, ensure that the carousel is clean and the holes on top are not blocked.
3. Place the assembled sample vials in the carousel and note the location. The vial number is located on the rim of the carousel.

Attention: *Use of non-Waters™ sample vials, low-volume inserts, and septa may result in damage to the needle.*

4. Slide the carousel into the sample compartment until it reaches the two positioning stops on the compartment floor (Figure 4-5).

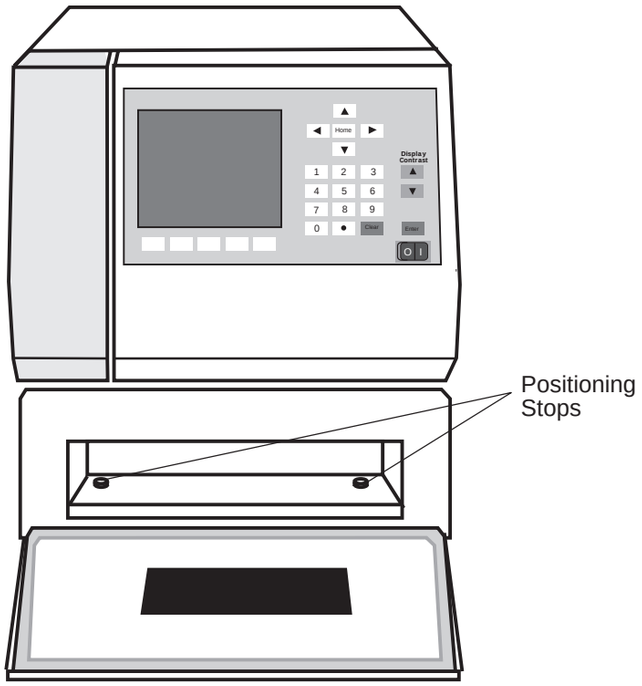


Figure 4-5 Inserting the Carousel

5. Close the sample compartment door. The autosampler homes the carousel.

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4.5 Ensuring Reproducibility

This section covers:

- Overview of Reproducibility
- Purging the Autosampler
- Performing a Compression Check

4.5.1 Overview of Reproducibility

Reproducibility depends on:

- Purity of the mobile phase in the autosampler
- Compressibility of the mobile phase due to dissolved gas
- Integrity of the autoinjector sample loop

Ensuring Reproducibility

1. Run a purge and a compression check:
   - To remove mobile phase that has been sitting in the system during a shutdown.
   - To check the system on a daily basis for air or solvent leaks.
   - To remove the previous mobile phase when changing to a new mobile phase.
   - To establish the compressibility for a new mobile phase.
2. Run a purge and a compression check (see Section 4.5.3, Performing a Compression Check) on the degassed mobile phase.
3. If the mobile phase fails the compression check, degas the solvent (see Appendix D, Reproducibility and Solvent Degassing).
4. If the degassed mobile phase again fails the compression check, run a leak test (see Section 6.4.2, Valve Leak Test) to verify the integrity of the sample loop.

4.5.2 Performing a Purge

Perform a purge from the Purge and Compressibility Page.

Purging the Autosampler

To perform a purge using the default values, press the Waters 717plus autosampler keys as indicated below (Figure 4-6):

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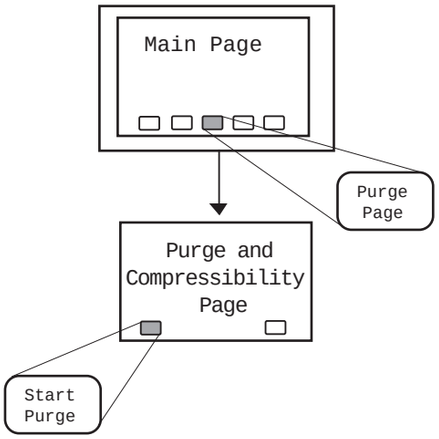


Figure 4-6 Purging the Autosampler

Changing Purge Time

Change the Purge Time if:

- System flow rates are less than 1 mL/min
- The auxiliary loop is installed

The purge time setting depends on:

- Flow rate of the mobile phase
- Sample loop size

To change the Purge Time:

1. From the 717plus Main Page, press **Purge Page** to display the Purge and Compressibility page (Figure 4-7).

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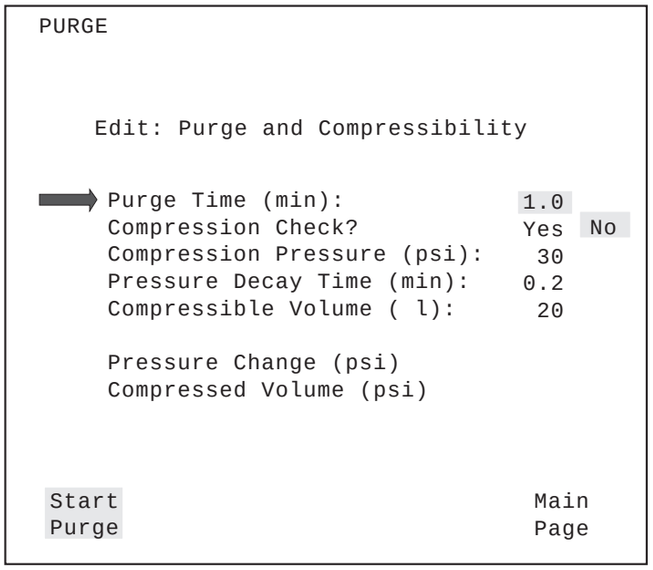


Figure 4-7 Purge and Compressibility Page

2. Calculate the purge time based on the flow rate and sample loop size. The time must be sufficient to allow three volume changes of the autosampler. The autosampler volume in Table 4-2 includes the inlet and outlet lines.

Table 4-2 Autosampler Volume

Sample Loop	Autosampler Volume
Normal (200 µL)	836 µL
Auxiliary (2.4 mL)	3236 µL

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Table 4-3 lists sample purge times for the two sample loops at selected flow rates.

Table 4-3 Purge Time Examples

Sample Loop	Flow Rate (mL/min)	Purge Time (min)
Normal	0.2	12.5
	0.5	5.0
	>1	2.5
Auxiliary	0.5	19.4
	1	9.7
	2	4.8

4.5.3 Performing a Compression Check

The compression check tests for gas in the mobile phase, and, when enabled, occurs immediately after a purge. For most mobile phases, use the default parameters.

Note: *The compression check is only valid using the standard 250 µL syringe and 200 µL sample loop.*

Change the default parameters if:

- Mobile phase is highly compressible (see Appendix D, Reproducibility and Solvent Degassing).
- Testing for leaks (see Section 6.4.2, Valve Leak Test).

Compression Parameters

When enabled, the compression check is executed immediately after a purge. The parameters are:

- Compression PressureComression Pressure
- Pressure Decay Time
- Compressible Volume

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Compression Pressure

For testing the compressibility of the mobile phase, use 30 psi. For leak testing, use the maximum pressure.

Range	30 to 350 psi
Default	30

Pressure Decay Time

Sets the length of time the system pauses before recompressing the mobile phase in the sample loop. The default value is sufficient for most applications. The longer the decay time, the more rigorous the test.

Range	0.0 to 3.0 min
Default	0.2 min

Compressible Volume

The default value is sufficient for most applications. Changes to the compression limit are dependent on the solvent used for the mobile phase. If the mobile phase is highly compressible, increase the compression limit setting (see Appendix D, Reproducibility and Solvent Degassing).

Range	5 to 30 µL
Default	20 µL

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Performing a Compression Check

To perform a compression check, press the keys indicated in Figure 4-8:

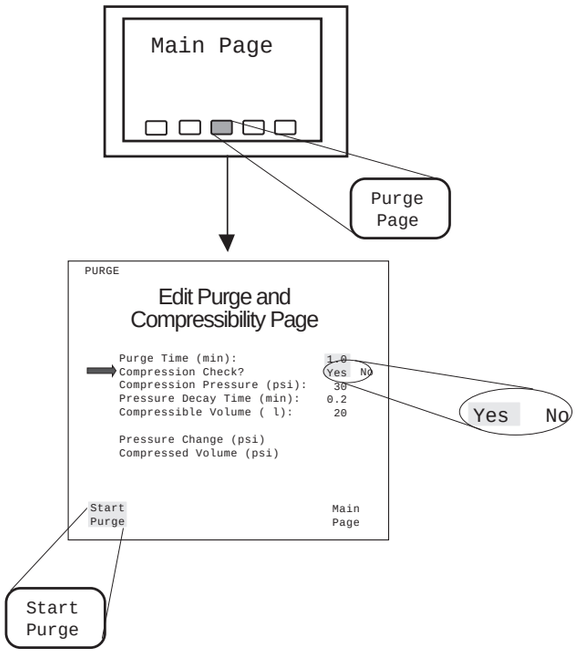


Figure 4-8 Running a Compressibility Test

- If the compression limit is exceeded, the following message appears:

```
Compressibility check failed
```

- If the compression check fails, review Section 4.1, Overview of Operation, for further testing.

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4.6 Running Autosampling

This section describes:

- Programming an auto run
- Programming step functions
- Using Auto Standards
- Using Auto Addition
- Using Auto Transfer
- Programming the Event Output
- Starting and stopping an auto run
- Monitoring auto run status

Features of Auto Run

Use Auto Run mode to program, run, and monitor sample injections. Auto Run mode allows:

- **Multi-method programming** - Allows programming of up to 96 different steps (methods). Each step can use different numbers of injections, volumes, run times, and optional functions.
- **Unattended operation** - Provides injection start and stop output signals for controlling external devices.
- **Programmable output signal** - Allows the 717plus to control external devices during a run.
- **Auto Standard, Auto Addition, and Auto Transfer functions** - Allow automated operation for standards, pre-injection addition of samples, and automatic pre-injection transfer and mixing.

Overview of Programming

Figure 4-9 is an overview of the steps involved in programming and running an auto run.

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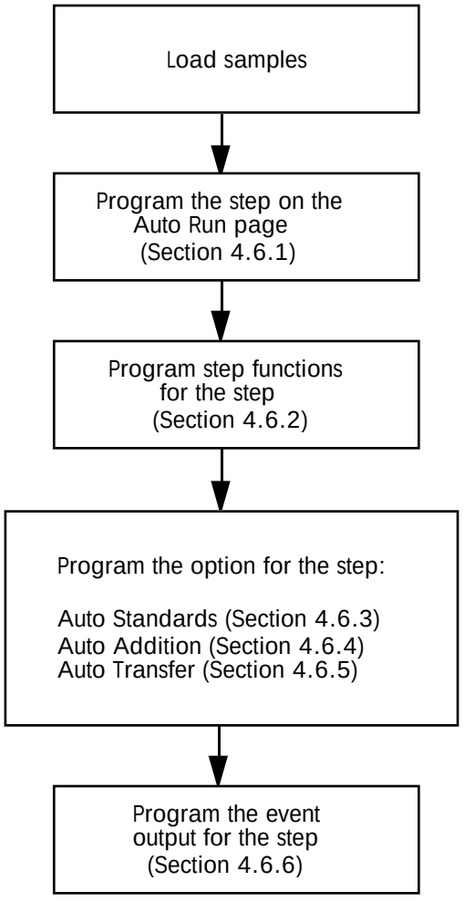


Figure 4-9 Overview of Programming

4.6.1 Programming Auto Run

Program and start an Auto Run from the Edit: Auto Run screen (Figure 4-10).

This section describes:

- Using the Auto Run screen
- Entering step parameters

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4.6.1.1 Using the Auto Run Screen

Display the Edit: Auto Run screen by pressing the **Auto Page** key on the Main Menu.

The Edit: Auto Run screen (see Figure 4-10) lets you program up to 96 steps.

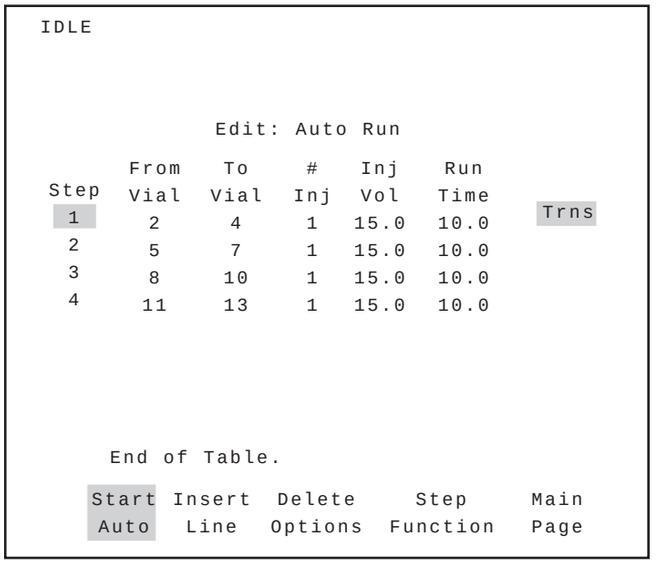


Figure 4-10 Edit: Auto Run Screen

Moving Through the Table

To move through the table you can:

Press:	To:
Home once	Move the cursor to the top of the page
Home twice	Move the cursor to step 1
Arrow keys	Moves the cursor up and down lines and between parameters

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Enter:	To:
Step number	Advance to a step
96 for step number	Move the cursor to the last step (whether or not there are 96 steps programmed)

Note: *To move through the table a screen at a time (10 lines), enter step numbers in increments of 10. For example, enter 11, 21, 31, and so on.*

Inserting a Line

To insert a line:

1. Use the arrow keys to move to a step number where the new line will be inserted.
2. Press **Insert Line**. The 717plus duplicates the previous line, and renumbers all subsequent lines.

Deleting a Line

To delete a line:

1. Use the arrow keys to move to a step number to delete.
2. Press **Delete Options**, and the Delete Line function key appears.
3. Press **Delete Line**. The 717plus removes the line, and renumbers all subsequent lines.

Deleting a Table

4. To delete a table:

1. Press **Delete Options**, and the Delete Table function key appears.
2. Press **Delete Table**. After you confirm your intention to clear the table, the autosampler removes all data on the page.

Options

If you have enabled an option for a step, the option is listed after the Run Time field.

Note: *If you have disabled an option, it is not listed for the step.*

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4.6.1.2 Entering Step Parameters

You must enter a value for each parameter in a step. Parameters you enter are saved in permanent memory.

Before Programming

Load the required vials in the carousel, noting the carousel positions.

Note: *Standard vials and common vials do not have to be loaded in consecutive positions.*

Programming

To program:

Step

1. Place the cursor on a blank line, then press **Enter**.

   The 717plus inserts a new line and copies the information, including step function and option settings, from the previous line.

   You can program up to 96 different steps. Each vial included in the step shares the same number of injections, injection volume, run time, step functions, and options. By changing steps and step parameters, you can run a different method using the same set of vials.

Vial From/To

2. Enter a vial number in the From Vial and To Vial fields. Vial number defaults to the values you entered on the previous line. Valid entries are 1 to 48 or 1 to 96, depending on the type of carousel in use.

   When injecting from a single vial, enter the same vial number in the From and To fields. When injecting from a sequence of vials, enter the starting vial in the From Vial field and the last vial in the To Vial field.



Attention: *The vial injection sequence entered in the From/To field is continuous. If a vial is missing, the autosampler will inject air into the LC system.*

Inj

3. Enter the number of injections to make from each vial. Valid entries are 1 to 99.

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Inj Vol

4. Enter the injection volume. The maximum injection volume depends on the size of the sample loop.

Sample Loop Size	Range (µL)
Standard	0 to 200
Auxiliary	0 to 2000

Run Time

5. Enter the run time in minutes. Valid entries are 0 to 999.9.

   The run time clock starts when the sample enters the mobile phase stream. At the same time, the autosampler closes the Inject Start contact. When the run time clock expires, the autosampler closes the Inject Stop contact and begins another injection sequence unless a Report Delay has been configured.

   Note: *You can delay the next injection in order to complete an integration printout. Use the Report Delay or External Hold input signal (see Section 3.6.2, Setting Parameters for LC System Operation).*

Step Functions

6. Program step functions (described in Section 4.6.2, Programming Step Functions).

Note: *You can program only one set of step functions and one option per step.*

4.6.2 Programming Step Functions

Use the Step Function screen to select the following parameters for each Auto Run step:

- Needle Position
- Purge After Step
- Options for an Auto Run step
- Programmable Event outputs

This section describes the Step Function screen (Figure 4-11).

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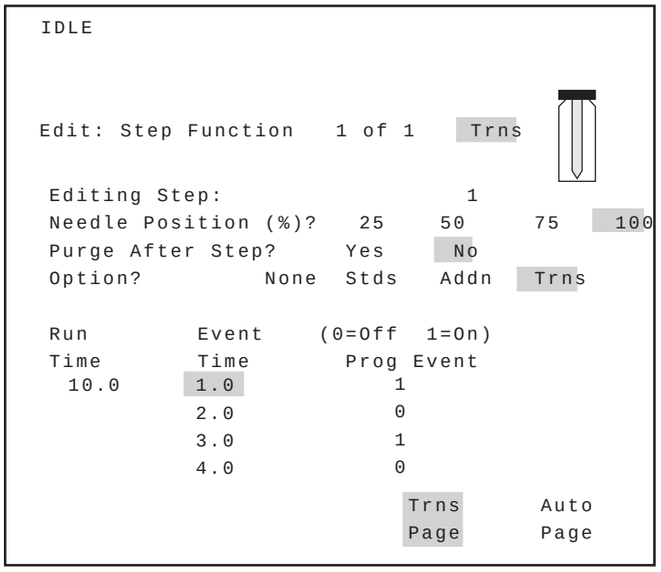


Figure 4-11 Edit: Step Function Screen

Note: *Figure 4-11 is an example of the Edit: Step Function screen with the Auto Transfer option selected. When other options are selected, keys for the selected function appear.*

If no option is enabled, the option field displays "None", and no option key appears.

4

Programming Step Functions

To program step functions:

1. Display the Edit: Step Function screen by pressing **Step Function** on the Edit:Auto Run screen.

   The currently selected step number appears on the Edit: Step Function screen.

Editing Step

2. To change the step number, enter a new number on the keypad and press **Enter**.

Needle Position

3. Move the cursor to the Needle Position% line. This determines needle withdrawal position. Use the right/left arrow keys to select the desired position of **25**, **50**, **75**, or **100%**. Default is 100%.

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The picture of the vial displayed in the upper-right corner of the screen shows the selected needle position.

Purge After Step

4. If desired, move the cursor to Purge After Step?, and select **Yes**. Default is No.

   Step function purges use the Purge Parameters set on the Purge and Compressibility screen. For information on setting the Purge Time, refer to Section 4.5.2, Performing a Purge.

Option

5. Move the cursor to the **Option?** field, then use the arrow keys to select the option for the step. The default is **None**.

   Note: *If you select None to disable an option, you delete all information programmed for the option. To disable the option without deleting, display the option screen and set the option to No.*

6. Program the option for the step. For information on programming the options, refer to:

   - Section 4.6.3, Using Auto Standards
   - Section 4.6.4, Using Auto Addition
   - Section 4.6.5, Using Auto Transfer

   Note: *You can program a different option for each step (not multiple options per step).*

Event Output

7. Program the event output for the step (see Section 4.6.6, Programming the Event Output).

4.6.3 Using Auto Standards

This section describes:

- Overview of Auto Standards
- Programming and Running Auto Standards
- Example Auto Standard Run

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4.6.3.1 Overview of Auto Standards

Auto Standards

Use the Auto Standards routine to program standard vials to run automatically during an Auto Run.

Use the Auto Standards menu routine to enter standard vial parameters, along with the number of sample vials to run between standard vials.

The Auto Standards table is saved in permanent memory.

Standard Vials

You can specify up to five standard vials for each Auto Run step. Standard vials:

- Can be unique or repeated
- Do not have to be in consecutive positions in the carousel
- Can be different for each step

Auto Standards Sequence

During an Auto Standards run, the 717plus:

- Injects standards (specified on Auto Standards screen)
- Injects samples (specified on Auto Run screen)
- Re-injects the same standards (specified on Auto Standards screen)

Section 4.6.3.3, Example Auto Standard Run, includes an example of an Auto Standards run.

4.6.3.2 Programming and Running Auto Standards

Before Programming

Before programming:

- Place your samples in the carousel, noting each position (usually in sequential order)
- Place your standards in the carousel, noting each position (usually in sequential order)
- Program the step on the Auto Run screen (see Section 4.6.1, Programming Auto Run)
- Program the step functions for the step (see Section 4.6.2, Programming Step Functions)

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Programming Auto Standards

To program Auto Standards:

1. From the Edit: Auto Run screen (see Figure 4-10), select a step, then press **Step Function** to display the Edit: Step Function screen.

   Note: *For instructions on setting Needle Position and Purge, refer to Section 4.6.2, Programming Step Functions.*

2. From the Edit: Step Function screen (see Figure 4-11), press the **down-arrow** key to move the cursor to the Option? field.
3. Press the **right-arrow** key to move the cursor to the Stds selection. The Stds Page key appears on the screen.
4. Press **Stds Page** to display the Edit: Auto Standards screen (Figure 4-12).

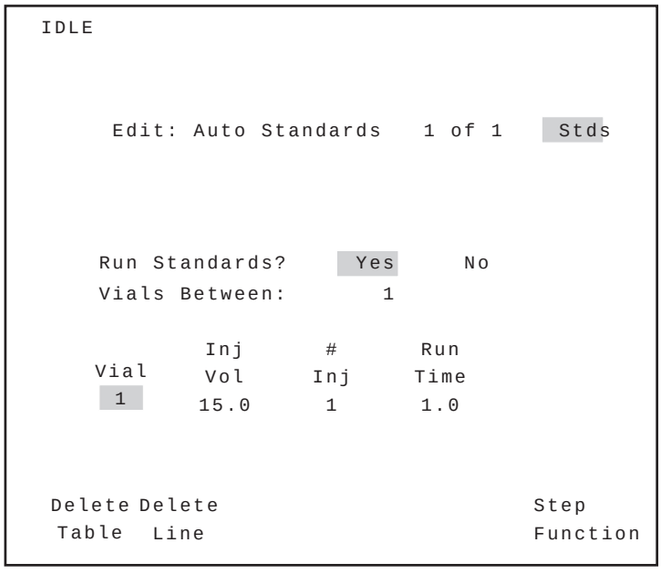


Figure 4-12 Edit: Auto Standards Screen

5. At the Run Standards? field, select **Yes** (default).
6. Move the cursor to the Vials Between field. Enter the number of sample vials to run between standards (1 to 48 or 1 to 96, depending on carousel type).

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7. Press the **down-arrow** key to move the cursor to the Vial field. Enter the following parameters for each standard vial. You can enter up to five standard vials for each Auto Run step.

Parameter	Description/Range
Vial	Carousel number, 1 to 96
Inj Vol	0.0 to 200.0 µL or 0.0 to 2000.0 µL[1]
# Inj	Number of injections for standard vial, 1 to 99
Run Time	Total run time from injection to Inject Stop signal, 0.0 to 999.9 min

[1] Dependent on sample loop installed in Waters 717plus

Running Auto Standards

To start the Auto Run:

1. When programming is complete, press **Step Function**, then **Auto Page** to return to the Edit: Auto Run screen.
2. Press **Start Auto**. The Auto Standards routine runs as part of each programmed step. A message appears indicating that Auto Standards is running. You cannot change screen settings of the currently running step.

Turning off Auto Standards

To turn off Auto Addition on the Edit Auto Addition screen, select **No** at the Run Addition? field. The information programmed for Auto Standards is saved, but Auto Standards do not run.

When Auto Standards are turned off, the Stds notation is not displayed on the Auto Run screen.

Note: *If you turn off Auto Standards on the Edit: Step Function screen (by setting the Option field to None), you delete the information programmed for Auto Standards.*

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4.6.3.3 Example Auto Standard Run

In an Auto Standards run, standards always run at the beginning of a step, and may run during or at the end of a step.

Whether standards run during or at the end of a step is determined by the number of vials in a step and the number of vials specified to run between standards.

Note: *If you run a stat sample during an Auto Standard run, the stat sample is not considered to be one of the sample vials running between standards.*

Standards During or at End of Run

If the number of vials in the step is *equal* to the Vials Between value, standards run at the beginning and at the end of the step.

If the number of vials in the step is a *multiple* of the Vials Between value, standards run at the beginning, during, and at the end of the step (Figure 4-13).

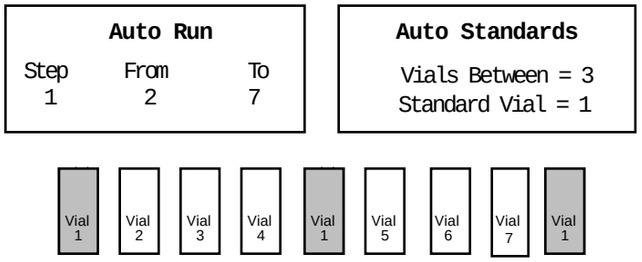


Figure 4-13 Example Auto Standard Run 1

No Standards at End of Run

Standards do not run after the last sample if (Figure 4-14):

- The number of vials in the step is *not* equal to the Vials Between value.
- The number of vials in the step is *not* a multiple of Vials Between value.

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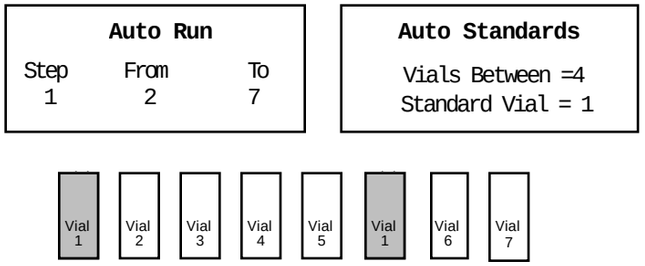


Figure 4-14 Example Auto Standard Run 2

4.6.4 Using Auto Addition

This section describes:

- Overview of Auto Addition
- Programming and Running Auto Addition
- Example Auto Addition Run

4.6.4.1 Overview of Auto Addition

Auto Addition

Auto Addition withdraws specified volumes from common vials, then withdraws from a sample vial. The common solutions and the sample are all contained *in the sample loop* before injection. You can set a time delay for the injection of the sample and common solutions.

Auto Addition is useful for applications requiring automatic addition of derivatizing agents, standards, or reference peaks.

The Auto Addition table is saved in permanent memory.

Common Vials

You can specify up to five common vials for each Auto Run step. Common vials:

- Can be unique or repeated
- Do not have to be in consecutive positions in the carousel
- Can be different for each step

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Auto Addition Sequence

During an Auto Addition run, the 717plus:

- Withdraws from all common vials (specified on Auto Addition screen)
- Withdraws from the sample vial (specified on Auto Run screen)
- Delays, if specified
- Injects

Section 4.6.4.3, Example Auto Addition Run, includes an example of an Auto Addition run.

4.6.4.2 Programming and Running Auto Addition

Before Programming

Before programming:

- Place your samples in the carousel, noting each position (usually in sequential order)
- Place your common vials in the carousel, noting each position (usually in sequential order)
- Program the step on the Auto Run screen (see Section 4.6.1, Programming Auto Run)
- Program the step functions for the step (see Section 4.6.2, Programming Step Functions)

Programming Auto Addition

To program the Auto Addition routine:

1. From the Edit: Auto Run screen (see Figure 4-10), select a step, then press **Step Function** to display the Edit: Step Function screen.

   Note: *For instructions on setting Needle Position and Purge, refer to Section 4.6.2, Programming Step Functions.*

2. From the Edit: Step Function screen (see Figure 4-11), press the **down-arrow** key to move the cursor to the Option? field.
3. Press the **right-arrow** key to move the cursor to the **Addn** field. The Addn Page key appears on the screen.
4. Press **Addn Page** to display the Auto Addition screen (Figure 4-15).

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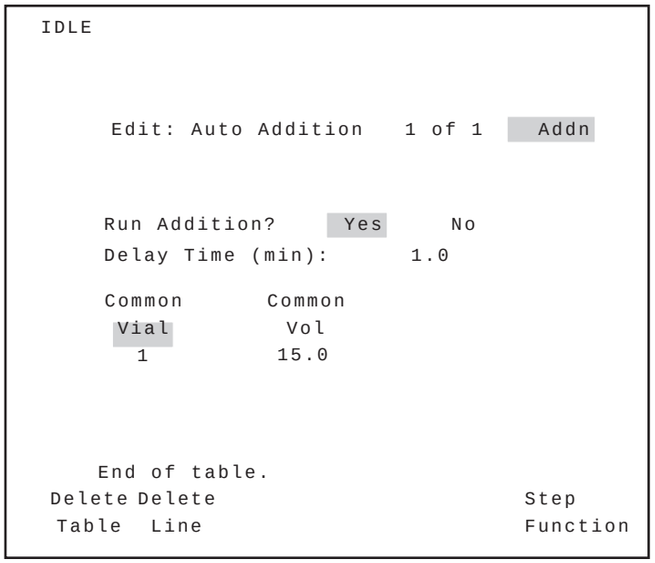


Figure 4-15 Auto Addition Screen

5. From the Run Addition? field, select **Yes** (default).
6. Move the cursor to the Delay Time field. Enter the time to delay before injection (0.0 to 99.9 minutes). Default is 1.0 minutes.
7. Move the cursor to the Common Vial field. Enter up to 5 common vials.

Parameter	Description/Range
Common Vial	Carousel number, 1 to 96
Common Vol	Volume to withdraw from common vial: 0.0 to 200.0 µL or 0.0 to 2000.0 µL[1]

[1] Dependent on sample loop installed in Waters 717plus

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Running Auto Addition

To start the Auto Run:

1. When programming is complete, press **Step Function**, then **Auto Page** to return to the Edit: Auto Run screen.
2. Press **Start Auto**. The Auto Addition routine runs as part of each programmed step. A message appears indicating that Auto Addition is running. You cannot change screen entries after the Auto Run begins.

Turning off Auto Addition

To turn off Auto Addition on the Edit Auto Addition screen, select **No** at the Run Addition? field. The information programmed for Auto Addition is saved, but Auto Addition does not run.

When Auto Addition is turned off, the Addn notation is not displayed on the Auto Run screen.

Note: *If you turn off Auto Addition on the Edit: Step Function screen (by setting the Option field to None), you delete the information programmed for Auto Addition.*

4.6.4.3 Example Auto Addition Run

In an Auto Addition run, the 717plus withdraws the specified volume from up to 5 common vials, withdraws the specified volume from the sample vial, then injects the total volume of *all* withdrawn volumes (Figure 4-16).

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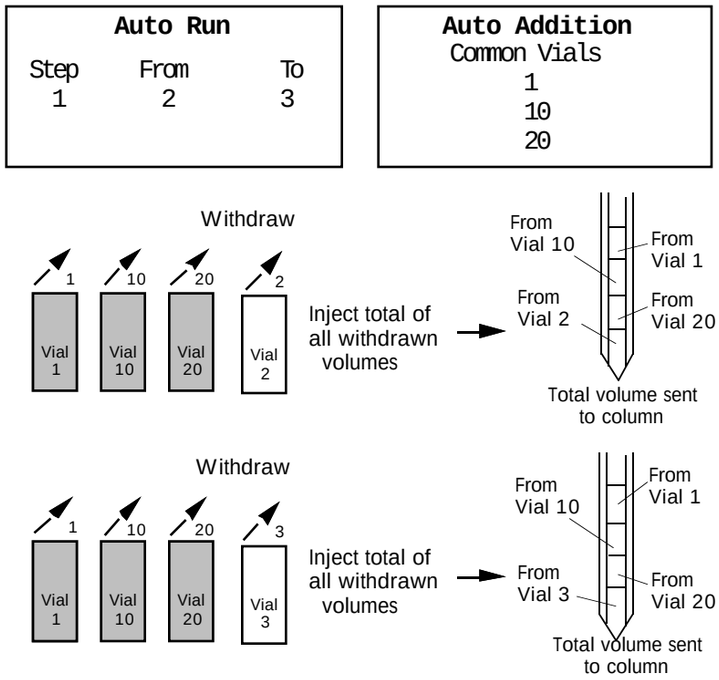


Figure 4-16 Auto Addition Example

4

4.6.5 Using Auto Transfer

This section describes:

- Overview of Auto Transfer
- Programming and running Auto Transfer
- Example Auto Transfer run

4.6.5.1 Overview of Auto Transfer

Auto Transfer

Auto Transfer withdraws solutions from a transfer vial, dispenses into the sample vial, and mixes. You can program up to 5 transfer vials for each step. After each transfer, you can program a delay time and a purge.

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Auto Transfer is used for applications requiring automatic transfer of derivatizing agents, standards, or reference peaks.

The Auto Transfer table is saved in permanent memory.

Auto Transfer Sequence

During an Auto Transfer run, the 717plus:

- Aspirates an air gap into the needle to prevent diffusion of sample
- Withdraws a transfer solution (specified on the Auto Transfer screen)
- Dispenses the transfer solution into a sample vial (specified on the Auto Run screen)
- Mixes, if specified
- Waits for a delay time, if specified. If a purge is specified (to rinse the needle and sample loop), the purge begins at the same time as the delay
- Injects the sample/transferred/mixed solution

Section 4.6.5.3, Example Auto Transfer Run, includes an example of an Auto Transfer run.

4.6.5.2 Programming and Running Auto Transfer

Before Programming

Before programming:

- Place your samples in the carousel, noting each position (usually in sequential order)
- Place your transfer vials in the carousel, noting each position (usually in sequential order)
- Program the step on the Auto Run screen (see Section 4.6.1, Programming Auto Run)
- Program the step functions for the step (see Section 4.6.2, Programming Step Functions)

Programming Auto Transfer

To program an Auto Transfer routine:

1. From the Edit: Auto Run screen (see Figure 4-10), select a step, then press **Step Function** to display the Edit: Step Function screen.

   Note: *For instructions on setting Needle Position and Purge, refer to Section 4.6.2, Programming Step Functions.*

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2. From the Edit: Step Function screen (see Figure 4-11), press the **down-arrow** key to move the cursor to the Option? field.
3. Press the **right-arrow** key to move the cursor to the Trns field (see Figure 4-11). The Trns Page key appears on the screen.
4. Press **Trns Page** to display the Edit: Auto Transfer screen (Figure 4-17).

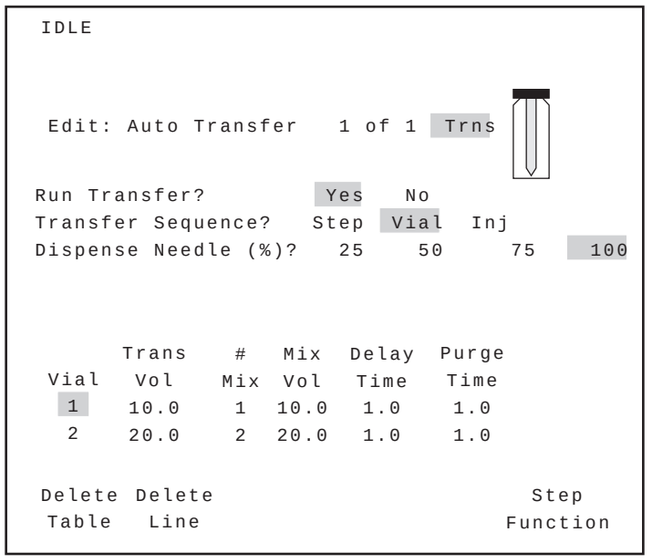


Figure 4-17 Auto Transfer Screen

5. At the Run Transfer field, select **Yes** (default).
6. Move the cursor to **Transfer Sequence?** field. Select a transfer sequence:
   - **Step** - Transfers one time *at the beginning of a step.* The solution is transferred from the specified vial into only the first sample vial in the step.
   - **Vial (default)** - Transfers one time *for each vial in the step.* The solution is transferred to each sample vial before the first injection of each vial.
   - **Inj** - Transfers *before every injection from every vial.* Use this method for multiple (progressive) dilutions of samples.

   Note: *Section 4.6.5.3, Example Auto Transfer Run, includes examples of each transfer sequence.*

7. Move the cursor to the **Dispense Needle (%)** field. Default is 100. The displayed number is the needle dispense position in the sample vial.

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Move the cursor to **25%**, **50%**, **75%**, or **100%**. To optimize mixing, select the position which places the bottom of the needle in the middle of the solution in the sample vial.

The Dispense Needle setting affects dispensing only. When the 717plus withdraws from the transfer vial or from the sample vial during mixing, the needle position is at 100%.

8. Move the cursor to the Vial field. Enter the following parameters for up to 5 transfer vials:

Parameter	Description/Range
Vial	Transfer vial (for withdrawal) number, 1 to 48 or 1 to 96
Trans Vol	Volume to withdraw from transfer vial: 0.0 to 150.0 µL or 0.0 to 1500.0 µL (dependent on sample loop installed) Volume is limited to 60% of syringe size. A 250 µL syringe is recommended for most applications.  ***Attention:*** *Do not program a transfer volume greater than the volume of the sample vial*
# Mix	Number of mix cycles, 0 to 9. A mix cycle withdraws a sample from the sample vial and returns it to the same vial.
Mix Vol	Volume of fluid withdrawn for mixing back to the sample vial: 0.0 to 150.0 µL or 0.0 to 1500.0 µL (depending on sample loop installed). Note that the volume is limited to 60% of the syringe size.
Purge Time	0.0 to 99.9 minutes Note that during an Auto Transfer purge, only the sample loop is purged. The syringe is not purged and a compression check is not performed.

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Parameter	Description/Range
Delay Time	Time to delay before next transfer or injection, 0.0 to 99.9 min. Delay and purge run simultaneously. For example, if you program a 3-minute Delay Time and a 1-minute Purge Time, the 717plus autosampler purges for 1 minute, then delays an additional 2 minutes. If the purge time is programmed longer than the delay time, this results in a delay that is as long as a purge.

Running Auto Transfer

To run the Auto Transfer routine:

1. When programming is complete, press **Step Function**, then **Auto Page** to return to the Edit: Auto Run screen.
2. Press **Start Auto** to start the run. The Auto Transfer routine runs as part of the Auto Run. A message appears indicating that Auto Transfer is running. You cannot change screen settings of the currently running step.

Turning off Auto Transfer

To turn off Auto Transfer on the Edit Auto Transfer screen, select **No** at the Run Transfer field. The information programmed for Auto Transfer is saved, but Auto Transfer does not run.

When Auto Transfer is turned off, the Trns notation is not displayed on the Auto Run screen.

Note: If you turn off Auto Transfer on the Edit: Step Function screen (by setting the Option field to None), you delete the information programmed for Auto Transfer.

4.6.5.3 Example Auto Transfer Run

Transfer Before Step

If you select Step as the Transfer sequence, the 717plus transfers a solution to the sample vial *one time at the beginning of a step.* The solution is transferred from the specified transfer vial into the first sample vial in the step.

Figure 4-18 illustrates a 2-step Auto Run in which the transfer takes place from vial 1 (common vial) to the first vial of each step (vials 2 and 10).

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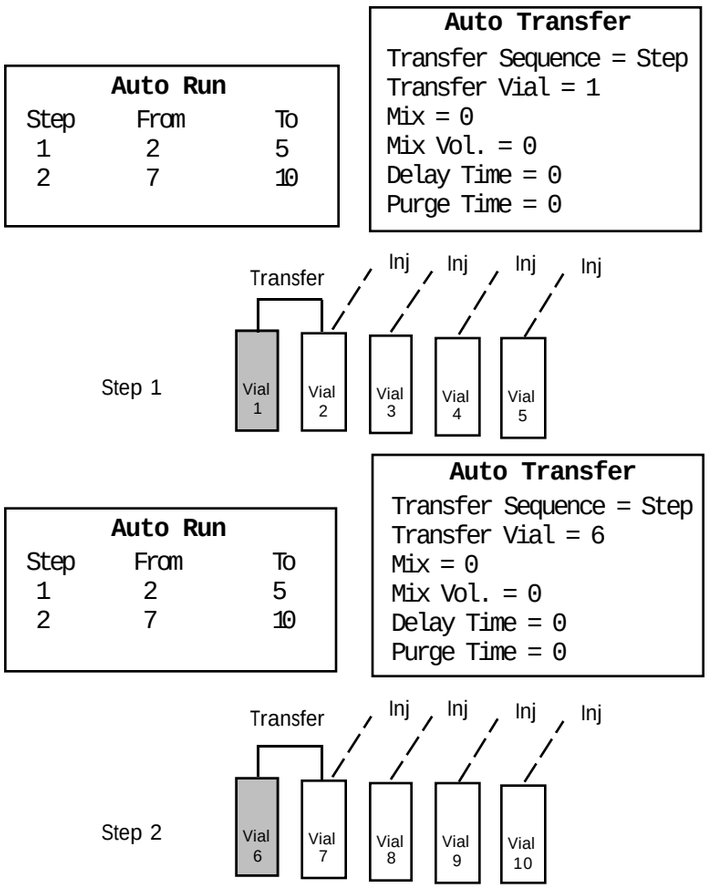


Figure 4-18 Transfer Before Step

Transfer Before Vial

If you select Vial as the Transfer sequence, the 717plus transfers a solution to the sample vial *one time for each vial in the step.* The solution is transferred before the first injection of each vial.

Figure 4-19 illustrates a 1-step Auto Run in which the transfer occurs one time for a vial, then all injections are made from the vial

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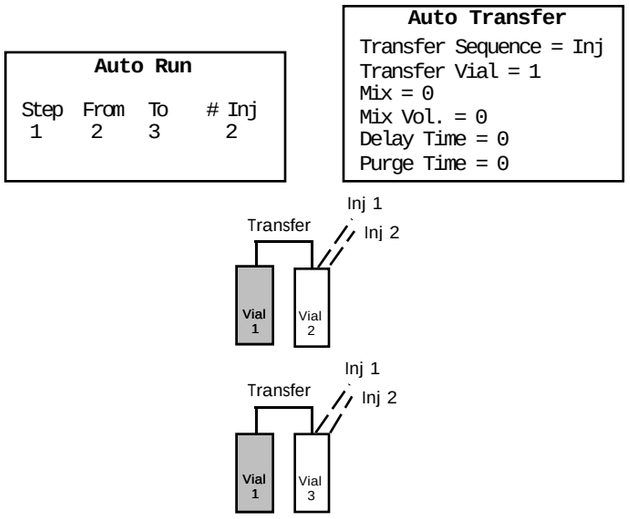


Figure 4-19 Transfer Before Vial

Transfer Before Injection

If you select Injection as the Transfer sequence, the 717plus transfers a solution to the sample vial *before every injection from every vial.* Use this method for multiple (progressive) dilutions of samples.

Figure 4-20 illustrates a 1-step Auto Run in which a transfer occurs before each injection.

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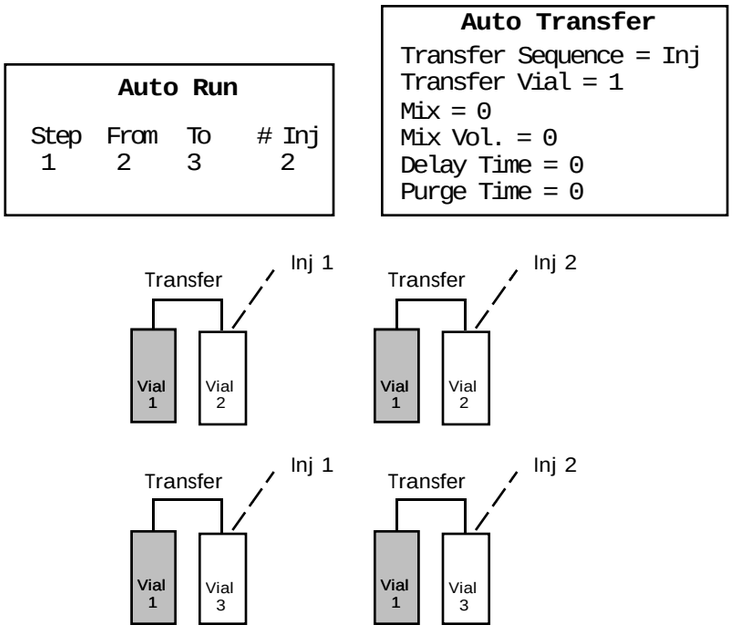


Figure 4-20 Transfer Before Injection

4.6.6 Programming the Event Output

The 717plus includes a contact closure that you can program to turn on or off up to four times during each step of an Auto Run. Use the Edit: Step Function screen to program the contact states and event times.

Note: *At the end of an injection, the event is left in the last programmed state. This means that if an event is on at the end of a run, it will be on at the beginning of the next run, unless you turn it off.*

Programming the Event Contact

To program the event output:

1. From the Edit: Auto Run screen (see Figure 4-10), select a step, then press **Step Function** to display the Edit: Step Function screen (Figure 4-21).

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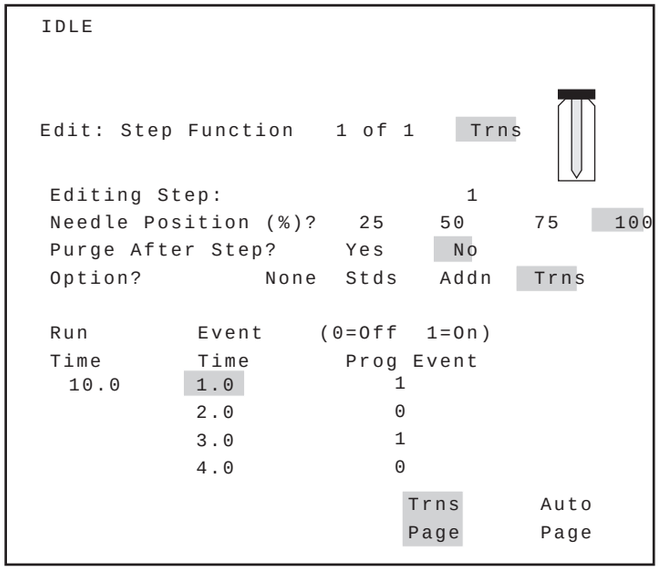


Figure 4-21 Edit: Step Function Screen

Program the event output using the Event Time and Prog Event fields at the bottom of the screen. The Run Time displayed is the run time for the selected step, and cannot be changed on this screen. The run time displayed is the maximum value that can be entered in the Event Time field.

2. Move the cursor to the **Event Time** field. Enter the time (from injection start) at which to turn on or turn off the first event. Valid entries are from 0 to a value equal to the run time (displayed in the Run Time field).
3. Move the cursor to the **Prog Event** field. Enter **1** to turn on the event. Enter **0** to turn off the event. Press **Enter**.
4. Repeat steps 3 and 4 to program the three additional event times if required.

4.6.7 Starting and Stopping an Auto Run

Note: *Run a purge before starting an Auto Run to ensure that fresh mobile phase is in the autosampler.*

Starting

To start a run, press **Start Auto**, and the Auto Run Status screen appears.

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Stopping

To stop an Auto Run:

1. Press **Stop Run**. A prompt appears:

```
Do you really want to stop the auto run?
```

2. Press **Yes** to stop the run.

   If the autosampler is in the pre-injection sequence (sample is still in the sample loop), you may either:

   - **Purge Sample** - Flushes the sample to waste, and returns to the Edit Purge menu. Select **Main Page** to return to the Main Menu.
   - **Inject Sample** - Completes the injection sequence, and displays the Auto Run Status screen. On the Auto Run Status screen, press **Go to Idle** to proceed with programming. The **Auto Page** and **Stat Run** function keys allow you to view parameters without making any changes.

4.6.8 Monitoring Auto Run Status

Monitor an auto run using the Auto Run Status screen (Figure 4-22).

```
AUTO  28¡                    Step 1 Vial 1

            Status: Auto Run

    Vial #                          1
    Inj                         1 of 2
    Volume ( l)                10.0
    Runtime (min)              12.0
    Time Remaining (min)        8.6
    Total Runtime (min)        20.6

                 Auto  Stat          Stop
                 Page  Run           Run
```

Figure 4-22 Auto Run Status Screen

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The Auto Run Status screen (see Figure 4-22) displays:

- **Step and Vial Number** - Appears in upper right corner, along with a blinking cursor that indicates that the run is in progress.
- **Vial #** - Displays current sample vial number.
- **Inj** - Displays the current injection and number of injections per sample vial on the current step.
- **Volume** - Displays the volume injected.
- **Runtime** - Displays the programmed run time for the current injection.
- **Time Remaining** - Displays the time remaining for the current injection.
- **Total Runtime** - Displays the time to run the current and all of the remaining injections in the Edit: Auto Run table.
- **Options** - Displays the option that is being run for that step, if any.

Note: *Total Runtime does* ***not*** *include the time for executing programmed options, the sample withdrawal time, or any report delay time.*

4.7 Making a Stat Run

The stat run feature allows you to interrupt an auto run to make injections from priority samples. When the stat run is complete, the autosampler returns to the next injection of the auto run program.

Performing a Stat Run

To make a stat run:

1. If the autosampler is making an injection, wait until the injection sequence is complete. Then remove the sample carousel.
2. Load the samples into the carousel in a continuous sequence.
3. From the Auto Run Status screen, press **Stat Run**, and the Edit Stat Run screen appears (Figure 4-23).

Note: *The autosampler completes the current injection before beginning the stat run. The carousel does not release during an injection sequence.*

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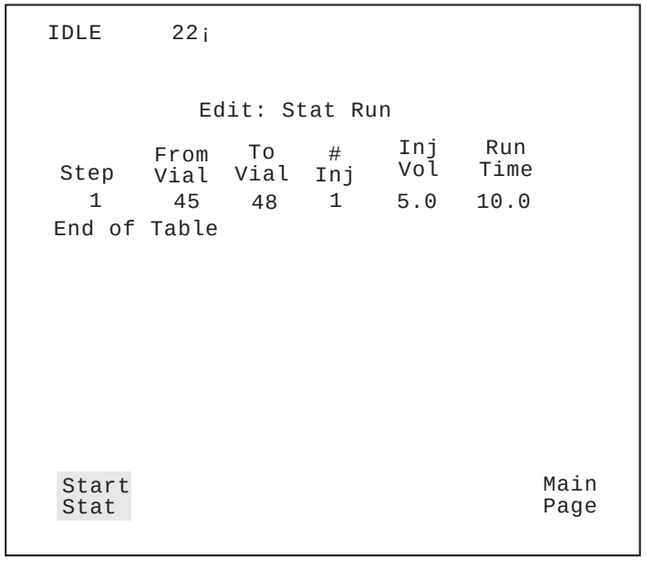


Figure 4-23 Edit Stat Run Screen

Entering Stat Run Parameters

Note: *You must enter a value for each parameter. For parameter ranges, see Section 4.6.1, Programming Auto Run.*

To program a Stat Run:

1. Enter the first vial of stat sample sequence in the From Vial field.
2. Enter the end of sequence of stat vials in the To Vial field. If you have only one sample, enter the vial number again in the To Vial field.
3. Enter the number of injections made from each vial in the # Inj field.
4. Enter the volume in microliters for each injection in the Inj Vol field.
5. Enter the length of time from start of injection until the End-of-Run signal and the start of the next injection in the Run Time field.

Starting a Stat Run

After programming the stat parameters, press **Start Stat** to begin the run.

Note: *The stat run does not begin until the run time for the last auto run injection ends.*

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Monitoring a Stat Run

When the Stat Run begins, the Stat Run Status screen (Figure 4-24) appears.

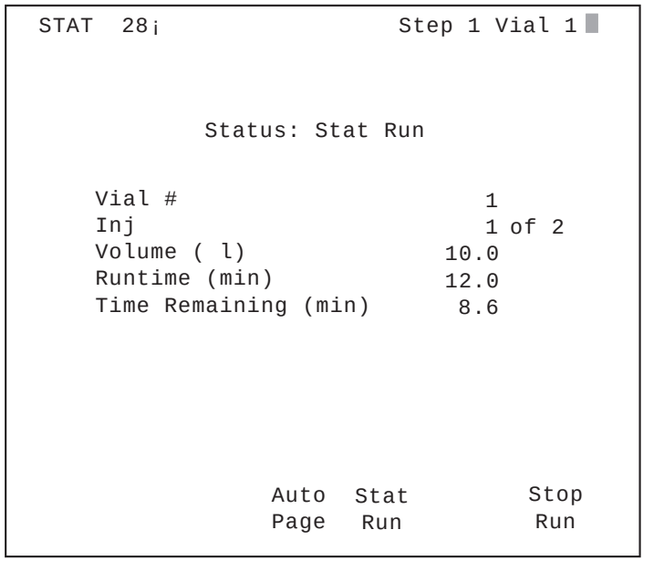


Figure 4-24 Status: Stat Run

The Stat Run Status screen displays:

- **Step and Vial Number** - Appears in upper right corner, along with a blinking cursor that indicates that the run is in progress.
- **Vial Number** - Displays current vial number.
- **Inj** - Displays the current injection and number of injections per vial on the current step.
- **Volume** - Displays the volume injected.
- **Runtime** - Displays the run time for the current injection.
- **Time Remaining** - Displays the time remaining on the current Stat run.

Stopping a Stat Run

Note: *Stopping a Stat run aborts the Auto Run. The autosampler does not return and execute the remaining steps of the Auto Run.*

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To stop a Stat run:

1. Press **Stop Run**. A prompt appears:

```
Do you really want to stop the Auto Run?
```

2. Press **Yes** to stop the run and return to the Main Menu.

4.8 Sampling Considerations

The sample and chromatography method you use may require changing the configuration of the autosampler. This section covers:

- Setting the temperature control for the sample compartment
- Making microbore (less than 5 µL) or semiprep (greater than 250 µL) injections
- Injecting viscous samples
- Purging during an auto run
- Using buffered mobile phases

4.8.1 Temperature Control

The heater/cooler module provides sample compartment temperature control from 4 to 40° C.

Environmental Restrictions

Ambient temperature must be 16 to 27° C at less than 80 percent relative humidity. At higher ambient temperatures, cooling capacity may be degraded.

Note: *Ensure that ventilation space is maintained (see Section 2.1, Site Requirements).*

To control sample compartment temperature:

1. When changing set point from below ambient to above ambient temperature, defrost the heater/cooler to prevent moisture build up inside the sample compartment (see Section 5.1, Defrosting the Heater/Cooler).
2. Set the sample chamber temperature on Configuration Page 2 by pressing the keys indicated in Figure 4-25.

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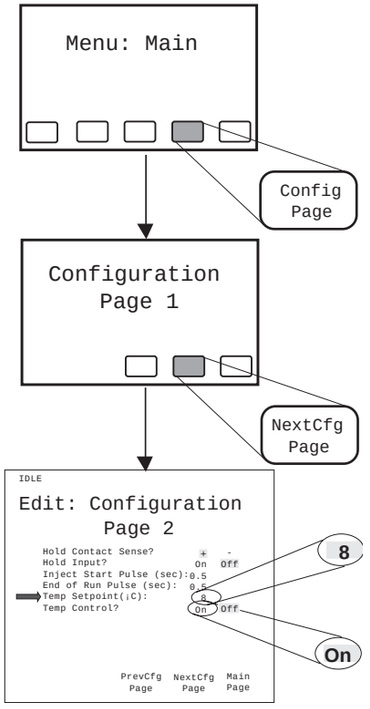


Figure 4-25 Setting Sample Chamber Temperature

3. Close the sample compartment door.

   Note: *The heater/cooler shuts off if the sample compartment door is left open more than 5 minutes*

4. Wait for the sample compartment to reach the set point. The heater/cooler may require up to 90 minutes to reach 4° C from an ambient temperature of 27° C.

4.8.2 Microbore/Semiprep Injections

The Waters 717plus a utosampler may be physically reconfigured to facilitate microbore injections (< 5 µL) and semiprep injections (> 150 µL).

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Making Microbore Injections

To make microbore injections:

1. Replace the standard 250 µL syringe with a 25 µL syringe (see Section 5.2, Replacing the Syringe).
2. Enter the hardware change on Configuration Page 3 by pressing the keys indicated in Figure 4-26.

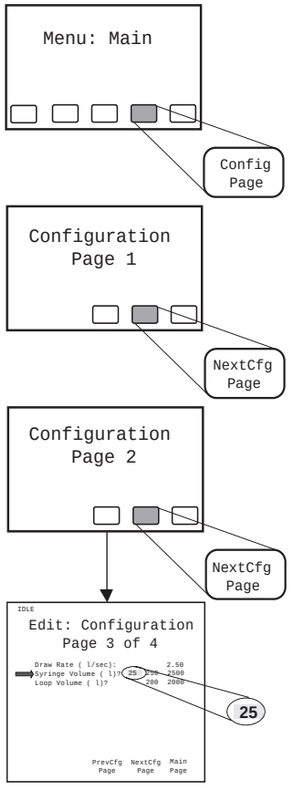


Figure 4-26 Changing Syringe Configuration

3. If required by sample viscosity, change the draw rate (see Figure 4-28).
4. Load sample into an appropriate size vial (see Appendix E, Selecting Sample Vials).

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Making Semiprep Injections

Semiprep chromatography involves large samples and high flow rates.

To make semiprep injections:

1. To increase sample injection volume, replace the standard 250 µL syringe with a 2500 µL syringe (see Section 5.2, Replacing the Syringe).
2. Connect the auxiliary loop to the standard sample loop (see Section 2.6.3, Installing the Large Sample Loop).
3. Enter the hardware change on Configuration Page 3 by pressing the keys indicated in Figure 4-27.

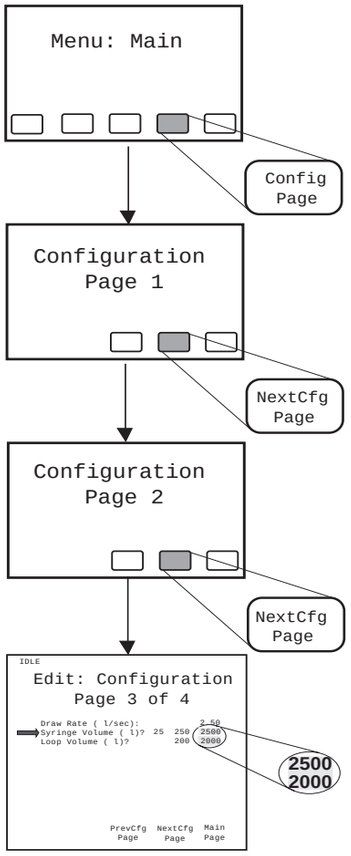


Figure 4-27 Entering the Semiprep Configuration

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4. If required by sample viscosity, change the draw rate (see Figure 4-28).
5. Load sample into an appropriate size vial (see Section 4.2.2, Selecting Sample Vials).

4.8.3 Injecting Viscous Samples

Slowing the sample withdrawal rate improves injection accuracy with viscous samples. The allowable range in draw rate for various syringes is shown in Table 4-4.

To change the sample draw rate, press the keys indicated in Figure 4-28.

Table 4-4 Sample Draw Rate

Syringe Volume (µL)	Draw Rate (µL/sec)
25	0.10 to 0.50
250	1.00 to 5.00
2500	10.00 to 50.00

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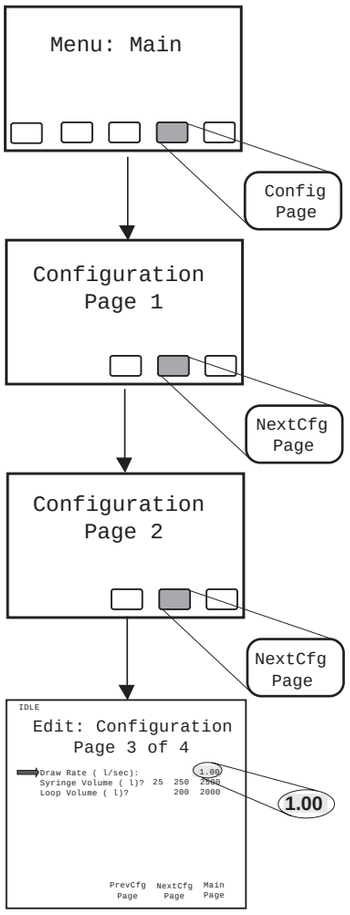


Figure 4-28 Setting Sample Draw Rate

4.8.4 Purging During an Auto Run

You can automatically purge during a run:

- Between methods (steps) to ensure fresh mobile phase
- Before running standards

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When the compression check is enabled (see Section 4.5.3, Performing a Compression Check), you may enable the autosampler to stop the next injection if the compression check fails.

Enabling Auto Purging

To enable auto purge between sets of vials, enter the number of vials between purges (Figure 4-29).

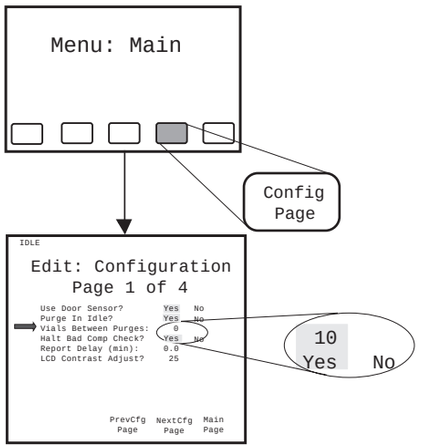


Figure 4-29 Enabling Auto Purge

Enabling Halt on Bad Compression Check

To stop the next injection if the mobile phase fails the compression check:

1. Ensure that the compression check is enabled (see Section 4.5.3, Performing a Compression Check).
2. Use the arrow keys to select **Yes** for Halt on Bad Compression Check (see Figure 4-29).

4.8.5 Using Buffered Mobile Phase

When using buffered mobile phases:

- Do not make abrupt changes from buffered aqueous solutions to organic solvents.
- Do not let the buffered mobile phase sit in the system. Always maintain a minimal flow.
- Enable the purge in idle mode during unattended operation.

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- Remove the mobile phase before powering down (see Section 3.8, Power Down and Storage).

Note: *Program the pump for a minimal flow after the last run to prevent damage to LC components.*

Purge in Idle

During unattended (overnight) runs using buffered mobile phases, enable the purge in idle mode to prevent buffer buildup in the autosampler.

To enable purge in idle, press the keys indicated in Figure 4-30.

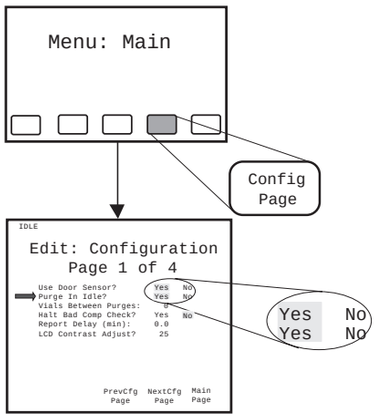


Figure 4-30 Enabling Purge in Idle

Removing Buffered Mobile Phase

Before changing from a buffered mobile phase to another mobile phase:

1. Replace the buffered mobile phase with a solution of 100 percent water, and flush the sampling system for 10 minutes at 1 mL/min.
2. Run three purges to ensure that the syringe is well-purged (see Section 3.4.1, Purging the Autosampler).

Attention: *To prevent bacterial growth do not leave 100 percent water in the autosampler (see Section 3.8, Power Down and Storage).*

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5 Maintenance

This chapter covers 717plus maintenance. Procedures are provided for defrosting the heater/cooler and for replacing the syringe, seal pak, and in-line filters.

5.1 Defrosting the Heater/Cooler

When to Defrost

If the Heater/Cooler fails to reach the lowest setpoint at recommended ambient conditions (16 to 27° C and 80 percent relative humidity), defrost the heater/cooler compartment.

Note: *Maintain proper ventilation space (see Section 2.1, Site Requirements).*

Defrosting the Heater/Cooler

To defrost:

1. Press the keys outlined in the figure below (Figure 5-1).
2. Open the sample compartment door. The defrost cycle takes 60 minutes.

Note: *If you want to stop the defrost cycle before the programmed time expires, press* **Stop Defrost.**

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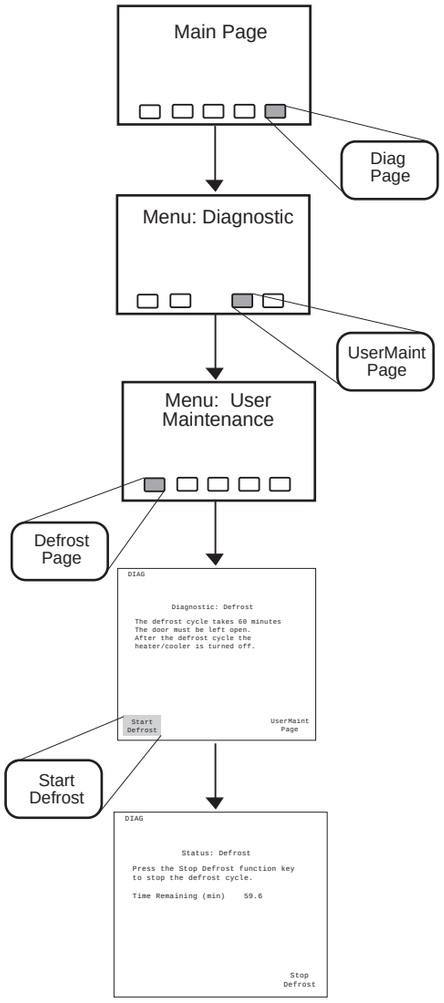


Figure 5-1 Defrost Menu Flowchart

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5.2 Replacing the Syringe

Replace the syringe if:

- Plunger tip becomes worn
- You want to use the optional 25 or 2500 µL syringes



Attention: *Use only Waters-approved syringes in the autosampler (see Appendix B for ordering information). Unapproved syringes may cause erroneous results and/or may not meet required safety standards.*

Syringe replacement involves:

- Removing the syringe
- Installing the new syringe
- Manually purging the syringe

5.2.1 Removing the Syringe

Removing the syringe requires:

- Releasing the plunger
- Lowering the syringe bracket
- Unscrewing the syringe

Releasing the Plunger

To release the plunger:

1. Set pump flow to 0 mL/min.
2. Remove the syringe compartment plastic cover by lifting up.
3. Remove the knurled nut that holds the plunger to the syringe guide mounting bracket (Figure 5-2).

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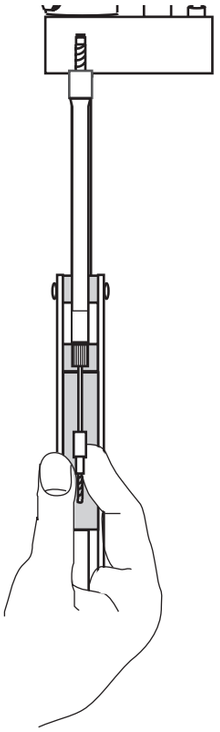


Figure 5-2 Syringe Assembly Components

Lowering the Bracket

To lower the mounting bracket:

1. Lower the bracket by pressing the keys indicated in Figure 5-3.

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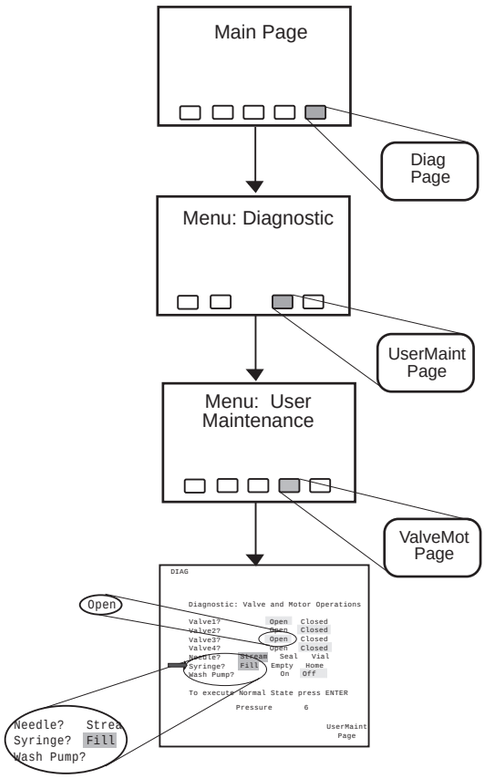


Figure 5-3 Positioning the Syringe for Removal

2. At the 717plus keypad, use arrow keys to move to the Valve 3 field. Highlight the **Open** entry, and press **Enter**.
3. Use the arrow keys to move to the syringe field. Highlight the **Fill** entry, and press **Enter**.
4. With the knurled nut removed, the plunger tip remains up as the mounting bracket is lowered.

Removing the Syringe

When the mounting bracket is lowered, unscrew the syringe assembly from the mounting block as follows:

1. Grasp the syringe barrel near the mounting block.
2. Turn the syringe counterclockwise until it releases from the mounting block.

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5.2.2 Installing the New Syringe

Installing a new syringe involves:

- Connecting and initializing the syringe
- Modifying configuration parameters if a syringe of a different size is installed

Connecting and Initializing the Syringe

To connect and initialize the syringe:

1. Screw the new syringe assembly partially into the mounting block (Figure 5-4). Do not tighten.

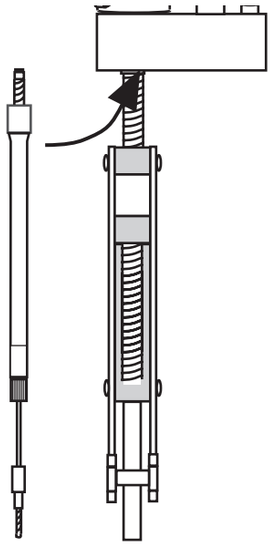


Figure 5-4 Installing the Syringe

2. Taking care to maintain the alignment of the plunger with the syringe, slide the plunger down so that the threaded end slides through the syringe guide mounting bracket.
3. Tighten the syringe hand-tight.
4. At the 717plus keypad, use the arrow keys to move to the Syringe field. Highlight the **Empty** entry, and press **Enter**. The mounting block moves upward to allow you to install the knurled nut.
5. Install the knurled nut.

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6. To reset the Valve and Motor Operations screen to the original state, move the screen arrow to the field:

   `To execute Normal State press Enter.`

   and press **Enter**.
7. To return to the Main Menu, press **UserMaint Page, Diag Page**, and **Main Page**.

Modifying Configuration Parameters

If the replacement syringe is a different size, change the syringe volume on Configuration Page 3.

Standard	Optional
250 µL	25 µL or 2.5 mL

To modify the syringe volume parameter:

1. Access Configuration Page 3 by pressing the keys indicated in Figure 5-5.

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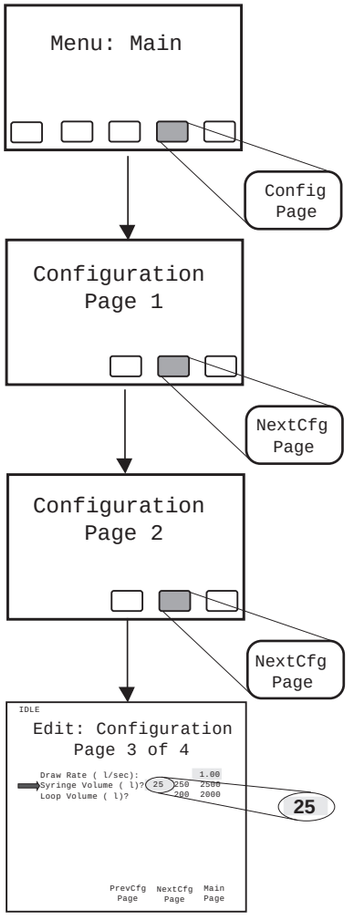


Figure 5-5 Changing Syringe Volume

2. Use the arrow keys to move to the `Syringe Volume` field. Highlight the appropriate volume, and press **Enter**.

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Purging the Syringe

Purge the autosampler a minimum of three times to ensure that there are no bubbles in the syringe.

To purge:

1. Set the pump flow to 1 mL/min.
2. From the Main Menu, press **Purge Page**.
3. Press **Start Purge**.
4. Repeat the purge a minimum of three times.
5. If three purges fail to remove bubbles from the syringe, manually purge the syringe (see Section 6.4.1, Manual Syringe Purge).

5.3 Replacing the Seal Pak

Replace the seal pak when:

- Contaminant peaks appear
- Seals leak

Note: *The needle and seal pak should always be replaced at the same time.*

The procedure for replacing the needle and seal pak involves:

- Removing the injector
- Removing the seal pak
- Replacing the needle
- Installing a new seal pak
- Installing the injector
- Calibrating the new seal pak

Tools Required

These procedures require the following tools:

- One T10Torx® wrench
- One T20 Torx wrench
- Two 5/16-inch wrenches
- One long flat-blade screwdriver

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5.3.1 Removing the Injector



Caution: *To avoid the possibility of electric shock, do not remove the power supply cover. The power supply does not contain user-serviceable components.*



Caution: *To avoid the possibility of electric shock, disconnect the autosampler power cord before continuing.*

To remove the injector:

1. Turn off the unit and disconnect the power cord from the rear panel.
2. Remove the autosampler cover (see Section 2.6.1, Removing/Replacing the 717plus Cover).
3. Using a Torx T20 wrench, remove the two screws securing the injector safety shield (located at the top of the shield). Remove the injector safety shield.
4. Disconnect the injector motor and sensor cables from the main circuit board.
5. Disconnect the fluid lines at inlet side of the two in-line filters (see Figure 5-9).

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6. Disconnect the two needle wash lines from the right side of the injector (Figure 5-6).

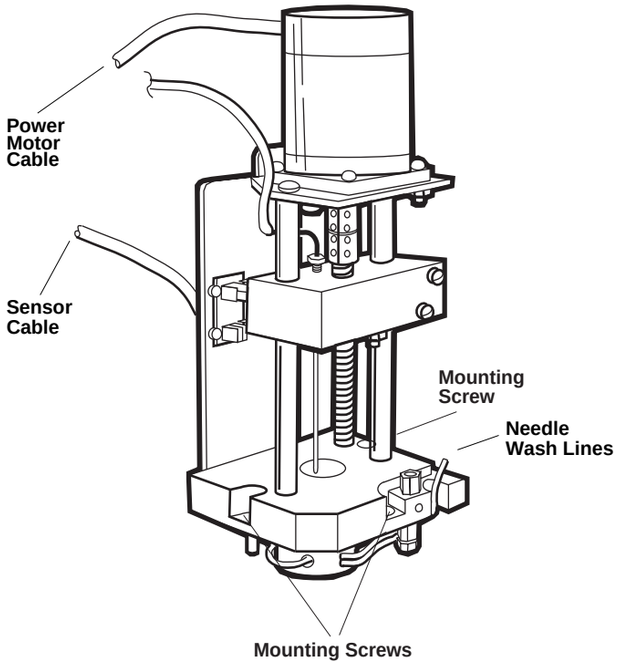


Figure 5-6 Removing the Injector (shown with Safety Shield Removed)

7. Using the long flat-blade screwdriver, loosen the three mounting screws securing the injector to the floor of the compartment (see Figure 5-6).
8. Carefully lay the injector on its side.

5.3.2 Removing the Seal Pak

To remove the seal pak:

1. Disconnect the tubing from the union on the side of the mounting plate.
2. Disconnect the needle wash lines from the seal pak.
3. Using a Torx T10 wrench, remove the four screws holding the seal pak to the base of the injector (Figure 5-7).

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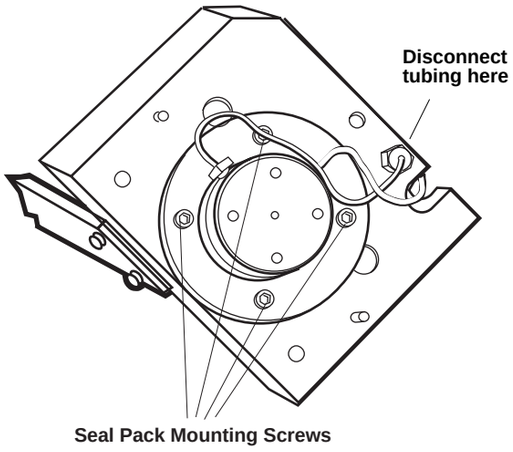


Figure 5-7 Bottom View of Injector

4. Pull the seal pak out of the injector.

5.3.3 Replacing the Needle

To replace the needle:

1. Unscrew the compression screw on the needle (Figure 5-8).

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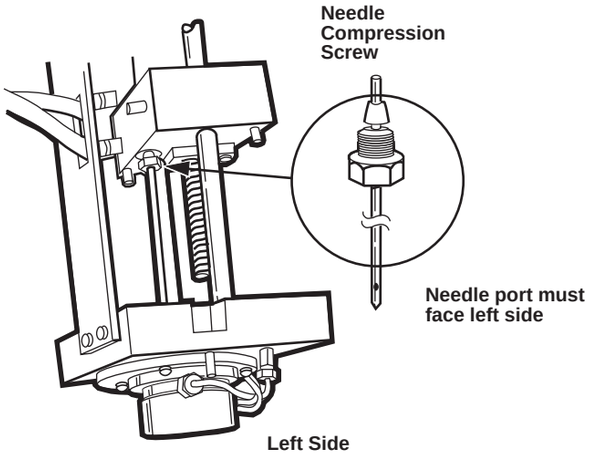


Figure 5-8 Needle Removal

2. Pull the needle down.
3. Rotate the motor drive shaft until the needle mounting block is as high as it can go.
4. Orient the needle port toward the left side of the injector (Figure 5-8). Identify the left side of the injector by the position sensors on the support bracket.

STOP ***Attention:*** *Hold the needle only at the upper end (away from the needle port). Use a clean wipe and 100% methanol to clean the needle after installation.*

5. Slide the compression screw and ferrule onto the end of the needle.
6. Push the needle into the needle mounting block until it is firmly seated. Tighten the compression screw hand-tight.
7. Check the orientation of the needle port. Ensure that it is still facing the left side of the injector assembly, and use the 5/16-inch wrench to tighten the compression screw no more than 1/4 of a turn.

5.3.4 Installing a New Seal Pak

To install the new seal pak:

1. Moisten the seal with MeOH/H_2O solution.
2. Slide the seal pak over the end of the needle and attach it to the bottom of the injector with the four screws.

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3. Connect the outlet line from the union fitting to the port on the left side. Tighten the connections 1/4-turn after making a finger tight connection.
4. Connect the inlet line (with in-line filter) to the port on the right side. Tighten the connections 1/4-turn after making a finger tight connection.
5. Connect the needle wash lines.

5.3.5 Installing the Injector

To install the injector:

1. Lower the injector into the base, fitting the guide pins in place.



Attention: *Be sure that the needle wash tubings are not pinched between the injector and the base.*

2. Attach the injector to the floor of the compartment by tightening the three mounting screws.
3. Connect the two needle wash lines.
4. Connect the outlet tubing (red line) to the union at the base of the injector.
5. Connect the restrictor to the in-line filter.
6. Using the Torx T20 wrench, replace the two screws securing the injector safety shield.



Caution: *To avoid the possibility of pinched fingers, always replace the injector safety shield after reinstalling the injector.*

5.3.6 Calibrating the Seal Pak

The replacement seal pak must be calibrated after installation.

Seal pak calibration involves:

- Purging the autosampler
- Auto zeroing the transducer
- Calibrating the seal pak

For details, refer to Section 3.4, Calibrating the Seal Pak.

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5.4 Replacing In-Line Filters

Caution: *To avoid the possibility of electric shock, turn off the unit and disconnect the power cord before performing the following procedures.*

Caution: *Wear safety glasses when performing this procedure.*

Replace the in-line filters as needed when the source of high backpressure is the injector.

Tools required:

- Two 5/8-inch open end wrenches
- One 5/16-inch wrench

To replace the in-line filters:

1. Set pump flow rate to 0 mL/min.
2. Remove the autosampler cover and locate the in-line filters (Figure 5-9).

Note: *For procedures on removing the 717plus cover, refer to Section 2.6.1, Removing/Replacing the 717plus Cover.*

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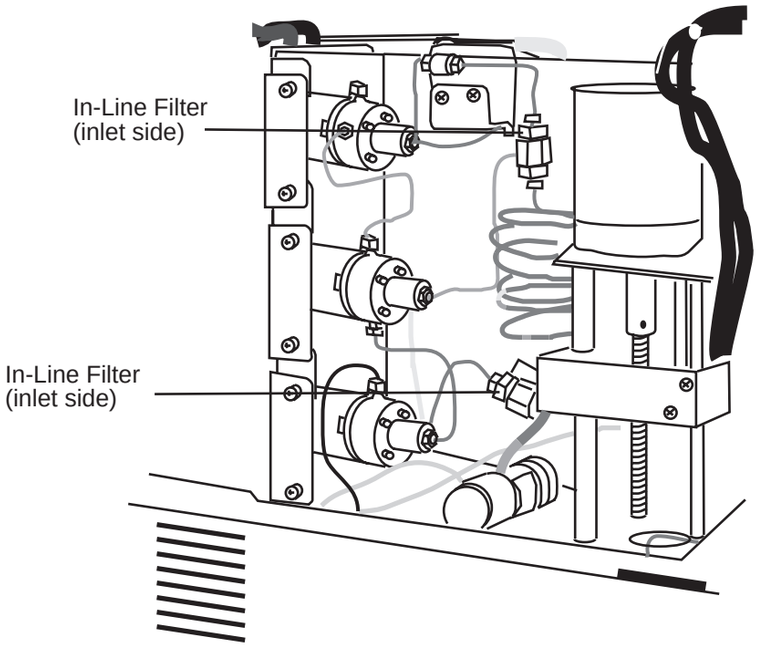


Figure 5-9 Locating In-Line Filters

3. Holding the in-line filter with a 5/8-inch wrench, disconnect both compression screws with the 5/16-inch wrench.
4. Repeat step 2 on the other in-line filter.
5. Disassemble each filter using two 5/8-inch wrenches.
6. Wash each in-line filter housing with methanol.
7. Assemble each in-line filter with a new filter insert (Figure 5-10).

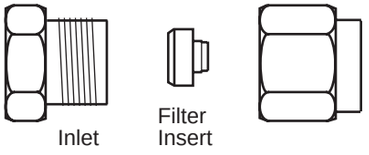


Figure 5-10 Assembling In-Line Filters

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8. Attach the assembled in-line filters as indicated in Figure 5-9.
9. Reconnect the power cord, and turn on the autosampler.
10. Flush the autosampler at 1 mL/min for 10 minutes.
11. Inspect the in-line filters for leaks, and tighten 1/4-turn as required.
12. Replace the autosampler cover (see Section 2.6.1, Removing/Replacing the 717plus Cover).

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6 Troubleshooting

This chapter describes troubleshooting the 717plus with the help of user diagnostics and error messages.

6.1 Safety and Handling

When troubleshooting instrumentation, keep the following safety considerations in mind:



Caution: *To avoid the possibility of electric shock, disconnect the power cord before removing the cover and examining the instrument.*



Caution: *Always observe safe laboratory practices when troubleshooting. Know the chemical and physical properties of the solvents. Refer to the Material Safety Data Sheet for the solvents in use.*

- If handling integrated circuit boards, use an anti-static mat and wear an anti-static wrist strap to remove excess static charge and prevent damage to the board.
- Do not touch any of the integrated circuit chips or other components which do not specifically require manual adjustment.

When You Call

If you cannot correct a condition using the procedures in this chapter, contact Waters. You can contact Waters Technical Service at (800) 252-4752, *U.S. and Canadian customers only.* Other customers, call your local Waters subsidiary or your local Waters Technical Service Representative, or call Waters corporate headquarters for assistance at (508) 478-2000 (U.S.).

To expedite service, have the following information available when you call:

1. Nature of symptoms
2. Serial number of autosampler
3. Type and model number of pump (single or multiple solvent)
4. Flow rate
5. Operating pressure

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6. Mobile phase(s)
7. Type and model number of detector (UV, RI, fluorescence, conductivity, electrochemical)
8. Detector settings (wavelength, sensitivity, and so on)
9. Type and serial number of column
10. Sample matrix and components
11. Data system
12. Software version (if applicable)

6.2 Error Messages

This section describes the Waters 717plus Autosampler error messages.

The six error message types provide information about autosampler components and subsystems (Table 6-1).

Table 6-1 Error Message Type

Type	Prefix	Purpose
Informational	Blank or Warning	Alerts the operator to incorrect parameter entries or operations.
Calibration	Error CAL	Identifies problems with the injector seal pak calibration.
Carousel	Error CAR	Identifies problems with the carousel, carousel reader, or carousel drive.
Heater/Cooler	Error H/C	Identifies problems with the heater/cooler module.
Injector	Error INJ	Identifies problems with the injector position sensors.
Syringe	Error SYR	Identifies problems with the syringe position sensors.

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Clearing Error Messages

To clear error messages:

- Press **Clear** on the front panel
- Correct the source of the error

6.2.1 Informational Error Messages

Informational error messages alert the operator to incorrect parameter entries or operations.

Table 6-2 Informational Error Messages

Error Message	Solution
Cannot prg (purge) while initializing	Press **Clear**, wait for initialization to finish
Cannot run stat while purging	Press **Clear**, wait for purge to finish
Inject volume exceeds loop vol (volume)	Press **Clear**, install auxiliary loop for volumes over 200 µL
Power fail interrupted run	Press **Clear**, and reprogram auto run table
Vial exceeds carousel size	Press **Clear**, check carousel size, and re-enter vial number

6.2.2 Calibration (CAL) Error Messages

Most calibration error messages appear during seal pak calibration (Table 6-3).

Table 6-3 CAL Error Messages

Error Message	Solution
CAL: Could not find bottom sensor	Recalibrate, call Waters
CAL: Could not find upper seal	Recalibrate, call Waters

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Table 6-3 CAL Error Messages (Continued)

Error Message	Solution
CAL: Pressure above 750 psi	Lower pump pressure (400 to 600 psi), recalibrate
CAL: Pressure below 400 psi	Raise pump pressure (400 to 600 psi), recalibrate
CAL: Seal width too narrow	Recalibrate, call Waters
CAL: Seal width too wide	Recalibrate, call Waters
CAL: Top sensor too high	Recalibrate, call Waters
CAL: Top sensor too low	Recalibrate, call Waters
CAL: Transducer pressure too high	Autozero transducer before recalibrating
CAL: Transducer pressure too low	Autozero transducer before recalibrating
CAL: User aborted calibration	Recalibrate

6.2.3 Carousel (CAR) Error Messages

Carousel errors (Table 6-4) may be the result of using a dirty carousel or using the wrong carousel.



Attention: *Use only Waters™ grey carousels from Waters. The Waters 717plus Autosampler does not work with WISP white or brown carousels.*

Clearing Carousel Errors

To clear carousel error messages:

1. Press **Clear**.
2. Open sample compartment door and remove carousel.
3. Clean carousel.
4. Insert the clean carousel or use a different Waters carousel (grey only).
5. If carousel errors continue, call Waters.

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Table 6-4 CAR Error Messages

Error Message	Solution
CAR: Both carousel lift sensors on	Reset autosampler, call Waters
CAR: Cannot run with door open	Close door
CAR: Carousel homing deviation	Follow the procedure above for clearing carousel errors
CAR: Could not engage carousel	Reset autosampler, call Waters
CAR: Could not maintain position	Follow the procedure above for clearing carousel errors
CAR: Could not position CAR (carousel) lift	Reset autosampler, call Waters
CAR: Could not position carousel	Follow the procedure above for clearing carousel errors
CAR: Could not position to vial	Follow the procedure above for clearing carousel errors
CAR: Lift not active in purge mode	Wait for purge cycle to complete before attempting to remove a carousel

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6.2.4 Heater/Cooler (H/C) Error Messages

Table 6-5 H/C Error Messages

Error Message	Solution
H/C: Door open time exceeded limit	Close door and allow sample compartment to equilibrate
H/C: High temp limit exceeded	Reset autosampler, call Waters
H/C: Internal fan failure	Call Waters
H/C: Low temp limit exceeded	Reset autosampler, call Waters
H/C: Temp (temperature) control has a fault	Call Waters
H/C: User aborted defrost cycle	Informational message, proceed with sampling

6.2.5 Injector (INJ) Error Messages

Table 6-6 INJ Error Messages

Error Message	Solution
INJ: Both injector sensors on	Reset autosampler, call Waters
INJ: Bottom sensor active	Reset autosampler, call Waters
INJ: Compressibility exceeds limit	Degas mobile phase. If compressibility test fails on degassed mobile phase, perform leak test (Section 6.4.2, Valve Leak Test).
INJ: Could not find bottom sensor	Reset autosampler, call Waters
INJ: Could not find top sensor	Reset autosampler, call Waters
INJ: Could not position needle	Reset autosampler, call Waters

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Table 6-6 INJ Error Messages (Continued)

Error Message	Solution
INJ: Injector seals are not calibrated	Calibrate seal pak (Section 3.4.3, Calibrating the Seal Pak)
INJ Pressure inc. (increase) on comp (compression) check	Perform leak test (Section 6.4.2, Valve Leak Test)
INJ: Top sensor active	Reset autosampler, call Waters

6.2.6 Syringe (SYR) Error Messages

Error Message	Solution
SYR: Both syringe sensors on	Reset autosampler, call Waters
SYR: Cannot move with v2 and v3 closed	Open valves 2 and 3 before moving syringe
SYR: Could not position syringe	Reset autosampler, call Waters
SYR: Syringe at empty position	Reset autosampler, call Waters
SYR: Syringe at full position	Reset autosampler, call Waters

6.3 Troubleshooting Tables

Figure 6-7 is a guide to troubleshooting autoinjector problems. It lists autoinjector-related symptoms, possible causes, and corrective action for the problem.

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Table 6-7 Autosampler Troubleshooting

Symptom	Possible Cause	Corrective Action
Autosampler does not run (fan and front panel lights off)	Autosampler not connected to power source	Ensure power cable is properly connected to power source and autosampler.
	No power at outlet	Check the outlet by connecting another electrical unit known to be working and verify if the unit operates. If that unit does not work, relocate the autosampler to a functioning electrical outlet.
	Blown fuse	Replace the fuse (see Section 2.3, Changing Voltage Configuration).
Autosampler does not run (fan and front panel light on)	Autosampler not connected to controller	Ensure IEEE cable is properly connected to controller. Verify that IEEE-488 addresses (if IEEE-488 communication is in use) are properly set. •If properly connected and IEEE-488 addresses are correct, turn off the autosampler and controller and disconnect the cable. Turn on the autosampler and verify that it is calibrated and operates under its own control. •If autosampler operates properly, refer to the controller operator's manual for troubleshooting information.
Autosampler does not run (fan and front panel light on)	Power failure	Reset the autosampler and resume operation.

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Table 6-7 Autosampler Troubleshooting (Continued)

Symptom	Possible Cause	Corrective Action
	Sample compartment door opened	Close sample compartment door. If problem continues, contact Waters.
	Sample carriage error	Contact Waters.
	Defective circuit board	Contact Waters.
Leak from fluid system (needle, injector, seal pak, fluid pack)	Loose or overtightened compression fitting	Verify fittings and ferrules for under/overtightening and wear. Replace if necessary.
	Defective valve seals	Test valves (Section 6.4.2, Valve Leak Test) and replace as required (call Waters).
	Defective seal pak	Replace seal pak (call Waters).
	Defective fluid pack	Replace fluid pack (call Waters).
	Damaged needle	Purge the autosampler to unplug the needle. If problem continues, replace the needle assembly and seal pak (call Waters).
	Blocked or damaged syringe	Replace syringe (see Section 5.2, Replacing the Syringe).
Leak from needle wash system	Loose or overtightened compression fitting	Verify fittings and ferrules for under/overtightening and wear. Replace if necessary.
	Defective fluid valve	Replace fluid valve (call Waters).
Leak from needle wash system (continued)	Defective needle wash pump	Replace needle wash pump (call Waters).

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Table 6-7 Autosampler Troubleshooting (Continued)

Symptom	Possible Cause	Corrective Action
	Autosampler is siphoning solvent from needle wash reservoir	Lower the needle wash solvent reservoir.
Sample injection problem (such as sample not being injected, abnormal peak shape)	Defective injection valve	Purge the autosampler. If problem continues, repair/replace the valve.
	Blocked needle due to particles in sample	Purge the autosampler to unplug the needle. Ensure sample and solvent are properly filtered (see Section 4.2.1, Preparing Samples) to prevent further blockages. If problem continues, replace the needle assembly.
	Air bubble in syringe or sample loop assembly	Purge the autosampler. If air bubbles are repeatedly being drawn in, verify that a vacuum is not being created when needle pierces the self-sealing septum (indicating seal is too tight around needle). Inject from the sample vial without a cap in place.
	Injection from empty sample vial	Compare sample vial entry and vial position. Enter correct sample vial number.
	Insufficient sample in vial	Ensure minimum sample volume requirement is in the vial (see Appendix E, Selecting Sample Vials).
Sample injection problem (continued)	Cap is on too tight on the self-sealing septum	Loosen the cap.

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Table 6-7 Autosampler Troubleshooting (Continued)

Symptom	Possible Cause	Corrective Action
	Sample too viscous	Dilute sample or decrease syringe draw speed rate.
	Vial septum not being pierced	Re-inject from the sample vial with a cap in place. Inspect if a hole is being made by the injector. If no hole is made, there is a problem with the injector/needle.
	Misaligned sample transport system	Call Waters.
	Defective injector seals	Replace injector seals (see Section 5.3, Replacing the Seal Pak).
No solvent flow through injector	Autosampler not connected to pump	Attach fluid lines to pump (see pump operator's manual).
	Autosampler stuck in purge (valve 1 closed)	Restart operation to reposition valve. If problem continues, repair/replace valve (call Waters).
	Blocked injection valve	Purge the autosampler. If problem continues, repair/replace the injection valve.
	Leak within autosampler or prior to autosampler	Check for leaks. Tighten loose fittings. If leaks continue, verify fittings and ferrules within autosampler for wear. Replace if necessary.
High system pressure due to autosampler	Blocked in-line filters	Replace filter inserts (see Section 5.4, Replacing In-Line Filters).
High system pressure due to autosampler	Blocked needle due to particles in sample	Refer to the Corrective Action under the “Sample not being injected” symptom listed above.
(continued)	Blocked injection valve	Purge the autosampler. If problem continues, repair/replace the valve.

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Table 6-7 Autosampler Troubleshooting (Continued)

Symptom	Possible Cause	Corrective Action
	Sample not miscible with mobile phase	To verify solubility, place sample and mobile phase in a test tube and observe if the sample dissolves. If necessary, further dilute the sample or change the mobile phase.
Sample carryover	Sample injection problem	To verify the problem, test with blank injections of solvent after a sample injection. If the carryover problem occurs after a sample injection, this may be due to a problem with the needle wash system (see below).
	Needle wash system problem (due to loss of prime, empty solvent reservoir, contaminated frits, or defective needle wash pump)	Verify these potential problem areas and perform one of the following: •**Empty solvent reservoi**r - Refill the needle wash reservoir •**Loss of prime** - Re-prime the needle wash system •**Contaminated frits** - Replace seal pak •**Defective needle wash pump** - Call Waters
Injection from wrong sample vial	Incorrect sample vial number specified	Compare sample vial entry and vial position. Enter correct sample vial number in autosampler.
	Sample vial mislabeled	Verify information on sample vial. Change label if necessary.
	Misaligned sample transport system	Call Waters.
Incorrect sample volume injected	Incorrect injection volume specified	Compare injection volume value and vial position. Enter correct injection volume value in autosampler.

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Table 6-7 Autosampler Troubleshooting (Continued)

Symptom	Possible Cause	Corrective Action
	Incorrect syringe size value specified on configuration menu	Compare syringe size value and installed syringe. Enter correct syringe size (see Section 3.6.3, Entering Hardware Changes).
	Incorrect syringe installed in fluidic system	Replace with appropriate size syringe (see Section 5.2, Replacing the Syringe).
	Insufficient sample in vial	Ensure minimum sample volume requirement is in the vial (see Appendix E, Selecting Sample Vials).
	Leaky syringe	Repair/replace syringe (see autosampler operator's manual).
	Sample too viscous	Dilute sample or decrease syringe draw speed rate.
	Vacuum created in vial	Make injections without a cap in place, remove excess sample from the vial, or loosen cap on the self-sealing septum.
Vials repeatedly break	Incorrect vials being used	Use Waters vials.
	Incorrect caps being used	Use Waters caps.
	Caps not put on properly	Ensure that caps are on properly.
	Needle or injector malfunction	Call Waters.
Vials repeatedly break (continued)	Misaligned sample transport system	Call Waters.

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Table 6-7 Autosampler Troubleshooting (Continued)

Symptom	Possible Cause	Corrective Action
Needle bent	Solid cap not removed from sample vial	Remove sample vial cap and replace with a septum and cap. Replace the autosampler needle.
	Incorrect vials being used	Use Waters recommended vials. Replace the autosampler needle.
	Septum too resistant	Ensure that only one septum is being used at a time. Replace the autosampler needle (see autosampler service manual).
	Misaligned sample transport system	Call Waters.
Heater/cooler fails to reach the set point	Frost prevents cooling	Defrost sample compartment.
	Exterior or sample compartment fans not working	Replace fan (call Waters).
	Fan filter dirty	Clean fan filter.
	Insufficient air flow	Ensure sufficient space behind autosampler (see Section 2.1, Site Requirements).
	Sample door left open more than 5 minutes	Close sample compartment door.
	High ambient temperature in laboratory	Reduce ambient temperature.

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6.4 Troubleshooting Procedures

Use the troubleshooting procedures below to correct or isolate problems.

The following procedures are covered in this section:

- Manual Syringe Purge
- Valve Leak Test
- Manual Transducer Adjustment

Special Valve Diagnostics

Two special diagnostics are accessible from the Valve/Motor page in user diagnostics:

- Valve Test Page
- Valve Rebuild Page



Attention: *The valve test diagnostics test is used to diagnose a faulty valve. This test* ***must only*** *be used with the help of a qualified Waters Service representative.*

6.4.1 Manual Syringe Purge

In the event that repeated purges do not remove air from the syringe, perform a manual purge.

1. Access the Valve/Motor Diagnostic page through the Diagnostics and User Diagnostics Menus.
2. Set the valves and syringe positions as shown in Figure 6-1.

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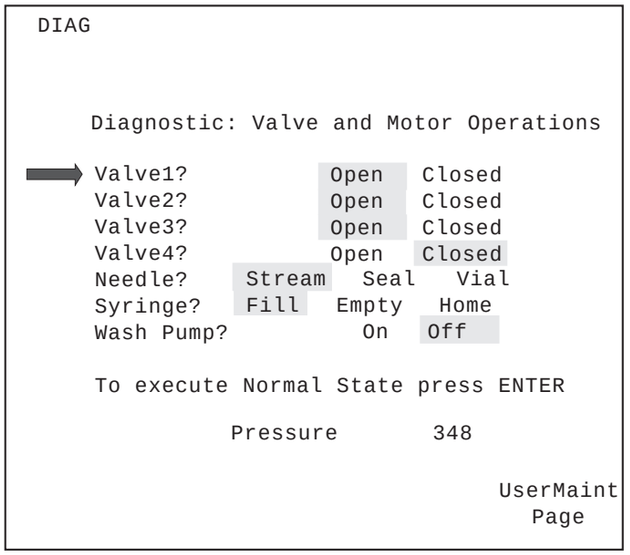


Figure 6-1 Positioning the Syringe for Manual Purge

3. Set the system flow to 1 mL/min.
4. Remove the syringe assembly cover.
5. Remove the knurled nut.
6. Push the plunger to the top of the syringe barrel.
7. Pull down the plunger halfway.
8. Repeat steps 6 and 7 three times.
9. On the valve/motor diagnostics page, move the arrow down to the field:

`To execute Normal State press ENTER`

and press **Enter**.

6.4.2 Valve Leak Test

If a compression test fails using degassed mobile phase, use the procedure below to isolate problems within the autosampler fluid system.

Caution: *Wear safety glasses when performing this procedure.*

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Preparing for the Valve Test

This procedure requires a pump that can deliver at least 5000 psi without leaking and has a pressure gauge.

1. Open the sample compartment door, remove the carousel, and place a beaker under the injector needle.
2. Cap the red outlet line.
3. Access the Valve/Motor Diagnostics page (Figure 6-2).

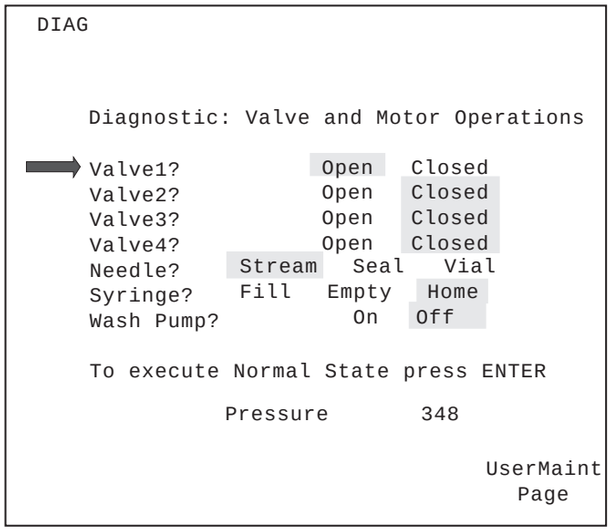


Figure 6-2 Valve and Motor Operations

Performing the Valve Test

Run each test in the order presented. Running a test consists of:

- Setting the valves and needle
- Setting the pump pressure
- Monitoring the pressure decay
- Checking for valve release time

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To run a valve test:

1. For each test, set valves and needle on the Valve and Motor Operations page as follows:

Test	Checks	Step 1	Step 2	Step 3	Step 4	Step 5
1	V1 and injector seals	Needle in Vial	V3 Open	V2 Closed	V1 Closed	—
2	V2	Needle in Stream	V3 Open	V1 Open	V2 Closed	—
3	Needle port too low in seal	Needle in Seal	V3 Open	V1 Open	V2 Closed	—
4	Needle port too high in seal	Needle in Seal	V3 Open	V1 Closed	V2 Open	—

2. For each test, run the pump at the designated flow until the required pressure is reached.

Test	Checks	Flow Rate (mL/min)	Pressure (psi)
1	V1 and injector seals	1.0	4500
2	V2	1.0	4500
3	Needle port too low in seal	1.0	4500
4	Needle port too high in seal	1.0	4500

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3. Shut off the pump, and monitor the pressure for 15 seconds for pressure decay.

Test	Checks	Allowable Pressure Decay (psi)	Leakage Locations
1	V1 and injector seals	500	Needle port, needle, or valve housing
2	V2	500	Waste line or valve housing
3	Needle port too low in seal	500	Needle port
4	Needle port too high in seal	500	Valve V3 outlet

4. Test the valve release time under pressure by opening the valve being tested. Pressure must be released in ≤ 3 seconds.
5. Repeat steps 1 through 4 for each test.
6. If the injector fails to calibrate, or the valves fail to maintain the required pressure, contact Waters Technical Service (refer to the sales/subsidiary list at the back of this document).

6.4.3 Manual Transducer Adjustment

If the auto zeroing (Section 3.4.2, Auto Zeroing the Transducer) fails to zero the transducer, perform the manual adjustment procedures below.



Caution: *To avoid the possibility of electric shock, disconnect the power cord before removing the cover and examining the instrument.*

To manually adjust the transducer:

1. Ensure that system pressure is zero.
2. Power down the autosampler.
3. Remove the autosampler cover (Section 2.6.1, Removing/Replacing the 717plus Cover).

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4. Power up the autosampler.
5. Access the Auto Zero Pressure page by pressing the keys indicated in Figure 6-3.

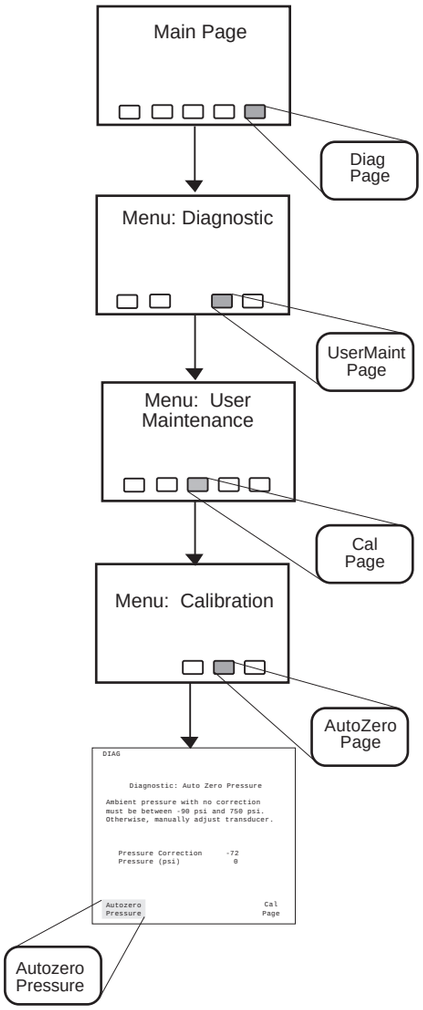


Figure 6-3 Accessing the Auto Zero Pressure Page

6. Using a small-blade screwdriver, access the adjustment screw through the access hole beneath the black plastic transducer (Figure 6-4).

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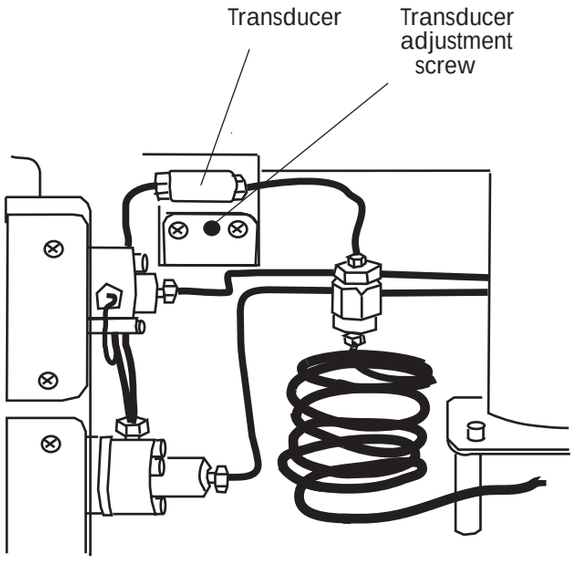


Figure 6-4 Adjusting the Transducer

7. Using the screwdriver, adjust the transducer until the pressure reading is -90 to +750 psi.
8. Perform an auto zero (Section 3.4.2, Auto Zeroing the Transducer).
9. Replace the autosampler cover (see Section 2.6.1, Removing/Replacing the 717plus Cover).

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A Appendix A Specifications

This appendix includes information on:

- Operational specifications
- Mechanical specifications
- Environmental specifications
- Power requirements
- Communications

Table A-1 Operational Specifications

Condition	Specification
Injection Volume Range	0.1 µL to 2000 µL in 0.1 µL Increments
Linearity (1 to 100 µL)	> 0.99 Coefficient of deviation
Carryover	< 0.1 %
Bandspreading	< 10 % Contribution for all solvent systems
Precision (typical, 5 to 50 µL)	< 0.5 % RSD
System Operating Pressure	4500 psig (31027 Kpa) maximum continuous operating pressure 5000 psig (34475 Kpa) maximum surge for <30 seconds
Wash Flow, Solvent Rate	> 0.4 mL per injection
Minimum Sample Required	7 µL using low volume inserts
Sample Compartment-Temperature Control (Optional Kit Required)	4 to 40 °C, ± 3 °C, set in 1 °C Increments; max. time to reach set point 1.5 Hr. (*low setpoint is derated above 27 °C ambient temperature)
Advanced Sampling Routines	Priority Samples, Auto Standards, Auto Addition, and Auto Transfer

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Table A-2 Mechanical Specifications

Condition	Specification
Wetted Surface Materials	316 Stainless Steel, Teflon, Glass, Fluoraloy-08 R, UHMWPE
Number of Sample Vials	1 to 96
Number of Injections	Programmable 1 to 99 injections per vial
Allowable Solvents	All standard LC solvents
Inlet Tubing to Injector	0.040 I.D. stainless steel
Outlet Tubing from Injector	0.009 I.D. stainless steel
Total Solvent Volume	836 µL
Weight	63 lbs. (28.6 kg)
Dimensions	15” width x 16” height x 21” depth (38.10 x 40.64 x 53.34 cm)

Table A-3 Environmental Specifications

Condition	Specification
Operating Temperature Range	4 to 40 °C
	Note that the cooler performance is derated when the ambient operating temperature exceeds 27 °C
Relative Humidity	80%, noncondensing
Storage Temperature Range	-40 to 70 °C

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Table A-4 Power Requirements

Voltage Range (VAC)*	Frequency (Hz)	Current
85 to 130	50 or 60 Hz	5 A maximum
185 to 265	50 or 60 Hz	4 A maximum

*The range is selected via the power entry module on the rear panel (see Section 2.3.2, Changing Voltage Configuration).

Table A-5 Communications

Condition	Specification
IEEE-488	24-pin female connector
RS-232	Modified modular phone connector
Event Inputs (2) Hold injection (2)	Each input has an internal pull-up resistor connected to +5 V and is protected to ± 30 V. A logic low is defined as an input voltage of between -30 V and 1.8 V. A logic high is defined as an input voltage of between 3.0 V and 30 V The minimum pulse width detectable is 30 milliseconds.
Event Output (1) Inject Start (2) Inject Stop (1)	Each output is a separate relay contact closure. Contact rating (permanent damage will result if exceeded): Maximum resistive load:10 VA Maximum switching voltage: 40 Vdc Maximum switching current: 0.25 A Maximum carry current: 1.0 A

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Appendix B
Spare Parts

The following spare parts are approved for customer installation. Any parts not listed in this section may require installation by a trained service representative.

Table B-1 Spare Parts

Description	Part Number
Battery	WAT080443
Cap for 1 mL vial (1000/pkg)	WAT078515
Cap, black phenolic for 4 mL screw top vial (144/pkg)	WAT072711
Carousel, 48-vial	WAT078723
Carousel, 96-vial	WAT078727
Feet	WAT036017
Filter, precolumn, assembly	WAT035190
Filter, precolumn, insert	WAT088084
Fuse, 5 Amp, 110 V, 1.25-inch x 0.25-inch	WAT072774
Fuse, 4 Amp, 220 V, 5 mm x 20 mm	WAT165-17
Heater/cooler assembly	WAT078563
Injector assembly	WAT078949
Low-volume insert, 250 µL glass, lowest minimum volume (144/pkg)	WAT072704
Low-volume insert, 250 µL glass (144/pkg)	WAT015199
Low-volume insert, 250 µL plastic (144/pkg)	WAT072030

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Table B-1 Spare Parts (Continued)

Description	Part Number
Low-volume insert, 150 µL glass (100/pkg)	WAT072294
Low-volume insert, spring for 250 µL (144/pkg)	WAT072708
Low-volume insert, spring for 150 µL (100/pkg)	WAT072289
Power cord, 110 V	WAT097194
Power cord, 220 V	WAT097410
Pump, needle wash, assembly	WAT078979
Restrictor loop	WAT078824
Sample loop	WAT045584
Sample loop, auxiliary 2000 µL	WAT045275
Seal pak and needle	WAT045559
Septa, PTFE for screw caps (1440/pkg)	WAT073005
Septa, PTFE for screw caps (144/pkg)	WAT072714
Septa, 35 mil self-sealing for screw caps (144/pkg)	WAT022861
Septa, 70 mil self-sealing for screw caps (144/pkg)	WAT073008
Solenoid, valve 4	WAT078800
Syringe 25 µL	WAT077343
Syringe 250 µL	WAT044886
Syringe 250 µL, plunger tip	WAT077347
Syringe 2500 µL	WAT077342
Syringe 2500 µL, plunger tip	WAT077349
Syringe door	WAT078910

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Table B-1 Spare Parts (Continued)

Description	Part Number
Terminal strip with label	WAT078867
Thermistor probe	WAT078574
Transducer	WAT045400
Tubing, inlet from pump	WAT045204
Tubing, outlet to column	WAT072215
Tubing, waste	WAT044873
Tubing, transducer to sample loop	WAT078571
Tubing, valve 1 to valve 2	WAT078565
Tubing, valve 2 to syringe	WAT078567
Tubing, valve 2 to transducer	WAT078568
Tubing, valve 3 to syringe	WAT078569
Valve, high pressure	WAT045438
Valve, high pressure, rebuild kit (requires tool kit, WAT045427)	WAT045424
Valve, high pressure, tool kit	WAT045427
Valve, high pressure, repair kit	WAT045426
Valve, low pressure	WAT078924
Valve, low pressure, rebuild kit	WAT045436
Vial, 700 µL clear plastic shell conical (100/pkg)	WAT022476
Vial, 1 mL clear glass shell (100/pkg)	WAT078514
Vial, 1 mL amber glass shell (100/pkg)	WAT022478
Vial, 1 mL clear glass shell with caps (500/pkg)	WAT022479

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Table B-1 Spare Parts (Continued)

Description	Part Number
Vial, 3 mL plastic shell conical bottom (48/pkg)	WAT022475
Vial, 4 mL clear glass shell (48/pkg)	WAT022468
Vial, 4 mL amber glass shell (48/pkg)	WAT022477
Vial, 4 mL screw top glass (48/pkg)	WAT072710
Vial, 4 mL screw top glass with caps and PTFE septa (1440/pkg)	WAT073018

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Appendix C
Warranty Information

This appendix includes information on:

- Limited Product Warranty
- Shipments, Damages, Claims, and Returns

C.1 Limited Product Warranty

Waters Corporation provides this limited warranty (the Warranty) to protect customers from non-conformity in the product workmanship or materials. The Warranty covers all new products manufactured by Waters and its subsidiaries.

The Warranty is as follows:

Waters warrants that all products sold by them are of good quality and workmanship. The products are fit for their intended purpose(s) when used strictly in accordance with Waters instructions for use during the applicable warranty period.

The foregoing warranty is exclusive and in lieu of all other express and implied warranties, including but not limited to fitness for any other purpose(s). In no event is Waters liable for consequential, economic or incidental damages of any nature. Waters reserves the right not to honor this warranty if the products are abused by the customer. The Warranty is not deemed to have failed of its essential purpose so long as Waters is able and willing to repair or replace any non-conforming part or product.

Warranty Service

Warranty service is performed at no charge and at Waters's option in one of three ways:

- A service representative is dispatched to the customer facility.
- The product is repaired at a Waters repair facility.
- Replacement parts with appropriate installation instructions are sent to the customer.

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Non-conforming products or parts are repaired, replaced with new or like-new parts, or refunded in the amount of the purchase price, when the product is returned. Warranty service is performed only if the customer notified Waters during the applicable warranty period.

Unless otherwise agreed at the time of sale, warranty service is not provided by dispatching a service representative when the equipment has been removed from the initial installation location to a new location outside the home country of the selling company.

Warranty service is provided during business hours (8 AM to 5 PM, Monday through Friday). Service is not available when Waters offices are closed in observance of legal holidays.

Warranty Service Exceptions

Warranty service is not performed on:

- Any product or part which has been repaired by others, improperly installed, altered, or damaged in any way.
- Products or parts identified prior to sale as not manufactured by Waters. In such cases, the warranty of the original manufacturer applies.
- Products that malfunction because the customer has failed to perform maintenance, calibration checks, or observe good operating procedures.
- Products that malfunction due to the use of unapproved parts and supplies.

Repair or replacement is not made:

- For expendable items such as filament devices, panel lights, fuses, batteries, and seals, if such items were operable at the time of initial use.
- Because of decomposition due to chemical action.
- For used equipment.
- Because of poor facilities, operating conditions, or utilities.

Warranty Period

The warranty period begins when the product is installed or, in the case of a customer installation, 15 days after shipment from Waters.

In no case does the warranty period extend beyond 15 months from date of shipment. If an item is replaced during its warranty period, the replacement part is warranted for the balance of the original warranty period.

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The warranty period for the autosampler is divided as shown in Table C-1.

Table C-1 Autosampler Warranty Periods

Parts	Warranty
Electronic printed circuit board	1 year
Switches	
Front panel	
Power transformer	
Fan (115 Vac)	
LCD assembly	
Cables	1 year
Injector assembly	
Vacuum pump	
Carousel drive assembly	
Valves	
Motors	
Carousel reader	
Heater/cooler option	
Service workmanship	30 days
Replacement parts	
Fuses	Expendable items
Tubings and fittings	
Carousel trays	

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Table C-1 Autosampler Warranty Periods (Continued)

Parts	Warranty
All seals	
Syringes (and seals)	
Filter frits	
Belt	

C.2 Shipments, Damages, Claims, Returns

Shipments

As all shipments are made FOB shipping point, we suggest insurance be authorized on all shipments. Instruments and major components are packed and shipped via surface, unless otherwise required. Supplies and/or replacement parts are packed and shipped via UPS, UPS Blue, air parcel post, or parcel post unless otherwise requested.

Damages

The Interstate Commerce Commission has held that carriers are as responsible for concealed damage as for visible damage in transit. Unpack shipment promptly after receipt as there may be concealed damage even though no evidence of it is apparent. When concealed damage is discovered, cease further unpacking of the unit involved and request immediate inspection by local agent or carrier and secure written report of his findings to support claim. This request must be made within 15 days of receipt. Otherwise, the claim will not be honored by the carrier. Do not return damaged goods to factory without first securing an inspection report and contacting Waters for a return merchandise authorization number (RMA).

Claims

After a damage inspection report is secured, Waters cooperates fully in supplying replacements and handling of a claim which may be initiated by either party.

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Returns

No returns may be made without prior notification and authorization. If for any reason it is necessary to return material to us, please contact our Technical Service Department or your nearest Waters subsidiary or representative for a return merchandise authorization (RMA) number and forwarding address.

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Appendix D
Reproducibility and Solvent Degassing

This appendix covers:

- Factors affecting reproducibility
- Solvent degassing

D.1 Factors Affecting Reproducibility

During sample withdrawal, the Waters autosampler creates a closed loop between the metering syringe and the sample vial. The behavior of the sample and solvent within this loop determines the performance and reproducibility of the injection.

Factors that affect the behavior of the solvent in the loop include:

Chemical Factors

- Intrinsic compressibility
- Dissolved gas
- Viscosity

Instrument Factors

- Integrity of sample loop
- Volume of sample loop

D.1.1 Chemical Factors Affecting Reproducibility

If the mobile phase acts like a perfect hydraulic fluid, the volume of sample withdrawn is the same as the volume of solvent pulled into the syringe. The autosampler measures the hydraulic property of a solvent by compressing it within the sample loop (compression check). The true injection volume is less than the programmed injection volume by the compressibility factor. If the compressibility increases, the actual injected volume decreases.

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The compressibility of a solvent depends on two factors:

- Intrinsic properties
- Dissolved gas

Intrinsic Compressibility

The intrinsic compressibility varies between solvents. Water, with its low compressibility, accurately couples syringe displacement with sample withdrawal. Methylene chloride exhibits the most compressibility.

Intrinsic compressibility of a solvent does not vary from injection to injection, and therefore does not affect the reproducibility of an injection. However, always consider intrinsic compressibility when you perform compression checks and set the compression limit (see Section 4.5.3, Performing a Compression Check).

Note: *Always perform a compression check when changing solvents or switching to a new bottle of solvent.*

Dissolved Gas

The dissolved gas in the mobile phase affects its compressibility. Dissolved gas can be highly variable, and it is the largest factor affecting reproducibility in chromatography.

Viscosity

If the sample is viscous, its response to syringe displacement is slower. When the syringe is withdrawn, the mobile phase forms a partial pressure and fails to withdraw the programmed amount of sample. The Waters 717plus autosampler allows you to adjust syringe speed for viscous samples (see Section 4.8.3, Injecting Viscous Samples).

D.1.2 Instrument Factors Affecting Reproducibility

Fluid system factors that affect reproducibility are:

- Integrity of sample loop
- Volume of sample loop

Integrity of the Sample Loop

The sample loop must be sealed from the sample vial to the syringe and the vial should be at atmospheric pressure. If there is leakage, air can displace some of the sample.

Test sample loop integrity by running the compression test at pressures greater than 30 psi (see Section 4.5.3, Performing a Compression Check).

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Volume of the Sample Loop

The drag from the tubing, viscosity, and the elasticity of the fluids (sample and mobile phase) affect the ability of the sample to follow the syringe withdrawal. If you use the auxiliary loop with injections of less than 200 µL, you increase the effects of drag and elasticity, and decrease the reproducibility of the injection.

Note: *Always use the smallest sample loop that can contain the injection volume.*

D.2 Solvent Degassing

Degassed solvents improve reproducibility in chromatography by providing:

- Accurate sample volume injections
- Stable baselines and enhanced sensitivity
- Reproducible retention times for eluting peaks
- Stable pump operation

This section presents the theory involved in solvent degassing, solvent degassing methods, and solvent degassing considerations.

D.2.1 Theory of Solvent Degassing

Only a finite amount of gas can be dissolved in a given volume of liquid under specific conditions. This amount depends on the temperature of the liquid, the pressure applied to the liquid, and the chemical affinity of the gas for the liquid.

Effects of Intermolecular Forces

Generally, a gas is most soluble in a solvent where the intermolecular attractive forces between the molecules of the solvent are similar to those of the gas (“like dissolves like”). If the main attractive forces are Van der Waals forces, the gas is more soluble in this solvent than in one with dipole forces or hydrogen bonding. Thus, a larger amount of hydrogen (H_2), nitrogen (N_2), oxygen (O_2), or helium (He) dissolves in alkanes and alcohol than in water.

Effects of Temperature

Temperature affects the solubility of gases in two ways:

- The higher the boiling point of the solvent, the more soluble the gas is in a given solvent.
- Increasing the temperature of the gas/liquid solution affects the percentage of gas in the solution.

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If the heat of solution results in an exothermic reaction, the percentage of gas in solution is reduced. If the reaction is endothermic, the percentage increases. For example, the solubility of He in H_2O decreases with an increase in temperature, but the solubility of He in benzene increases with an increase in temperature.

Effects of Partial Pressure

The mass of gas dissolved in a given volume of solvent is proportional to the partial pressure of the gas in the vapor phase of the solvent. If the pressure of the gas decreases, the amount of that gas in solution also decreases.

Effects of Dissolved Oxygen

Dissolved oxygen affects detector performance in several ways. Oxygen dissolved in solvents may form a UV-absorbing complex. The amount of complex formed varies with the solvent. The effect is particularly evident in the solvents methanol and THF. Dissolved O_2 has a minimal effect on the absolute responsivity of a UV detector, but can cause:

- Increased noise because less light reaches the detector
- Increased temperature response
- Baseline drift
- Reduced dynamic range (range of absorbance)

Changes in the characteristics of a solvent may adversely affect the precision and accuracy of the solvent delivery pump. This may cause variations in retention time and peak height or area.

D.2.2 Solvent Degassing Methods

There are four main methods used to degas solvents:

- Sparging with a less-soluble gas
- Heating
- Reducing pressure by vacuum
- Sonication

These methods may be used individually or in combinations.

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Sparging

Sparging, or bubbling helium through solvent, removes the other gases from solution by saturating the solvent with helium. Lower concentrations of unwanted gases decrease background absorbance of UV detectors. Well-sparged solvent also improves pump performance. Gas sparging brings the solvent to a state of equilibrium, which may be maintained by keeping a blanket of helium over the solvent.

Heat

Heat raises the vapor pressure of the solvent at its surface. As the partial pressure of the solvent is raised, the partial pressure of the gas decreases proportionally. This prevents any further absorption of the gas into solution. This is true for most gases in water, but not necessarily true with organic solvents.

Vacuum

A vacuum reduces the pressure on the surface of the solvent. Since the mass of gas in solution is proportional to the partial pressure of the gas at the surface of the solvent, the mass of gas in solution decreases as the pressure decreases.

Sonication

Sonication with high energy sound waves drives energy into the solvent and causes the submicron size “bubbles” of gas to aggregate. As the gas aggregates, the bubbles become large enough to float out of the solvent and dissipate. Sonication alone degases a gallon of solvent in approximately 20 minutes. However, sonication does not remove as much oxygen as the helium sparge method.

D.2.3 Solvent Degassing Considerations

Select the most efficient degassing operation for your application. To remove the gas in as short a time as possible, consider the following:

- Helium sparging gives stable baselines and better sensitivity in a detector, and prevents reabsorption of atmospheric gases.
- To degas a solvent by heat, you must boil the solvent. This is not practical for mixed solvents. However, low levels of heat reduce the rate of reabsorption of the gas.



Caution: *Do not apply vacuum to the brown gallon bottles in which solvent is shipped. There is a high risk of implosion under these conditions.*

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- Vacuum alone is too slow to be an acceptable means of degassing solvent. However, a 0.5 micron sintered glass vacuum filter, with 300 mm of vacuum, can filter and degas a gallon of solvent in approximately eight minutes. Vacuum degassing may change the composition of mixed solvents.
- Sonication plus vacuum degases a liter of solvent very quickly. This technique is less likely to change the composition of mixed solvents because the mixed solvents are not held under vacuum as long.

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Appendix E
Selecting Sample Vials

Use this appendix as a guide for selecting sample vials. Select a sample vial based on chemistry, volume of sample and injection.

Sample Chemistry

Based on the chemistry of the sample, select:

- **Glass vial** - General purpose
- **Polypropylene vial** - Recommended for ion chromatography
- **Amber glass vial** - Recommended for light-sensitive samples
- **Polymethylpentene vial** - Recommended for low volume ion chromatography

Volume of Sample and Injection

To determine the best sample vial size, refer to Table E-1 and Table E-2.

Table E-1 Sample Vials for 48-Vial Carousel

Sample Vial Description	Total Capacity	Maximum Injection	Maximum Residual Volume
Glass with screw cap†	4.0 mL	2.4 mL	1.6 mL
Glass shell	4.0 mL	2.4 mL	1.6 mL
Plastic shell	4.0 mL	2.4 mL	1.6 mL
Amber glass with screw cap †	4.0 mL	2.4 mL	1.6 mL
Plastic shell, conical bottom	3.0 mL	2.9 mL	95 µL
Low volume insert (screw cap vial), glass, pull point	250 µL	244 µL	6 µL
Low volume insert (screw cap vial), glass, round bottom	250 µL	230 µL	20 µL

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Table E-1 Sample Vials for 48-Vial Carousel (Continued)

Sample Vial Description	Total Capacity	Maximum Injection	Maximum Residual Volume
Low volume insert (screw cap vial), plastic, round bottom	250 µL	230 µL	20 µL

† Screw cap available with either Teflon® or self-sealing septa

Table E-2 Sample Vials for 96-Vial Carousel

Sample Vial Description	Total Capacity	Maximum Injection	Maximum Residual Volume
Glass shell	1 mL	600 µL	400 µL
Plastic shell, conical bottom	700 µL	650 µL	50 µL
Amber glass shell	1 mL	600 µL	400 µL
Low volume insert (1 mL glass shell)	150 µL	144 µL	6 µL

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