ValveLink8.3®

User's Manual

AUTOMATE® SCIENTIFIC™ ©

ValveLink8.3 - Part #01-18

For indoor use only from 5° to 40°C.
Do not get wet or subject to visible condensation.
Clean with a mild soap solution with a damp cloth only.

This equipment must be earth grounded. Use any of the screws on the side or bottom of the case. See page 23.

⚠ Do not unplug valves while on!

Do not attempt to repeatedly cycle valves on and off in under one millisecond.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Supply voltage:
ValveLink8.3 controller = 12V AC up to 3.3 amps @ 50-60Hz
External power supplies:
USA & Japan = 110V AC up to 0.36 amps @ 60Hz
European = 230V AC up to 0.17 amps @ 50Hz

CE

ValveLink8.3®

User's Manual

The ValveLink8.3 is intended for research use only.

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AUTOMATE SCIENTIFIC

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Introduction

FOR RESEARCH USE ONLY

The ValveLink8.3 is designed for solution-switching use in research applications ONLY. AutoMate Scientific, Inc. cannot be responsible for injury or death resulting from medical or pharmacological use.

Hardware Overview

The ValveLink8.3® is a digital/manual valve controller designed for use with research automation software. Valves can be controlled by digital TTL* signals from any I/O card or device or a single analog voltage input. Eight pushbuttons allow manual user control with eight bi-colored LED indicators. A USB (Universal Serial Bus) port is provided for further valve control and networking by computer. All four input sources (digital, analog, USB, and pushbuttons) are simultaneously active, and the LEDs constantly display the current valve status. ValveGuard™ technology detects bad valves. It prevents damage to your ValveLink8.3 and let's you easily observe problem valves. A spill sensor protects your equipment when a leak is detected.

The ValveLink8.3 is designed to drive 12 volt DC solenoid valves plugged into RCA jacks on the back of the box. Why not connect valves directly to your computer? Several reasons:

1) Most computer interfaces provide +5V signals – not strong enough to drive most valves (6 to 12V DC and higher).
2) Computer interface signals are often too noisy for electrophysiology amplification. The ValveLink8.3 is designed with special low-noise circuitry to minimize interference with high-gain amplification.
3) Finally, many solenoid valves are designed to be opened with a short, full-voltage pulse, then "held-in" with a lower voltage to keep the valves from heating. The ValveLink8.3 automatically provides dual-voltage hold-in.

* TTL stands for Transistor-Transistor Logic, a +5/0 volt standard for representing on and off – used by the ValveLink8.3 for computer valve control.

ValveLink8.3 Laboratory Applications

Perfusion
A ValveLink8.3 can be programmed to precisely switch solutions perfusing over biological samples for physiological research. The ValveLink8.3's circuitry is designed to open valves with low noise for electrophysiological amplification. Several features called 'Modes' have been built into the ValveLink8.3 for advanced perfusion use.

Washing
Combined with an AutoMate Scientific ported washing tray, the ValveLink8.3 can automate washing of electrophoresis gels and blots, and developing of x-ray or photographic film or prints. You have complete control over which washing steps of your Western, Northern, Southern, Coomassie Blue and Silver staining runs are automated and which are handled conventionally. Unattended washing can save a busy lab countless hours of tedious monitoring.

Liquid Chromatography
A ValveLink8.3 can be easily programmed to automate solution selection in multi-step ion exchange, gel filtration or affinity chromatography runs with excellent reproducibility. The ValveLink8.3 is especially useful in preparative work when a protocol has been established and programmed to repetitively isolate your valuable molecule.

Accessories

AutoMate Scientific offers a number of products which compliment the ValveLink8.3 controller: valves, pressure upgrades, Perfusion Pencils®, ThermoClamp™ temperature controllers, perfusion chambers, manipulators, rack mounting brackets,
BNC cables and entire perfusion systems.

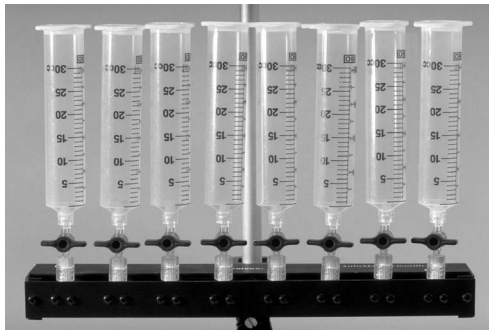
Oocyte Chamber
Part #OPC-1

Petri Dish Chamber
Part #PCP-1

Pinch Valves (set of 4)
Part #02-pp-04

Perfusion Systems
AutoMate Scientific builds ValveLink8.3 and ValveBank perfusion systems with several choices of valves (below) in 4, 8, or 16 channels. Systems include reservoirs, drippers, stopcocks, brackets, flow regulator, ringstand, tubing and micro-manifold. Please visit http://www.autom8.com/build_your_own.html to configure a custom system to your specifications and generate a quotation.

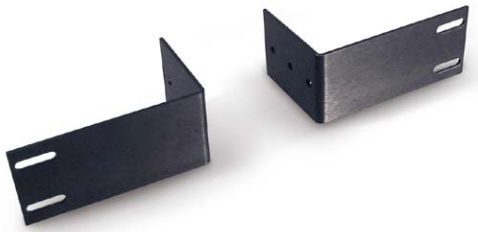
Valves
Solenoid valves are available as part of perfusion systems or sold separately. We sell 12V DC PTFE and Pinch valves with indicator LEDs built-in. PTFE valves are faster (open and close in 10 ms.), but pinch valves are cheaper and easier to clean (open and close in 30-50 ms). PTFE valves include three choices of fittings: hose barb (standard), luer lock, or nut & ferrules for connecting hard PTFE tubing. Luer lock fittings allow direct connection of syringes as shown. This method eliminates wasted solution in tubing between the reservoirs and valves. Small 2-way stopcocks are included with all AutoMate Scientific perfusion systems.



Luer lock PTFE valves

ValveLink8.3 Accessories
BNC cables and rack-mounting brackets make it easier to connect your ValveLink8.3 to your digital outputs and to mount the controller in a 19" rack with your other equipment.

4-BNC cable Part #01-19



AutoMate Scientific also sells a full range of manual and motorized micro-manipulators, amplifiers, stimulus isolators, data acquisition systems, filter wheels and pipette pullers.

Rack brackets Part #01-17

ThermoClamp™-1 Temperature Control System

• Combination inline heater plus multi-channel focal drug delivery maintain bath temperature and rapid drug wash-out with a high-flow bath line while quickly switching 4-8 preheated solutions through the Perfusion Pencil.® Maintain steady 37°C at 5ml/minute flow rates through both the bath line and tip.

• Advanced auto-tuning temperature lock
Fuzzy logic PID software maintains chamber or reagent temperature to within 1°C of setpoint or better. The ThermoClamp calibrates its own tuning for ideal temperature control - no need to guess "loop speed" settings.

• Designed for physiology research
No metal anywhere in the flow path - unlike some competitors. Low noise for electrophysiology with internal and external grounding plus electrical isolation between liquids and heating elements.

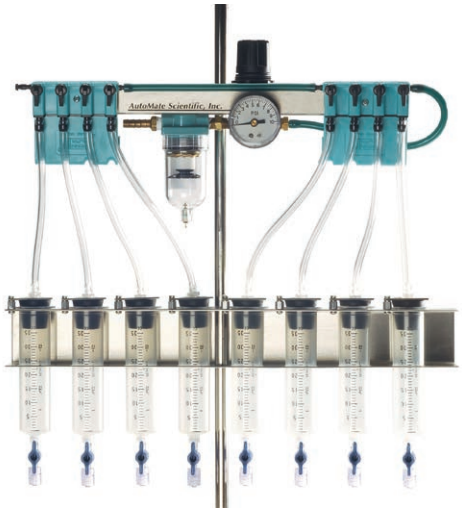
• Ready to use
Includes everything you need for heated perfusion: power supply, temperature sensors, and inline heater with easy luer lock tube connections.

Part #03-14-xxx	ThermoClamp-1 Temperature Control System [4 Channel]
Part #03-18-xxx	ThermoClamp-1 Temperature Control System [8 Channel]
	Controller, heated Perfusion Pencil, removable tip & bath sensor
	xxx = Specify removable tip i.d. size: 100, 250, or 360μm

Pressure Regulated Perfusion System

AutoMate Scientific offers a Pressurized Perfusion Upgrade with four, eight or sixteen channels for:

- Faster switching
- Microliter fine delivery
- Small diameter pipette delivery
- Steady flow-rate
- Microinjecting



The package can be added to any new or existing perfusion rig - from AutoMate Scientific, any third-party manufacturer, or even homemade. Connect to house air, tank, or compressor (30 to 100 psi). Precision regulator delivers zero to 10 psi to pressurized syringe reservoirs.

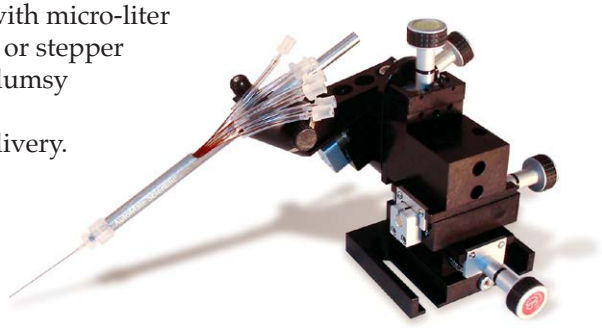
Part #09-04	4-channel
Part #09-08	8-channel
Part #09-16	16-channel

For Single-cell or Whole-cell Superfusion

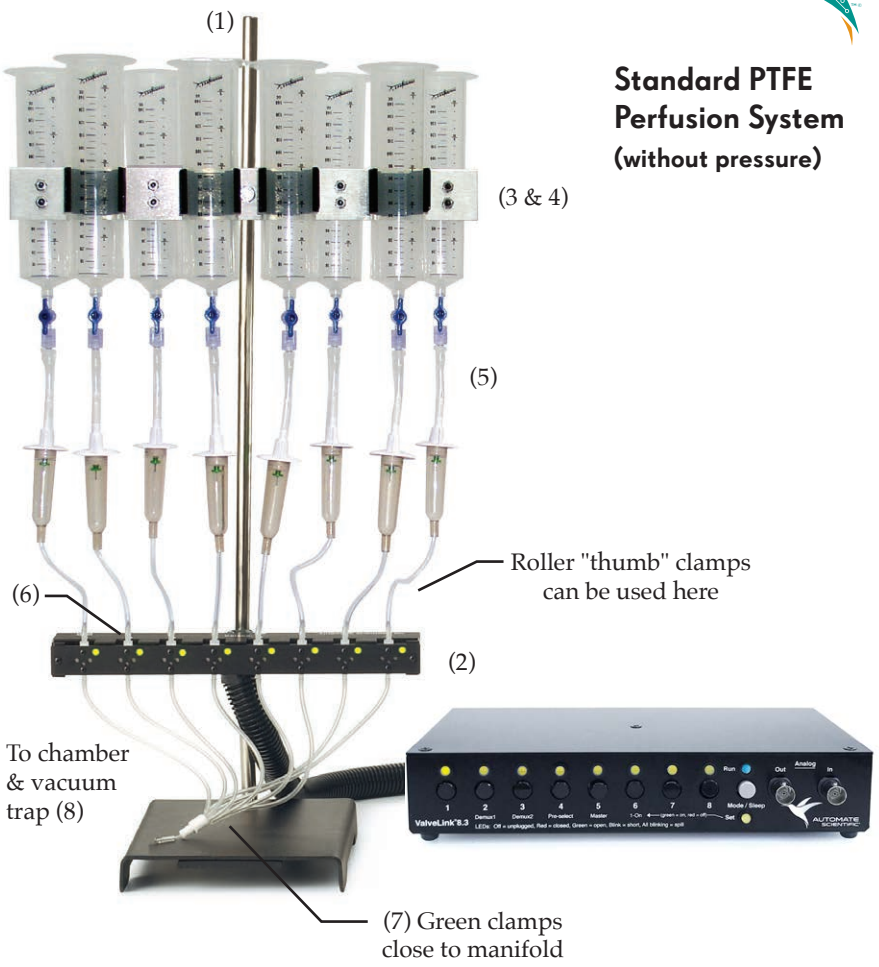
Perfusion Pencil® Multi-Barrel Manifold Tip

4-16 micro-bore tubes into 1 outflow

- Rapid solution change with micro-liter dead volume. No piezo or stepper motor translation. No clumsy rotating valves.
- Single-cell and patch delivery. For mounting on any micromanipulator.
- 100, 250 & 360μm removable tips available



System Set-up Diagrams

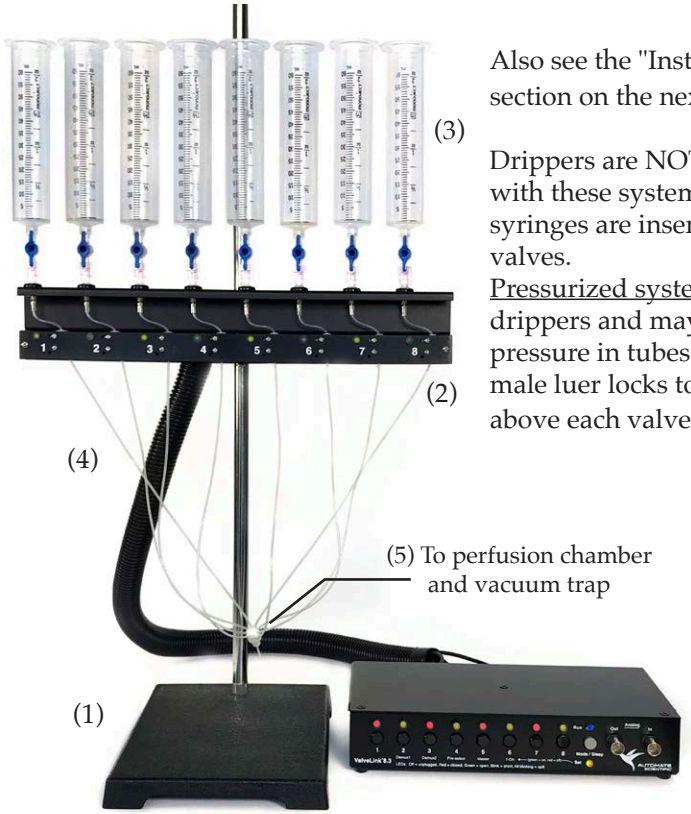


Standard PTFE Perfusion System (without pressure)

1) Assemble ringstand rod and base.
2) Attach valve unit.
3) Attach reservoir bracket(s).
4) Insert syringes with stopcocks.
5) Insert short pieces of $3/16$" i.d. tubing over tops of drippers, then insert over syringe fittings.
6) Attach dripper tubing to upper valve barb. Cut as desired, but leave long enough to move reservoirs.
7) Insert green clamps on pieces of $1/16$" tubing between bottom valve barbs and manifold.
8) Connect manifold outflow into your perfusion chamber.
9) Plug numbered valve cables into ValveLink8.3 ports.

Pinch Valve, Pressurized and Luer-Lock Perfusion Systems

Instructions on this page are for Economy perfusion systems, PTFE luer lock valves, pressurized systems or pinch valve systems. Regular hose barb PTFE perfusion systems please see the previous page. Luer lock systems should also see the photo on page 5. Find additional photos and diagrams of the pressure system on page 15.



Also see the "Installation Tips" section on the next page.

Drippers are NOT included with these systems because the syringes are inserted directly into valves.
Pressurized systems - no room for drippers and may interfere with pressure in tubes. Use provided male luer locks to connect tubing above each valve.

1) Assemble ringstand base and rod.
2) Attach valve unit.
3) Insert syringes with stopcocks.

Pinch valves have no fittings. Simply slide larger tubing over small pinch valve tube above and below the valves.

4) Connect tubing between bottom valve tube and manifold.
5) Connect manifold outflow into your perfusion chamber.
6) Plug numbered valve cables into ValveLink8.3 ports.

Installation Tips

- Flow rate is adjusted by the relative height of reservoirs and manifold flow regulator plus optional air pressure.
- Leave the tubing between the reservoirs and valves long enough to raise and lower the reservoirs.
- Unused lines should be replaced with plugs on manifold, or temporarily clamped-off just above manifold to avoid back bleeding into empty lines. They MUST also be filled with solution.
- Priming one line at a time reduces bubbles.
- Connect your vacuum trap line directly to the outflow of the manifold for running cleaning solutions and drying your lines quickly.
- Determine dead volume from the manifold to prep by measuring time and volume required to flush a colored liquid with a clear one. Calibrate flow rates by running one line into a graduated cylinder for a fixed period of time.
- Filter solutions down to 5-10 microns when using PTFE or Lee valves.
- See more tips in the "Techniques" chapter later in this manual.

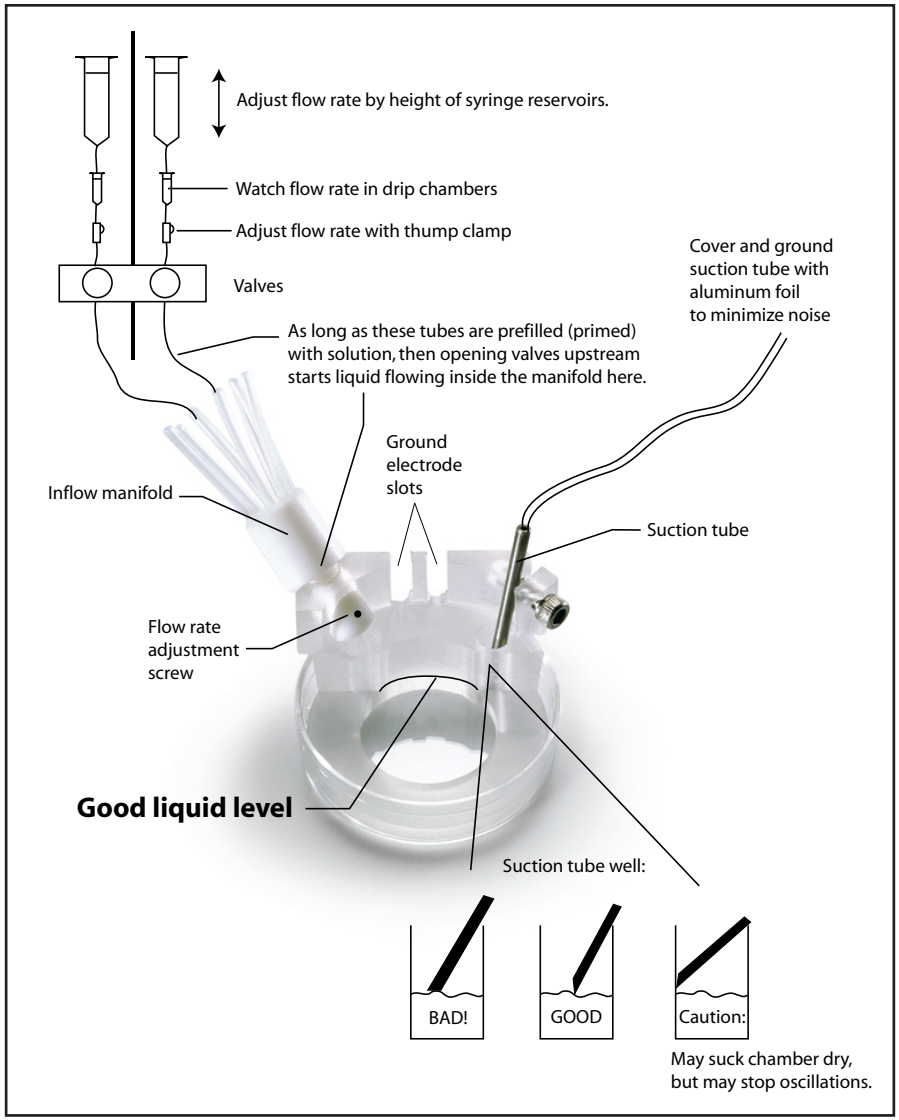
Bubbles and Degassing

Bubbles are often caused by outgassing. This is particularly true when media is stored cold overnight and allowed to warm to room temperature in the perfusion system tubing. Since warm liquids hold less gas, bubbles will form in the tubing and valves as gas leaves the media. The best solution is to pre-warm your solutions by at least 2-3 degrees above room temperature even if you are adding gas (CO_2, Carbogen, etc.) to your reagents. If you are using an inline heater like the ThermoClamp, it is a good idea to warm solutions 2-3 degrees above your inline heater temperature to prevent bubbles from forming there. If possible, keep the solutions in the reservoirs at this higher temperature all day using reservoir heaters.

Degassing can also be facilitated by applying a slight vacuum to the reservoirs, although this is not recommended if you are purposely gassing your media.

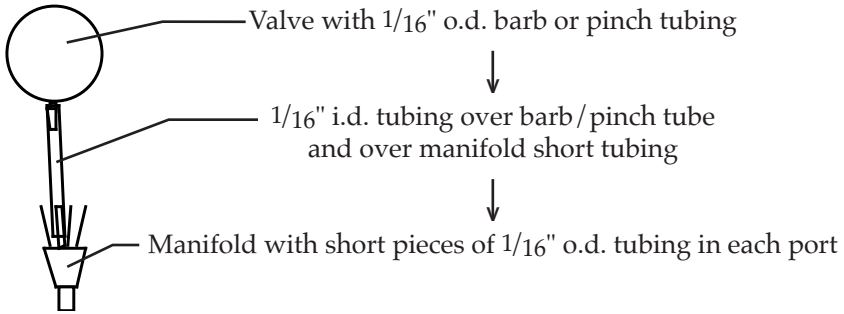
Perfusion Cheat Sheet

Your perfusion system may not include optional drip chambers, thumb clamps or the Petri dish chamber, but these hints from Woods Hole may still help.

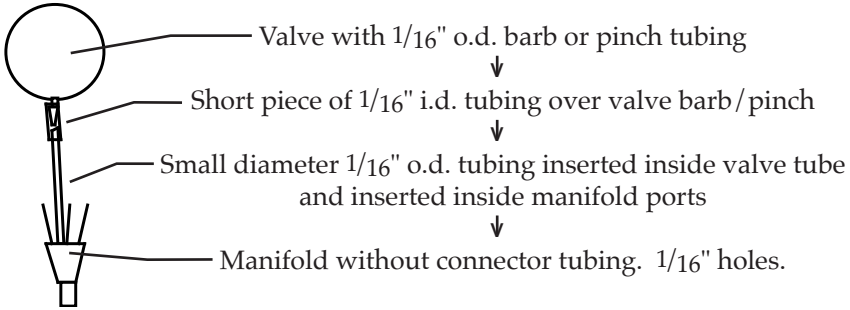


PTFE Micro-manifold Use

To use the micro-manifold, you either need pinch valves or PTFE valves equipped with 1/16" o.d. outflow hose barbs. Micro-manifolds are shipped with a short piece of 1/16" o.d. tubing in each hole (inputs and outflow). You can either connect the valves to manifold inports with a piece of 1/16" i.d. tubing over both the valve barbs (or pinch tubing) and short pieces of manifold tubing:



... or, for even **less dead volume**, use a short piece of 1/16" i.d. tubing over the valve barb (or pinch tubing), and piece of smaller 1/16" o.d. tubing inserted inside the secondary tube and manifold ports (you may need to supply extra small PE-160 or PTFE tubing for this option):



Cutting the tubing at an angle and wetting it will make insertion easier. Cutting the tubing square, however, will minimize dead volume when inserted as far as possible into the manifold – being careful not block at the point of convergence. Remember to keep all tubing as short as possible. Use the provided Allen wrench and small screw near the manifold outflow to adjust flow rate. AutoMate Scientific now sells small PTFE manifold 'stoppers' for plugging unused manifold ports as part #05-05 for a set of four.

Pinch Valve Tubing

Pinch valves have no fittings. Simply slide larger tubing over small pinch valve tube above and below the valves. The tubing in each pinch valve can be replaced for easy cleaning. It is 1/32" i.d. x 1/16" o.d. silicone tubing. We have only found one type of tubing this size which works well in these pinch valves. AutoMate Scientific sells this replacement tubing as part #05-14. The tubing can be removed from the valves even when they are closed. Remember that any liquid remaining in the tube may spill when it is removed from the valve. New tubing can be installed while the valves are closed, but it is much easier if they are opened/energized. If you are concerned about the same piece of tubing being squeezed for long periods of time, you can slide the silicone tubing up or down in the valve by a few millimeters to expose a new section to the plunger. The same piece of tubing can be used for years without fatigue.

Valve Care

Rinse PTFE valves every day. Do not get pinch valves wet. See sections on Faulty Valves, Stuck Pinch Valves, Valve Cables, Replacing Valves and Leaks in the "Techniques" chapter later in this manual.

Perfusion Pencil Flow Rates

360µm Removable Tips (reservoir height 40cm)	
Gravity (full reservoir)	1.15ml/min +/- .04
2psi air pressure	3.98ml/min +/- .08
8psi air pressure	10.66ml/min +/- .27

250µm Removable Tips (reservoir height 40cm)	
Gravity (empty reservoir)	0.35ml/min +/- .05
Gravity (full reservoir)	0.45ml/min +/- .05
2psi air pressure	1.66ml/min +/- .14
8psi air pressure	5.16ml/min +/- .04

100µm Removable Tips (reservoir height 40cm)	
Gravity	0
2psi air pressure	0.07ml/min = 4.6ml/hour
8psi air pressure	0.25ml/min = 15ml/hour

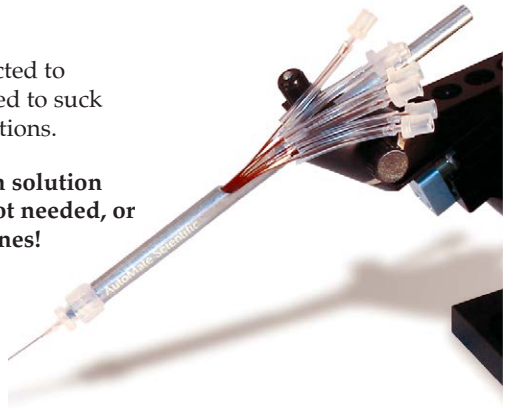
Perfusion Pencil Multi-barrel Manifold

(Sold separately)

One of the eight lines may be connected to vacuum through a valve programmed to suck the dead-volume clear between solutions.

All inflow tubes must be filled with solution before use even if some lines are not needed, or liquids will backflow into empty lines!

Tighten removable tip for minimum dead volume.



Chemical Information
The tubing inside the manifold body is polyimide (nylon). The removable tips include a polycarbonate luer lock fitting with a fused silica (quartz) needle coated with polyimide. These materials are resistant to most acids, bases and organic solvents. To avoid dust contamination, we recommend pre-rinsing the Perfusion Pencil and tip with distilled water. Also, it is good practice to discard the first few microliters of solution before using the device. The Perfusion Pencil and removable tips are shipped non-sterile. They can be chemically sterilized or autoclaved. However, repeated autoclaving may weaken the adhesive bond between the luer lock fitting and the needle.

Maintenance
You can expect several years of useful lifetime for your tip if you wash it daily. Use a syringe or vacuum to pull water, then alcohol three times each through the tip. If the Perfusion Pencil is filled with pure salt solution, leaving it in the syringe overnight will not usually cause the tip to block. However, if it is used for high viscosity fluids, flushing after each use is recommended.

Cutting
The removable tips are shipped with 0.5" (1 cm) length polyimide needles. They can be cut shorter by rolling a razor blade on them against a hard surface. However, this may leave a small crack or barb on the tip. To get a flat cut, score the coating of the needle with a ceramic cleaving stone or a diamond cutter and pull directly apart, making sure not to pull at an angle. You may notice a larger outer tube enclosing the lower part of our smaller, 100μm needles. This is simply for added rigidity, and can be cut if needed.

Part No.

#04-04-xxx	4-into-1 Pencil with tip
#04-08-xxx	8-into-1 Pencil with tip
#04-16-xxx	16-into-1 Pencil with tip (xxx = 100, 250, or 360μm)

Replacement Tips:

#04-xxx	Specify i.d. size: 100, 250, or 360μm

Perfusion Pressure Kit

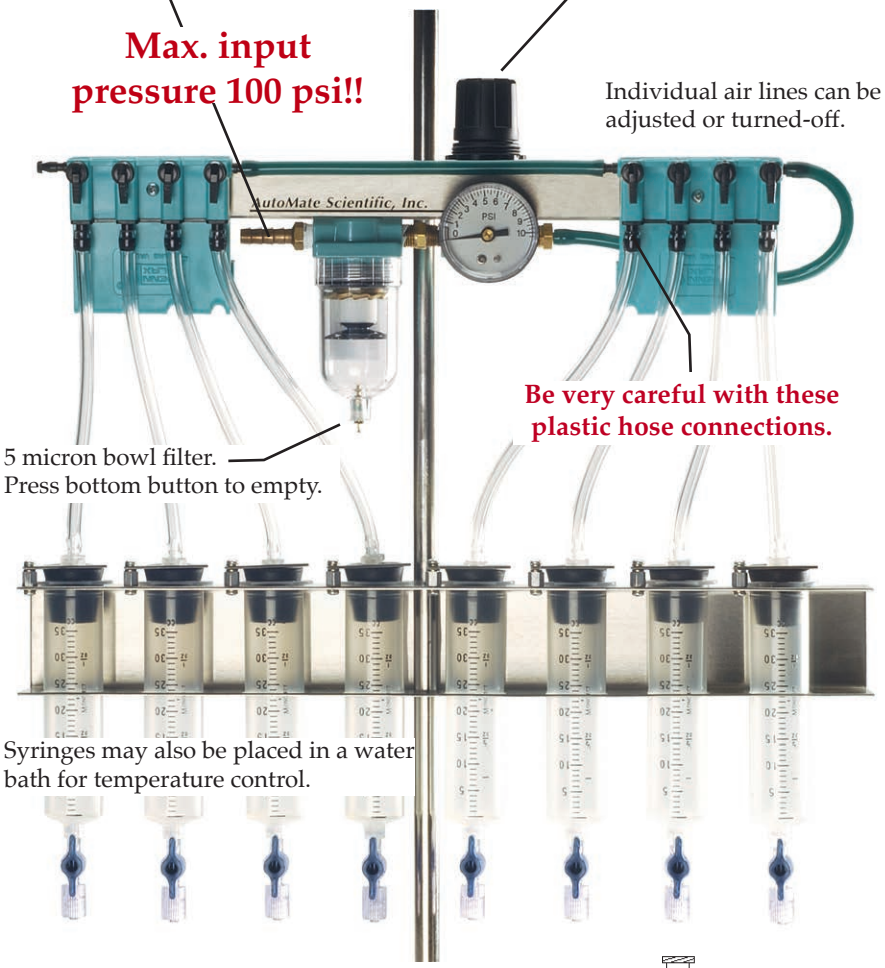
(Sold separately)

Brass input connector hose barb size 1/4"

Press regulator knob down to lock. Pull up to unlock.

Max. input pressure 100 psi!!

Individual air lines can be adjusted or turned-off.



Be very careful with these plastic hose connections.

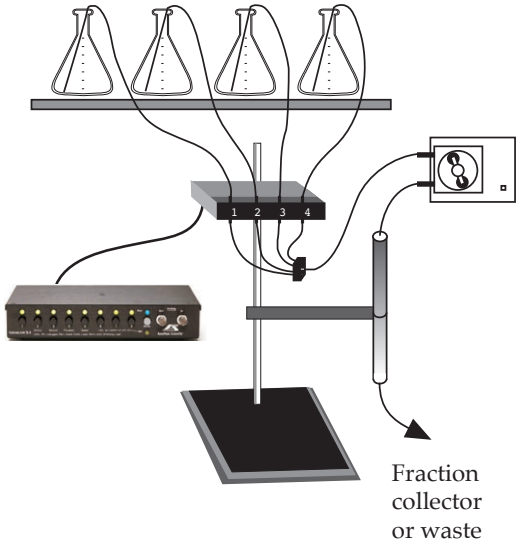
5 micron bowl filter.
Press bottom button to empty.

Syringes may also be placed in a water bath for temperature control.

2-way stopcocks and luer-lock to 1/16" hose fittings are included for each channel to connect syringes to hose.

Hoses should continue from syringes to valves.

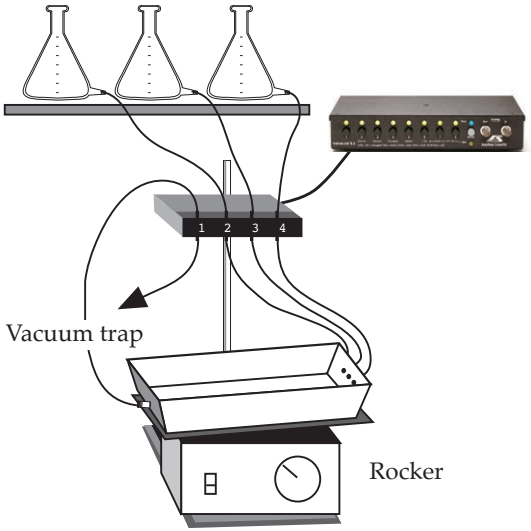
Chromatography



Without a pump, flow rate is determined by relative height of reservoirs.

1) Position reservoirs above column ringstand.
2) Attach valve unit to column stand.
3) Run tubing from upper valve barbs into reservoirs.
4) Connect short pieces of tubing between lower valve barbs & manifold.
5) Connect manifold outflow to your pump with 1/16" i.d. tubing.
6) Pump outflow connects to column inlet as usual.
7) Plug numbered valve cables into ValveLink8.3 ports.

Gel/Blot Washing System



Flow rate is determined by relative height of reservoirs.

1) Position reservoirs above washing area.
2) Attach valve unit to ringstand.
3) Run tubing from upper valve barbs to reservoir nipples.
4) Connect tube from lower valve barbs to tray inlets.
5) Connect tray outflow to fourth upper valve barb.
6) Connect this valve's outflow to vacuum trap.
7) Plug numbered valve cables into ValveLink8.3 ports.

Operation

With a ValveLink8.3, a researcher can turn valves on and off using:

- front-panel manual pushbuttons
- digital inputs
- analog input
- or USB port and software (see USB chapter).

LED lights on the front of the controller indicate valve status. The ValveLink8.3 sends an analog voltage out the "event marker" BNC on the front panel every time a valve is opened or closed. This marker can be recorded using a single channel for a permanent record of valve activity synchronized with a physiological recording. Also, a spill sensor is monitored to close all valves in case a liquid overflow happens. This can save precious reagents and protect valuable microscope equipment in the event of a spill. With no power switch, the ValveLink8.3 can be put to sleep by holding the "Mode/Sleep" button for three seconds. Press the same button to wake from sleep. Descriptions of these features follow...

Manual Control

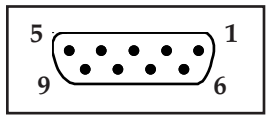
Each press of a front-panel pushbutton toggles its valve on and off subject to Mode settings described in the next chapter. The buttons can be pressed even when the ValveLink8.3 is being controlled by an external device or computer. Press the "Mode/Sleep" button for three seconds to close all valves quickly (and put the ValveLink8.3 to sleep - see below).

Digital Inputs

Eight TTL pins (wires) can be used to listen to outputs from interface hardware on a personal computer or other digital sources. The ValveLink8.3 will open and close valves mirroring the computer signals (low = off, high = on) with one millisecond accuracy. Usually data acquisition software like pClamp, Pulse, LabView, etc. or custom user software is programmed to send digital signals to open and close valves at specified times. Each input pin (1-8) represents one valve. This way all eight valves can be operated independently by eight computer outputs. See the description of Modes #2 and #3 in the next chapter to control eight or sixteen valves using only three or four TTL outputs. Read the "Computer Interfacing" chapter for more information on connecting the ValveLink8.3 to data acquisition software and hardware.

Digital Input Port Pin-out

[Back panel diagram view]
Standard female DB-9 connector



pin#	pin#
1 = ground	6 = TTL8
2 = TTL7	7 = TTL6
3 = TTL5	8 = TTL4
4 = TTL3	9 = TTL2
5 = TTL1	

AutoMate Scientific sells BNC cables with four or eight TTL inputs wired to BNCs for you. Parallel port and Heka EPC / ITC cables are also available.

Analog Input

The front panel "Analog Input" BNC accepts a 0-5V DC signal to open a valve using only a single analog output from your computer. Here are the voltages it accepts:

0 (zero) volts = All off

	Ch 1	2	3	4	5	6	7	8
Voltage	0.5	1.1	1.6	2.1	2.7	3.3	3.9	4.6V

Changing from one voltage to another closes ALL other valves.

Simultaneous Edge-triggered Inputs

You may be wondering how the ValveLink8.3 can respond to so many inputs simultaneously -- digital, analog and pushbuttons all at the same time. If a digital input is "high," then shouldn't that valve be open? How can you close it by pushing the button? The answer lies in an electronics concept called "edge triggering." Rather than watching the state of an input (i.e. high or low TTL input), the ValveLink8.3 watches for a change in state (i.e. rising or falling edge of TTL input). When a TTL input changes

from low to high, that valve opens. Then the ValveLink8.3 ignores that input until it changes (high back to low) again. If that valve's manual pushbutton is pressed, it toggles the valve from open to closed or vice versa - regardless of the state of its other inputs. Therefore, whichever input happens last determines the state of the valve.

LED Indicators and ValveGuard™

The eight numbered valve LEDs on the front of the ValveLink8.3 give you the current status of each valve. They can each be in one of four different states:

Red = Valve plugged-in but closed
Green = Valve plugged-in and open
Off = No valve plugged-in or broken valve wire
Flashing red = Short-circuit detected in valve wire

These last two states represent our ValveGuard technology. Special circuitry detects a good valve resistance or short-circuit. Broken or shorted (crossed) valve wires used to be the biggest cause of valve failure and controller damage. Now these two problems are easily observed and isolated before they can damage the controller. See the "Valve Cables" section in the "Techniques" chapter later in this manual to repair a broken valve cable yourself.

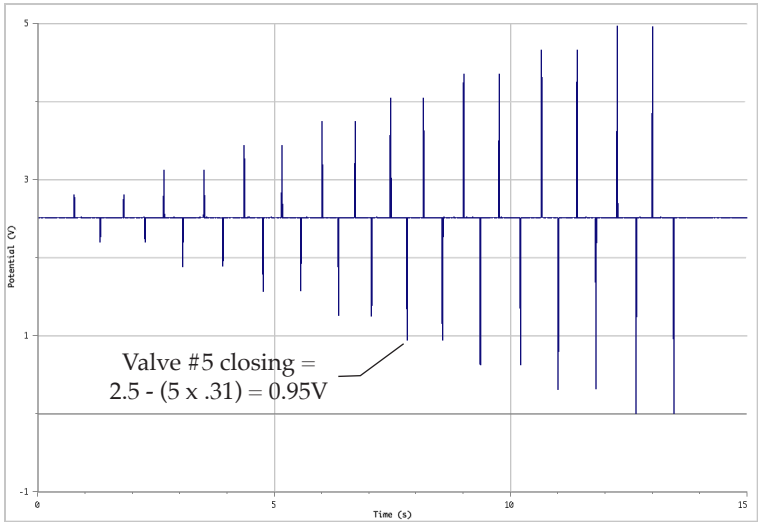
Press the valve button to clear a flashing short signal and try opening the shorted valve again. If all LEDs are flashing it means the spill sensor has been tripped. See the Spill Sensor section below. The ValveLink8.3 will not even try to open a valve which is not plugged-in (its LED is off).

Event Marker

The ValveLink8.3 outputs a 10 millisecond voltage pulse on its front-panel analog output BNC as an event marker every time a valve opens or closes. The marker voltage occurs regardless of how the valve was opened or closed (i.e. manual pushbutton or computer digital input). This voltage can be easily recorded with a single channel of your data acquisition software for a permanent, synchronized record of valve activity. Here are the voltages sent by the ValveLink8.3:

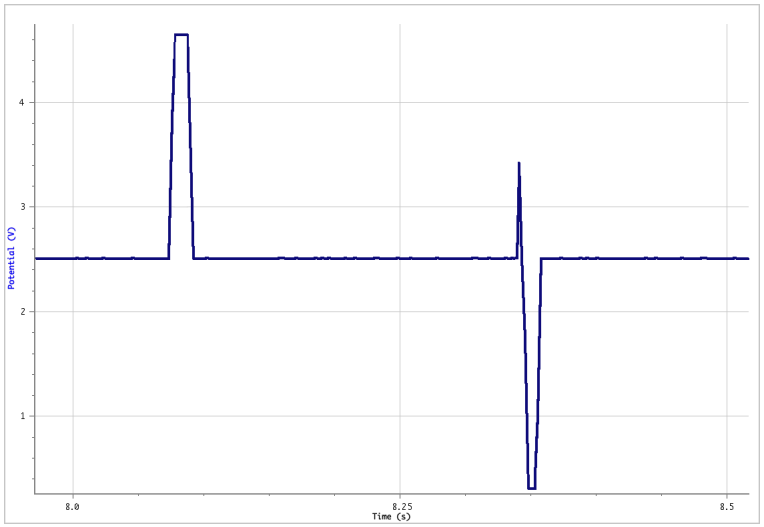
+2.5 volts is the baseline when nothing is happening. Valves opening create a 10 millisecond pulse upwards, while closing valves cause a

negative pulse. The voltage is 2.5 ± (valve# x 0.31V). For example, whenever valve 4 opens, a 10 millisecond pulse appears on the analog output at 2.5 + (4 x .31) = 3.74V. When the same valve #4 closes, it creates a pulse of 2.5 - (4 x .31) = 1.26V.



This graph shows the analog output voltage vs. time resulting from each valve opening and closing twice.

ValveLink8.3 Modes #2, #3 and #6 (see next chapter) and the analog input automatically close other valves when a new one is opened to insure that only one liquid is flowing at a time. If the user opens a valve in this way, then any others will close at the same time. In order to indicate valves opening and closing simultaneously on the event marker output, the controller will give a short voltage spike upwards representing the valve which opened, and immediately spike downwards to the appropriate voltage for the remainder of the 10 millisecond pulse to signify the valve which closed.



This ValveLink8.3 analog output graph shows the voltage resulting from valve #7 (4.67V) opening at time 8.07 seconds, then valve #3 (3.43V) opening with Mode #6, "1-On" active. This immediately closes valve #7 (0.33V). The output returns to "baseline" of 2.5 volts after each 10ms pulse.

Spill Sensor

A two-pin socket on the ValveLink8.3 back panel accepts a 3mm Molex "Microfit" female plug for a spill sensor. The spill sensor circuitry watches any wires plugged-into this ValveLink8.3 port for a drop in electrical resistance representing a liquid spill. In perfusion work spills usually occur when the chamber vacuum stops or the vacuum trap fills-up. The spill sensor circuitry immediately closes all valves and begins blinking all LEDs to notify you of the spill. The ValveLink8.3 remains in this state until you press any button to override the spill. After you clear the spill warning, you may immediately begin opening valves again.

AutoMate Scientific provides a spill sensor made of Mylar tape and two closely-spaced copper contacts. When liquids cross this tape, they make contact with both copper strips simultaneously and complete an electrical path for the spill sensor circuitry. In this way a drop of liquid passing the sensor strip appears as a sharp drop in electrical resistance between the two, otherwise disconnected copper conductors. Even distilled water will conduct enough current to trigger the sensor. The adhesive tape is designed to be placed around the flat outside edge of your perfusion

chamber where liquid would pass if it overflows. It can also be wrapped around the outside of a light condenser or inverted microscope objective turret where liquid would flow if it drips out of the perfusion chamber.

Researchers may create or use their own spill sensors with the ValveLink8.3. Conductive mats or other commercially-available spill sensors generally use the same principle as AutoMate Scientific's copper strips. Likewise, you can easily create your own custom sensor using two bare wires or conductive pens or epoxy. Inexpensive conductive pens like those from "Circuit Works™" are designed for repairing circuit boards. They leave lines which quickly dry into silver traces. A similar conductive epoxy is also available. It makes the connection of two wires to your silver traces even easier. Simply draw two parallel silver lines approximately 1/16" (1 mm) apart on any surface where leaking liquids would pass. Make sure the lines do not touch, or draw one wide line and etch a gap down the middle once it has dried. Then connect a small wire from each trace back to the spill sensor port on the ValveLink8.3.

Another nice feature of the ValveLink8.3 spill sensor circuit is its dynamic recalibration. Competing spill sensors simply watch for a low resistance and trigger. Unfortunately, their conductive mats keep a low resistance and cannot be reused until they dry. The ValveLink8.3 lets you press any button to override the spill. Because it is microprocessor-based, the controller keeps a running value for the sensor resistance and watches for a 5% drop in resistance. Therefore, even a damp sensor can be used again immediately as the controller adjusts to the new resistance and watches for any subsequent leaks by another proportional resistance drop. As the mat dries, the ValveLink8.3 is constantly monitoring the increasing resistance and watching for a drop from the latest value.

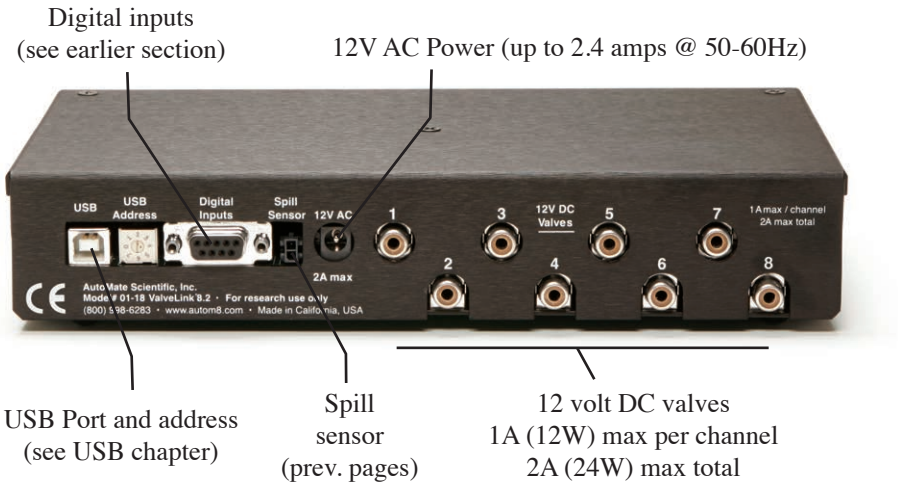
Where is the power switch? Sleep

The ValveLink8.3 does not have a power switch. As long as it is plugged-in, it is on. The ValveLink8.3 is perfectly happy being left on forever and consumes very little power when all valves are closed. However, an optional sleep mode has been included. Press and hold the "Mode/Sleep" button until the blue and yellow Mode LEDs begin flashing (about three seconds) to put the ValveLink8.3 to sleep. In this state all valves and valve LEDs are off, and all inputs (buttons, TTLs, USB, etc.) are ignored. Press the Mode button again to wake the controller. Sleep mode can also be used as an emergency "off" switch if you need to quickly close all valves and stop the computer inputs.

3-way Valves

The ValveLink8.3 also supports 3-way, single-solenoid valves (2 wires each). Operate the ValveLink8.3 as you normally would for 2-way valves, after determining which of two inlets or outlets are opened with the on and off states. Note that one inlet will always be open with these valves.

Back Panel



Power Supply

The ValveLink8.3 is normally supplied with a 1.5 amp wall transformer. This is adequate for any valves provided by AutoMate Scientific or a total of 1 amp of valves opened simultaneously. Please contact AutoMate Scientific to request a larger power supply if you wish to exceed 1 amp of valve power (i.e. two 12 watt valves opened at once).

Case and Valve Grounding

This equipment must be earth grounded. Use a #6 screw in any hole on either side of the ValveLink8.3 case for grounding. Order AutoMate Scientific part no. 01-05 “Low noise, valve and case grounding package” for an extra grounding wire attached to each individual valve extending back to the controller. Each of these items grounds four (4) valves. Please order two for eight channel perfusion systems. This item must be ordered at the same time as the valves. Connect the ground wire from the valves to a screw on the side of the controller case or to your rig's ground point.

Modes

The ValveLink8.3 includes several useful features as auxiliary 'Modes.' The user changes the current mode settings by pressing the "Mode" button. The yellow "Set" LED will light. Individual modes are toggled on and off by pressing their button. The LED associated with each button should toggle from red to green, with green representing ON. All of the modes can be used simultaneously, except numbers #2 and #3 which cannot both be on. Press the "Mode" button to return to normal ValveLink8.3 operation with any modes activated.

Mode Descriptions

#2 Binary Demultiplexed Addressing Mode (Valves 1-8 for two ValveLink8.3s)

TTL inputs 1-3 decode into a binary number 0-7 representing which valve to open (see chart below). Example: TTL input 0000 0101 opens valve 6 (its decimal equivalent + 1). When this 3-bit number changes, the previous valve is closed. When Mode #2 or #3 is used, TTL inputs 1-4 are used for addressing and no longer directly control valves 1-4. For two ValveLink8.3s, bit 4 is used as described below to further select bank 1 or 2.

Binary chart (showing TTL inputs 4321)

Digital bit pattern	Decimal	Valve
0000	0	1 (decimal + 1)
0001	1	2
0010	2	3
0011	3	4
0100	4	5
0101	5	6
0110	6	7
0111	7	8
1000	8 + 0	1 on second ValveLink8.3 See Mode #3 below.

The only drawback to either addressing mode is that only one valve can be opened by TTL inputs at a time. Without Mode #2 or #3, each TTL input corresponds to a single valve and multiple valves can be opened simultaneously. Because Modes #2 and #3 need several TTL inputs to select a single valve, only one can be opened in this manner at once. The ValveLink8.3 will automatically activate Mode #6, "1-On" whenever Mode #2 or #3 is used.

#3 Addressing Mode - Valves 9-16 (2nd ValveLink8.3)

This is the same binary decoding of bits 1-3 as Mode #2, but bit 4 is used to select between two ValveLink8.3s and control up to 16 valves with a single 4-bit TTL source. Set the first ValveLink8.3 to Mode #2, set the second to Mode #3, and connect TTL input bits 1-4 from both ValveLink8.3s to your digital output. Bits 1-3 decode which valve is opened on the ValveLink8.3 selected by the fourth bit (high = ValveLink8.3 in Mode #3 & low = ValveLink8.3 in Mode #2). Example: TTL input 0000 1001 opens valve 10 (valve 2 on the second ValveLink8.3.) As in Mode #2, TTL inputs 1-4 are used for addressing and no longer directly control their respective valves. BNC "tee" connectors will facilitate connection of BNC cables from two ValveLink8.3s to a common set of digital outputs.

#4 Pre-selected Valve Mode

When Mode #4 is activated, the user is prompted to select a channel 1-8 when leaving mode selection. All LEDs will flash waiting for a channel selection. Press "Mode" again to finish. Thereafter, the selected valve is toggled on and off by TTL input bit #8. This mode allows a researcher to permanently connect a single TTL output to ValveLink8.3 input eight, and select which of eight valves to activate with that single TTL signal. This mode prevents input #8 from controlling valve #8 as it normally would, unless valve #8 is chosen as the 'pre-selected' Mode #4 valve.

#5 Master Valve

When Mode #5 is selected, the user is prompted to select a channel 1-8 when leaving mode selection (like Mode #4 above). This valve then becomes the master valve. Whenever all other valves have been closed through pushbuttons or any inputs, the master valve will automatically open. This feature is useful if a control solution is required whenever all other solutions are stopped.

#6 One-at-a-time or "1-On" Mode

When active, Mode #6 automatically closes all other valves whenever a valve is opened – either by pushbutton, TTL, analog or USB input. This guarantees that no more than one valve is open at a time. This mode is automatically activated when Mode #2 or #3 is used.

If Modes #4 and #5 are both active, the user will be prompted for the Mode #4 'pre-selected' valve first, then the Mode #5 'master' valve when leaving mode selection. If Modes #2-4 are turned-off, then the TTL inputs resume direct control of their respective valves.

Multiple Modes

As mentioned above, most of the five modes above can be active concurrently, such as Mode #2 - Addressing, Mode #5 - Master Valve, and Mode #6 - One-at-a-time. Valves are opened or closed accordingly. Only Modes #2 and #3 cannot both be on simultaneously.

Example mode selection LEDs (red = off, green = on):

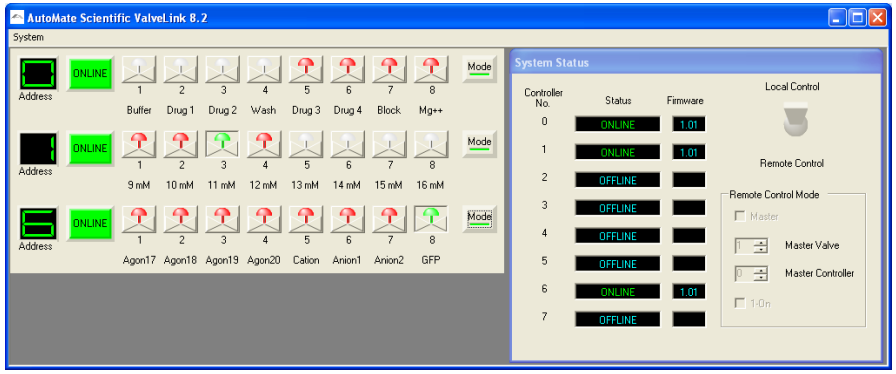
1	2	3	4	5	6	7	8
Dark	Red	**Grn**	Red	**Grn**	**Grn**	Dark	Dark

#3 on = Addressing Mode valves 9-16 (2nd ValveLink8.3)
#5 on = Master Valve
#6 on = One-at-a-time Mode

In this example, when the "Mode" button is pressed to leave mode selection, all LEDs will flash waiting for the master valve (Mode #5) to be selected. Select a valve and press "Mode" again to finish.

USB Communications & Software

The ValveLink8.3 includes a USB-1 port for easy connection to a computer. The connector is a USB "B" style female socket. AutoMate Scientific sells USB "A" male to "B" male cables and 4-port USB hubs for use with the ValveLink8.3. AutoMate Scientific offers a free program for Microsoft Windows 2000 and above called "ValveLink8.3 User Interface." This program allows manual control of valves from your PC and networking of up to eight ValveLink8.3s. It can be downloaded from AutoMate Scientific's web site at http://www.autom8.com/valvelink.html.



Screen shots show Windows XP, but ValveLink software also works on Vista to Windows 10.

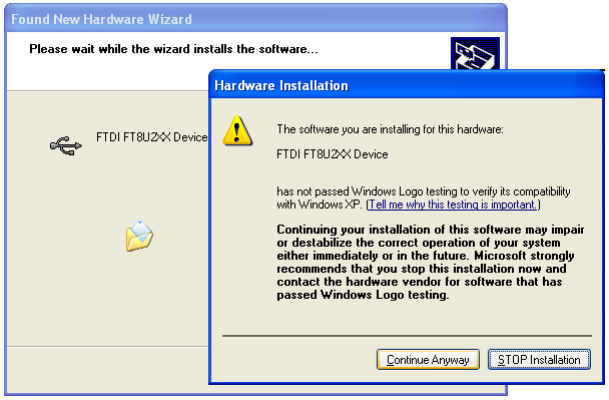
Installation

If you have one, insert the ValveLink8.3 CD into your computer and follow the instructions to install the main application. Or double-click the "setup.exe" installer you have downloaded from AutoMate Scientific's web site.
Once the program is installed you can plug a USB A-B cable into the ValveLink8.3 (powered ON) and into your running computer.

Depending on your version of Windows, the first time a ValveLink8.3 is installed by USB cable, Windows will "find new hardware." A dialog box will appear asking if you want Windows to connect to Windows Update to search for the necessary software drivers. Select "Yes" and click "Next" to continue.

In the next dialog box, select "Install automatically" and click "Next." Your computer may need to access the internet.

You may see a warning box explaining:

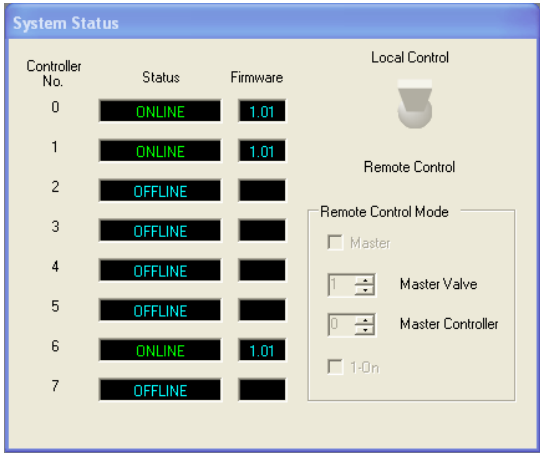


"The software you are installing for this hardware: FTDI FT8U2XX Device has not passed Windows Logo testing to verify its compatibility with Windows. Continuing your installation of this software may impair or destabilize the correct operation of your system..." Click "Continue Anyway" and "Finish" the hardware installation.

Your computer may "Find new hardware" a second time. Repeat the two steps abaove again, and your computer will be ready to run the ValveLink sofware.

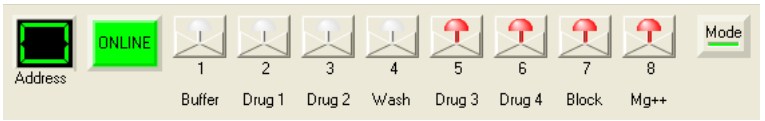
Software Operation

After the ValveLink8.3 software and USB drivers are installed on your computer, you may run the program. Any ValveLink8.3s currently plugged-into the computer or USB hubs will appear in the System Status box as "Online" next to their USB address. This address comes from the 8-position rotary switch on the back of each ValveLink8.3 next to its USB port. If you connect multiple ValveLink8.3s to the computer, be sure to set each one to a different address.



If you connect a ValveLink8.3 to the computer while the User Interface program is already running, click "Discover Controllers" under the System menu to add it. The System Status window also shows the current version of the firmware (internal programming) of each ValveLink8.3. You can visit AutoMate Scientific's web site to check the latest firmware version, but it can only be updated by AutoMate Scientific at its office.

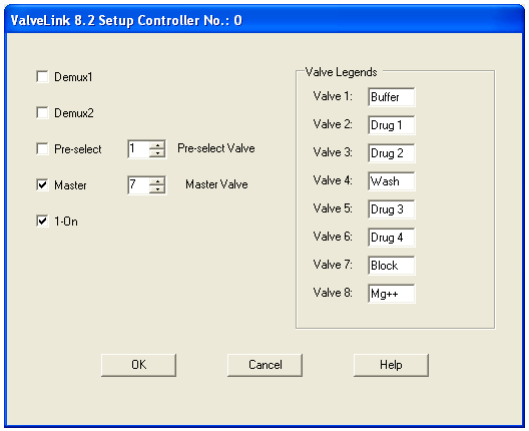
Each ValveLink8.3 will display its own control window with its Address and eight LED buttons of each valve. These buttons should mirror those on the front of the ValveLink8.3 and clicking the buttons should toggle valves exactly like the real buttons.



Depending on your computer's speed and USB bus, there may be a noticeable delay between the real ValveLink8.3 buttons and LEDs and updates on your computer screen. USB communications in Windows are not necessarily real-time. A 100 millisecond delay is not uncommon.

If the CPU is busy with other programs, printing, or lots of traffic on the USB bus, then signals to and from the ValveLink8.3 may suffer. For maximum performance, plug the ValveLink8.3 into a USB port connected to its own USB bus. Remember that computers with multiple USB ports may simply be splitting a single USB bus internally. Check with your computer's manufacturer or add a separate USB card to your computer for minimum latency.

The System Status window has a large switch labeled "Local Control" and "Remote Control." When set to "Local," each ValveLink8.3 follows its own Mode settings as described in the "Modes" chapter earlier in this manual. When set to "Remote Control," all networked ValveLink8.3s behave according to a single common "Mode" setting made on the System Status window. In this way, up to eight ValveLink8.3s can be networked into a single, virtual 64-channel controller. A single "Master Valve" can be selected on a "Master Controller" like Mode #5 on the ValveLink8.3. Also "1-on" Mode means only one valve will be open at-a-time on all of the networked controllers.



When the System Status switch is set to "Local Control" you can click the "Mode" button on any ValveLink8.3 sub-window to access a dialog box of Modes for that ValveLink8.3 along with eight text "labels" which will display under each button. These labels can be used to help identify which solutions are being delivered through each valve.

The same comments about USB communications speed above also apply to multiple-ValveLink8.3 networking. If "1-on" Mode is used and a button is pressed on one ValveLink8.3, that signal must travel to the User Interface program on the PC and back to all other ValveLink8.3s to close any open valves. The double delay may be noticeable on slower computers or USB busses.

AutoMate Scientific chose the older USB-1 protocol over the newer, high-speed USB-2 architecture for three reasons: 1) less expensive, 2) older computers don't have USB-2 ports, and 3) USB-2 has more bandwidth (transfers large amounts of data faster), but the same latency (delay) as USB-1. The ValveLink8.3 needs short bursts of data quickly, so USB-2 would not help.

***This software requires Windows .NET version 4.0 or higher be installed.**

Computer Interfacing

The ValveLink8.3 can be controlled from a computer using its digital inputs, analog input or USB port. AutoMate Scientific supplies free software for communicating over the USB port, but the digital and analog inputs require you to provide software to generate the signals. Most customers use their data acquisition software like Axon Instruments' "pClamp" or Heka's "Pulse." General I/O software like "LabView" from National Instruments also works well.

You can directly control individual ValveLink8.3 valves from your computer using one digital output per valve, or you can control all eight valves with just three digital outputs using Mode #2 or 3 described in the "Modes" chapter. Computer digital signals are also called "TTL" for Transistor-Transistor Logic. An "on" or "high" signal is +5V and "off" or "low" is zero volts. Almost any analog output can also produce these two voltages. Therefore, if you do not have enough digital outputs, then analog outputs can also be used to drive the ValveLink8.3 when set to either +5 or 0V. When the input goes high, a valve opens, and when it drops low, the valve closes again.

While AutoMate Scientific generally does not support software or hardware from other companies, we have accumulated some instructions for connecting the ValveLink8.3 to pClamp software and DigiData hardware from Axon Instruments. These instructions may help even if you are using other software.

1) Connect one or more pClamp/DigiData digital outputs to the corresponding ValveLink8.3 digital inputs (and ground) using the wiring diagram on page 18 of this manual, or an AutoMate Scientific-supplied BNC cable. DigiData digital outputs 0-3 appear as BNC connectors on the front panel. Digital outputs 4-7 are located on the back panel of newer DigiData interfaces. Older DigiData 1200's only have four outputs.

2) The 'Modes' chapter explains the two different methods of controlling valves: Demultiplexed or not.

3) You can manually generate digital outputs 0-3 from Clampex using the 'Real Time Control Panel' adjacent to the 'Scope' window. Click the four checkboxes to turn the outputs on or off and test your connection.

4) To program the digital outputs from pClamp you have two choices: Sequencing Keys/User Lists or Waveform - Epochs.

Sequencing Keys/User Lists:
Clampex lets you program activities as "Sequencing Keys" (Config menu) which can include digital outputs (Operations tab / Parameters / Digital Out Bit Pattern). The Sequencing Keys can be assigned to hot keys or grouped together into "User Lists" (Acquire menu / New Protocol / Stimulate / User List). Each Sequencing Key becomes one 'step' in your perfusion/recording experiment, and can be assigned a time duration. It is also possible to link Sequencing Keys into a series without needing User Lists. You can also program a "Digital Holding Level" (Lab Bench / Configure / Overrides) which maintains a valve state between protocols.

Waveform - Epochs:
The bottom of each Epoch column on the Protocol / Waveforms screen offers a set of four digital bit patterns. This way you can program valve activity for each recording epoch interval.

Also see the "Scenarios" section of the "Experiments" chapter of your pClamp manual. The "Isolated Patch-Clamp Single-Channel Recording" section (manual page 125 or 135) describes triggering with a drug application system (DAS).

Contact AutoMate Scientific for advice on how to program your computer to control valves, or to purchase cables for connecting the ValveLink8.3 to your I/O hardware.

Dead Volume

Dead volume should be minimized in order to switch solutions as rapidly as possible. Dead volume for this purpose refers to the volume between the manifold (or Perfusion Pencil) and final destination (perfusion chamber, 96-well plate, etc.) A certain amount of time must pass for a new liquid to clear the previous one from this final piece of tubing. Solution switching takes place at the manifold - assuming each channel's tubing has been primed (filled) from its valve to this point. Therefore, the manifold should be positioned as close to the ultimate destination as possible, while the valves can be some distance away. The micro-manifolds available from AutoMate Scientific are designed to be inserted directly into orifices in some perfusion chambers. This absolutely minimizes dead volume – resulting in bath switching times of under a second.

AutoMate Scientific Perfusion Systems may include a disposable flow regulator which will *increase* dead volume if used improperly. The regulator can either be eliminated if controlling flow rate is not necessary, or positioned *before* the manifold to eliminate dead volume. However, this second method only controls the flow rate of individual solutions (instead of all solutions when located after the manifold). Therefore, the researcher can either limit the flow of a single liquid, or purchase flow regulators for each line.

A final method for reducing dead volume is to use smaller bore tubing, although this may also reduce flow rate resulting in the same switching time as for larger tubing.

Small-bore PTFE Tubing

AutoMate Scientific's micro-manifolds use 1/16" tube ports which can either be used with 1/16" o.d. tubing, or enlarged up to 1/16" i.d. tubing for standard Tygon tubing. Please inquire about AutoMate Scientific's PTFE tubing and nut and ferrule valve fittings for small bore use. Also see the micro-manifold instructions on page 12.

Cutting PTFE tubing at an angle and wetting it makes it easier to insert.

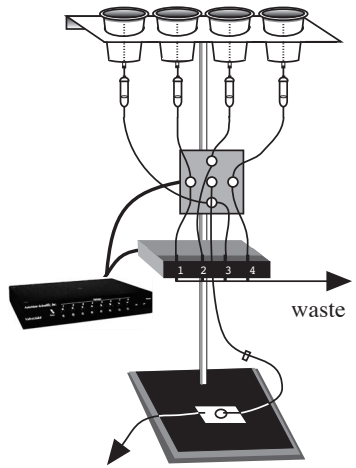
Backflow

When a manifold is used in a plumbing arrangement, none of its ports can be left unconnected, or liquid will simply flow backwards out of the opening. Small, green hose clamps are included with AutoMate Scientific Perfusion System drippers which can be easily attached to short pieces of tubing to act as plugs for unused holes. AutoMate Scientific also sells manifold 'stoppers' for plugging unused manifold ports.

Likewise, one must be careful not to open any valve whose reservoir is completely empty or inflow tube is disconnected. Ordinary solution pressure in other lines will force liquid back up the outflow tubing, through the valve, and either back into the reservoir or out the disconnected inflow onto the floor. Again, clamp-off any unused lines at the manifold or be sure all valves are closed while changing connections.

Solution will quickly backflow into empty tubes even when their valves are closed because air is so compressible. Fill all tubes down to the manifold or Perfusion Pencil with solution even if they are not being used.

AutoPrime™ System



The AutoPrime Perfusion System is designed to deliver oxygenated (or other gas-saturated) solutions without administering 'stale' liquid which has remained stationary in the tubing long enough to lose its oxygenation. Unless one uses 'hard-walled' (i.e. PTFE) tubing, gas will escape through the tubing leaving the stale solution with a ruined pH and gas concentration. The 8-channel AutoPrime System uses eight valves per four liquids, with the second set used as 'flush' valves to waste. Shortly before a solution is to be switched 'on,' its flush valve opens and re-primes the upper tubing with fresh solution from the reservoir down to its delivery valve (where a tee fitting is located connected to the flush valve.) The flush valve is then closed, and the delivery valve can be opened. The previous solution in a delivery sequence can continue to flow while re-priming occurs. Contact AutoMate Scientific for more details.

Faulty Valves

The bane of all liquid delivery apparatus! Despite AutoMate Scientific's best efforts and pursuit of high quality valve manufacturers, some valves fail. Space shuttle launches have often been delayed due to valve problems. We can only pass along our valve supplier's one year warranty with their disclaimer "Improper use or mishandling of the units, in the opinion of the manufacturer, voids this warranty!" (their exclamation mark too.) Please request a copy of AutoMate Scientific's "Valve Troubleshooting Guide" to diagnose and sometimes repair valve problems. In order to minimize valve trouble, please observe these guidelines:

1) Clean your valves after each use. Accumulated debris or precipitate will rapidly cause leaking valves and seals. Use an in-line filter if you expect a chance of particles in your solutions. Put your AutoMate Scientific controller's programmability to good use by writing a washing protocol. At the end of the day, fill each reservoir with cleaning solution (distilled water or appropriate liquid), and open all valves. A protocol can be easily written to flush each valve in sequence. Saline solutions allowed to dry in stainless steel valves will cause them to rust. This is considered improper use. We also recommend rinsing your valves once before their first use.

Beware of flaking PTFE tape or silicone fitting glue. Large debris are often the cause of valve failure. Try backflushing a valve that is suspected to have failed for this reason by connecting a tube and syringe to the *outflow* of the valve and pushing liquid while it is energized. Sometimes this ejects the clog.

2) Do not operate AutoMate Scientific valves with homemade controllers delivering over 12V DC, or attempt to cycle them rapidly (< 1ms).

3) Do not exceed the rated operating pressure (> 30psi).

Before returning any valves to us please check:

1) That it was purchased in the last 12 months (AutoMate Scientific and valve manufacturers record each by serial number.)
2) That the valve is faulty and not the controller channel – find a valve that works in a particular output channel and try the bad valve in that port to see that it still does not function.
3) If it is leaking, see #1 above and the section below.

If it qualifies for all three of the above, AutoMate Scientific will accept the valve for subsequent return to the factory. Repair or replacement is at their discretion, as AutoMate Scientific does not have the ability to open the valves to determine the cause of trouble. We may be able to loan replacement valves, which may be billed if the valve factory finds abuse on the user's part and refuses to honor the warranty.

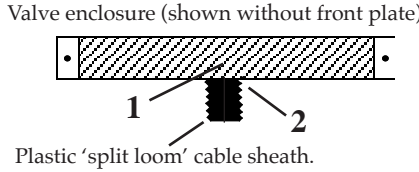
Stuck Pinch Valves

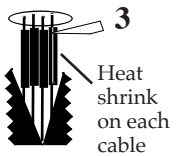
Occasionally pinch valves will stick closed, especially after they have gotten wet. Usually this is a sign that they are about to completely fail, but sometimes they can be rejuvenated by simply prying them open or lubricating them. First energize (turn on) the valve; then, using a flat screwdriver, gently force the white plunger open where it normally pinches the tube closed. The valve may begin functioning normally. Also, **pinch valves will not usually work without a piece of pinch tubing installed!** You can also remove the pinch tubing and spray a drop of WD-40 lubricant or isopropyl alcohol down the pinch valve plunger. Replace the tubing. This will often add more life to a dying pinch valve.

Valve Cables

One problem that is easy to diagnose and fix is a broken cable connection. Use any ohmmeter to measure the resistance across the inner pin and outer 'barrel' of the RCA plug end of the valve cable (while unplugged from the controller.) A resistance of zero ohms indicates a short, or infinite resistance means one of the wires is broken in the cable assembly. This occurs most often at the joint between the heavy black cable and the valve lead wires – under the heat-shrink tubing, inside the outer black sheath, a few inches from the valve itself. This can often be reached without completely disassembling the valve enclosure.

Simply 1) remove the screw inside the black valve box holding the plastic sheath in its hole, 2) remove the black tape at the top of the sheath and peel it back a couple of inches, find the offending cable (trace it back from the bad valve), and 3) carefully slice its heat-shrink tubing longitudinally to remove it. The wires may have come apart or broken here, or inside the next piece of electrical tape isolating the two leads, otherwise within the cable or valve itself (which can be





further determined with the volt/ohmmeter). If you find the break, resolder the connection, wrap the inner wires in separate pieces of electrical tape, retest the valve, and reassemble the sheath following the above instructions in reverse order.

Valve Returns & Replacing a Valve

If you need to return a defective valve, you may either return the entire valve assembly for repair / evaluation, or remove and return the individual valve from its case. This only involves five screws: remove the two outer plate screws holding all of the valves into the black metal case, the single screw holding the plastic 'sheath' into its underside hole, the electrical tape at the top and bottom of the sheath, the offending valve's cable from the plug end up through the valve casing, and finally, the two screws holding the valve on to the front plate.

Please package the valve(s) carefully and ship freight prepaid to AutoMate Scientific's address on the back cover of this manual. No RMA number is needed as long as you include a note with the following:

1) Your name, company/institution name, phone number, and an address to return the repaired valve to.
2) Your original invoice number and date, if available.
3) A sentence stating the nature of the problem and any steps you have already taken to fix or identify it. Does the valve energize / click? De-energize? Open / close? Leak?
4) Whether the valve was driven by any device *other* than an AutoMate Scientific controller (and its operating and holding voltages).
5) The application used with the valve, along with the exact chemical(s) and the duty cycle (pulse) rate if used.
6) A Statement of Chemical Exposure as follows:
   a) These valves have not been exposed to chemicals other than H_2O except as described above. b) All applicable Safety and Handling data sheets for the above described chemicals are enclosed. c) We accept full responsibility for any injury to AutoMate Scientific employees or employees of the valves original manufacturer caused by handling of the residues of chemicals contained in or on the valves to be returned.
7) An authorized signature, title, and date.

AutoMate Scientific will gladly fax you a form with easy blanks to enter the above information. We will process your return and notify you of further information as quickly as possible.

Leaks and Replacing Valve Fittings

The second bane of all liquid delivery apparatus! These hints may help:

1) Make sure the valve is turned off! (as opposed to leaking)
2) See all of the guidelines in the previous "Faulty Valves" section - especially #1.
3) Identify whether the valve leaks constantly, under pressure, inside or outside. Try backflushing if there is an internal leak.
4) Check and replace obvious loose or worn tubing.
5) Outside leaks usually occur at the fittings and can be stopped with a bit of silicone glue, epoxy, super glue (Cyanoacrylate) or PTFE tape. Apply sealant around the threads of the dry fitting and screw back into the valve. Be sure not to use too much glue or tape, as they can easily cause clogs or leaks of their own. **Overtightening can also cause the plastic fittings to leak – hand tighten.**

Glue on valve fittings is intended as a gap filler for small openings between the threads and hole, not as an adhesive. Few glues will adhere to PTFE.

Hardware Troubleshooting

Should the ValveLink8.3's LEDs fail to light while plugged-in, check the power connections. Disconnect all valves to check for a short. Remember that ValveLink8.3 valve LEDs do not light if valves are not plugged-in. The ValveLink8.3 uses an internal "poly" fuse which will reset itself after an overload situation has been fixed. Try unplugging the ValveLink8.3 for a while then reconnecting it.

Safety Instructions

The following instructions pertain to the risk of fire, electric shock, or bodily injury. Please read all of these instructions carefully.

1. Follow all the instructions and warnings marked on this product or included in this manual.

2. Do not use this product on an unstable cart, stand, or table. This product may fall, causing serious damage to the product.

3. Slots and openings in the cabinet are provided for ventilation. To ensure the reliable operation of your product, and to protect it from overheating, these openings must not be blocked or covered. Do not use this product on a bed, sofa, rug or other similar surfaces. This product should never be placed near or over a radiator or heat register. This product should not be placed in a built-in installation unless proper ventilation is provided.

4. Never push objects of any kind into the product through the cabinet openings, as they may touch dangerous voltage points or short-out parts that could result in fire or electric shock. Never spill liquids of any kind in the product.

5. This product should only be connected to the AC power source indicated on your product system's information label. If you are not sure of the type of AC power available, consult your dealer or local power company. Only connect this product to a power outlet that matches the power requirements of this product.

6. Do not allow anything to rest on the power cord. Do not locate this product where people will walk on the cord.

7. If you have to use an extension cord with this product, make sure that the total amperage rating of all equipment plugged into it does not exceed the amperage rating of the extension cord. Also, make sure that the total of all products plugged into the main AC power outlet does not exceed 15 amps.

8. Unplug your product from the main electrical power before cleaning. Do not use liquid cleaner or aerosol cleaners. Use a damp cloth for cleaning.

9. Do not use this product near water.

10. Unplug this product from the main power outlet and call for service under any of the following conditions:

A. If the power cord or plug is damaged or frayed.
B. If liquid has been spilled into the product.
C. If the product has been exposed to rain or water.
D. If the product has been dropped or the cabinet has been damaged.
E. If the product exhibits a distinct change in performance, indicating a need for service.

STOP!!

If you ever have to remove the main system unit cover, observe the following precautions:

A. The power supply cord must be unplugged before the main system unit cover is removed. (Separe le cordon d'alimantation et puis enleve le couvercle.)

B. Once removed, the cover must be replaced and screwed in position before the power supply is plugged back in. (Apres le couvercle en place et remettre le cordon d'alimentation.)

Warranty

AutoMate Scientific, Inc. warrants its products against defects of workmanship and/or material for ONE YEAR from the date of sale. Any product that fails to perform as specified may be returned, freight pre-paid to the factory (with a written explanation of the problem) for examination and repair or replacement. If it is defective, AutoMate Scientific will repair or replace (at our option) the product without charge and return it to you.

If the examination indicates that non-compatible fluid, destructive environment, accidental damage, modification or abusive practices have occurred, all labor, materials and freight costs shall be at the expense of the customer.

Due to the nature of clinical laboratory applications, AutoMate Scientific, Inc. will NOT accept the return of any products which have been used with HAZARDOUS MATERIALS or harmful environment.

This warranty is in lieu of all other warranties, whether oral or written, express or implied. In no event shall AutoMate Scientific, Inc. or its licensor/licensees be liable for contingent, special, direct, indirect or consequential damages for the breach of any express or implied warranty or resulting from the use, failure or malfunction of any product, including damage to property and, to the fullest extent permitted by law, damages for personal injury, even if AutoMate Scientific, Inc. has been advised of the possibility of such damages or if this warranty is found to fail its essential purpose. AutoMate Scientific, Inc's liability is limited to the reimbursement of the cost of the product. All other warranties, including, but not limited to warranties for fitness or merchantability for a particular purpose are expressly excluded. No verbal changes to this policy will be authorized.

AutoMate Scientific, Inc. manufacturers and sells goods in accordance with U.S. federal, state and local laws, but assumes no responsibility or liability for laws, regulations, duties, or taxes imposed by any foreign country. All terms and conditions hereof shall be governed by the laws of the State of California.

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