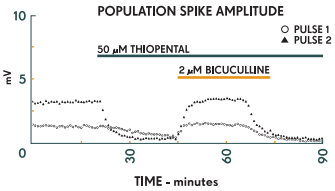
Increase reproducibility with fewer hours in lab.

"I am writing to tell you how pleased I am with the ValveBank8 Perfusion System. It's great that I can load the reservoirs, press go, and start recording. I can read papers rather than fussing with solutions and switching valves every 10-15 minutes. Since solutions are switched at exactly the same time from one experiment to the next, I have been able to automate my data analysis protocols as well."

Brain Slice Field Recording



Unattended solution delivery using a ValveBank8 AutoPrime Perfusion System

Dr. M. Bruce MacIver, M.Sc., Ph.D.
Department of Anesthesia
Stanford University Medical Center

Gravity Perfusion Systems

- **Unattended solution switching**
  Avoid vibrations from switching valves by hand. The ValveBank® or ValveLink® controller handles all solution delivery so you can watch results – not switch stopcocks. Many special features are included for easy perfusion control. Low noise circuitry.

- **Increased reproducibility**
  Valve switching is accurate to 0.01 seconds with programs up to 99 hours long under microprocessor control. Consistent liquid delivery means better data.

- **Pinch, PTFE-Inert and Lee™ Valves**
  Choose between speed, cost, and ease of cleaning. Several options are available for fittings and reservoirs.

- **Manual and external valve control**
  Flexible design. Easy cleaning and calibration. Primary/secondary mode valve operation controlled by your computer, pClamp, Patchmaster, SutterPatch, LabView, AxoGraph, etc.

Valve Choices:

- **Pinch Valves for Reduced Maintenance**
  Easiest valves to clean and switch tubing. Liquids never touch the valves. Switches in 30-50 ms. 1/32" i.d. silicone tube passes through, and is pinched closed by solenoid activation. All AutoMate Scientific valves include an individual indicator LED. Our aluminum enclosure keeps the valves dry from spills and offers luer lock ports for syringe reservoirs.

- **PTFE-Inert Valves for Fast Switching**
  Required for fast kinetics applications. Excellent chemical and corrosion resistance. Non-stick surface resists particles and chemical deposits. Switches in less than 10 ms, with 20 µl of dead volume from port to port. Threaded female inlet and outlet ports accept Hose Barb, Luer Lock and Nut & Ferrule fittings (see diagrams next page).

- **Lee™ Mini Valves for Extremely Fast Switching and Minimal Pressure Pulse**
  For the most demanding applications AutoMate Scientific offers tiny valves from the Lee Company. Enclosed in our aluminum box with luer locks for syringe reservoirs, these valves can open and close in 1.5-4 ms with a ValveLink8.3 controller.

Pinch Valves

PTFE-Inert Valves

Lee™ Valves

Perfusion Systems Include:

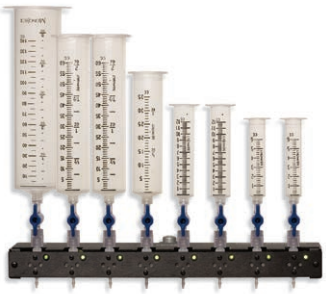
Controller, valves, 60 ml syringe reservoirs, 2-way stopcocks, (reservoir bracket and drippers in PTFE-Inert systems only), ringstand, 1/16" i.d. tubing and four-, eight- or sixteen-into-one micro-manifold with built-in flow control. 5, 15, 35, 60 or 140 ml syringe reservoirs available.

The Economy Pinch Valve System includes a ValveLink8 controller, four pinch valves, 35 ml syringes, 2-way stopcocks, ringstand, 1/16" i.d. tubing and four-into-one micro-manifold with built-in flow control.

Computer Interfacing:

Perfusion systems can be controlled by a computer using data acquisition hardware (i.e., DigiData, ITC-16, or National Instruments board) and software (i.e., pCLAMP, Patchmaster, SutterPatch, or LabView). Both ValveBanks and ValveLinks accept real-time TTL inputs to control valves. Most acquisition software already being used in your experiments can talk to our controllers. AutoMate Scientific offers an optional program called EasyCode® for the Macintosh and PC/Windows to program ValveBanks (not ValveLinks). This software is used before an experiment – valve sequences are downloaded into the memory of the ValveBank where they are run. An article by AutoMate Scientific can be found in Axon Instrument's AxoBits 17 newsletter outlining these strategies – accessible on our web site.

Luer-lock Fittings in PTFE-Inert Valves



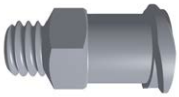
Luer-lock fittings in PTFE-Inert valves allow direct connection of syringe reservoirs for minimal dead volume.

PTFE-Inert Valve Fitting Choices

Hose Barb

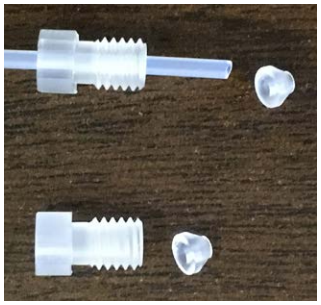
- Standard
- Available for 1/8" and 1/16" i.d. soft tubing

Lure-Lock



- For direct attachment of syringes
- Eliminates extra tubing between reservoirs and valves
- Includes 2-way stopcocks and syringes

Nut & Ferrule



- HPLC-like, screw-in fittings for rigid, small-diameter (1/16" o.d.) tubing

Ordering Information

Part No.	Perfusion Systems
17-21-20	ValveLink®4.3 Economy Pinch Valve Perfusion System
13-01-23	ValveBank®4 PTFE-Inert Perfusion System
13-pp-24	ValveBank4 Pinch Valve Perfusion System - 1/32" i.d. silicone tube
13-21-27	ValveBank4 Lee Mini Valve Perfusion System
17-01-23	ValveLink4.3 PTFE-Inert Perfusion System
17-pp-24	ValveLink4.3 Pinch Valve Perfusion System - 1/32" i.d. silicone tube
17-21-27	ValveLink4.3 Lee Mini Valve 1.5 to 4 ms Perfusion System
13-01-53	ValveBank8 PTFE-Inert Perfusion System
13-pp-54	ValveBank8 Pinch Valve Perfusion System - 1/32" i.d. silicone tube
13-21-57	ValveBank8 Lee Mini Valve Perfusion System
17-01-53	ValveLink8.3 PTFE-Inert Perfusion System
17-pp-54	ValveLink8.3 Pinch Valve Perfusion System - 1/32" i.d. silicone tube
17-21-57	ValveLink8.3 Lee Mini Valve 1.5 to 4 ms Perfusion System
17-01-83	ValveLink16.3 PTFE-Inert Perfusion System
17-pp-84	ValveLink16.3 Pinch Valve Perfusion System - 1/32" i.d. silicone tube
17-11-87	ValveLink16.3 Lee Mini Valve 1.5 to 4 ms Perfusion System

U.S./Canada prices shown. International prices add 15%. Email or visit web store for latest prices.

xx-[TB]-xx **Indicate [T]op inflow and [B]ottom outflow PTFE-Inert valve fittings:**
[0]=1/8" i.d. hose barb, [1]=1/16" i.d. hose barb, [2]=Luer-lock female with stopcocks and 35 ml syringes, [3]=10-32 threaded nut & ferrules for 1/16" o.d. tubing (add $30/set of 4), [p]=Pinch valves have no fittings

Systems include: Controller, user manual, valves, 35 ml or 60 ml syringes, stopcocks, (reservoir bracket and drippers in PTFE-Inert systems only), ringstand, 1/16" i.d. Tygon tubing, and 4-, 8- or 16-into-1 micro-manifold with flow control. 5, 15, 35, 60 or 140 ml syringe reservoirs available.

Visit https://www.autom8.com/build-your-own/ to configure a perfusion system and quote.

Ordering Information

Part No.	Valves & Fittings
	Each pair of 4 valves ordered together will be mounted in a case of 8.
02-01-02	**Set of 4 PTFE-Inert valves** - cabled and mounted
02-pp-04	**Set of 4 Pinch valves** - cabled and mounted, 1/32" i.d. silicone tube
02-21-07	**Set of 4 Lee mini valves** - cabled and mounted
02-01-02i	**Individual PTFE-Inert replacement valve**
02-pp-04i	**Individual Pinch replacement valve**
02-21-08i	**Individual Lee mini replacement valve**
01-05	**Low-noise, valve and case grounding package** (per 4 valves) A grounding wire attached to all valves extending back to the controller. This item is recommended for electrophysiology and required for CE conformity.
02-06	**Valve extension cables** - 2 meter RCA M/F (set of 4 cables)
05-01	**Luer-lock fittings** - with 2-way stopcocks (set of 4)
05-02	**Nut & ferrule fittings** - for 1/16" o.d. tubing (set of 4)

U.S./Canada prices shown. International prices add 15%. Email or visit web store for latest prices.

02-[TB]-02 **Indicate [T]op inflow and [B]ottom outflow PTFE-Inert valve fittings:**
[0]=1/8" i.d. hose barb, [1]=1/16" i.d. hose barb, [2]=Luer-lock female with stopcocks,
[3]=10-32 threaded nut & ferrules for 1/16" o.d. tubing (add $30/set of 4),
[p]=Pinch valves have no fittings

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Perfusion System

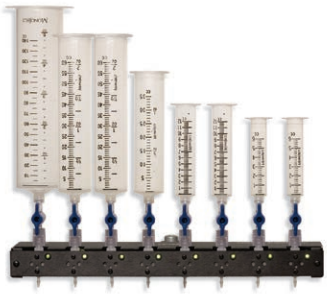
13-01-53 ValveBank8 PTFE-Inert Perfusion System

Valve Controllers

ValveLink Controller

ValveBank Controller

Reservoirs



You can choose 15, 35, 60 or 140ml reservoirs

How to configure and order a perfusion system.

AutoMate Scientific sells complete perfusion systems as well as individual components. This can make it confusing for customers to determine which pieces they need to order. We hope this guide helps. All of the items mentioned below are explained in more detail on the following pages, or you can quickly customize a complete perfusion system on our web site at https://www.autom8.com/build-your-own/.

1. Gravity, bath perfusion systems
2. Pressurized, fast, local drug application
3. Temperature control
4. Putting it all together

1. Gravity, bath perfusion systems

Our Perfusion Systems are complete gravity, bath perfusion systems. You can choose the number of channels (liquids), one of two valve controllers (ValveBank® or ValveLink®), and one of three different kinds of valves (pinch, PTFE-inert, and Lee valves). Everything you need for a regular gravity perfusion system is included: controller, valves, reservoirs, ringstand, 1/16" i.d tubing and 4-, 8-, or 16-into-1 micro-manifold with flow regulator. Gravity PTFE-inert systems include drippers and a reservoir bracket.

This Perfusion System is ideal for switching solutions flowing into a perfusion chamber for slice electrophysiology, oocytes, imaging, etc. with flow rates from near zero up to 6-10 ml/minute. We usually recommend pinch valves (cheapest and easiest to clean) unless you need faster switching. Our ValveLink controller is designed for customers who have digital/TTL

Gravity Perfusion Systems Ordering Information

Part No.	Electrophysiology
17-pp-54	ValveLink8 Pinch Valve Perfusion System
2x #01-05	Low-noise grounding packages (4 valves each)
01-20	Full BNC cable or alternate cable for Heka amplifiers

Part No.	Imaging or no digital outputs
13-pp-54	ValveBank8 Pinch Valve Perfusion System
	You can choose 15, 35, 60 or 140ml reservoirs.

outputs from their computer -- from data acquisition software like pCLAMP, Patchmaster, SutterPatch, WinWCP, MetaMorph, etc. or I/O hardware with software like LabView or MATLAB. Alternatively, our ValveBank controller is completely programmable without needing a computer. It is ideal for setups without computer control or imaging software with only 1-2 digital trigger or shutter outputs.

2. Pressurized, fast, local drug application

For customers needing faster switching times (ligand-gated channels, etc.) we recommend local drug application -- often called "spritzing" or "superfusion." This means the perfusion tubes meet in a smaller manifold with a tiny tip ideal for squirting solution directly at a patch or region of interest. AutoMate Scientific's Perfusion Pencil® can achieve switching times below 10 milliseconds WITHOUT the need of "steppers" or piezo switchers. This manifold combines 4, 8 or 16 tubes into a single, removable tip with a micro dead volume of 2-3 µl. When the perfusion system's valves upstream switch from one liquid to the next, the change happens inside the Perfusion Pencil tip, resulting in very fast switching times.

For researchers who need faster switching times, steadier flow rates, fine microliter delivery or small pipette tips, we recommend adding a Pressure Upgrade to the perfusion system. These pressurized syringe reservoirs with regulator push liquids out much faster than gravity, especially with small Perfusion Pencil tips. Air pressure is much more quiet (electrically and audibly), more smooth and more reliable than peristaltic pumps.

Electrophysiologists often need their solutions bubbled with Carbogen for slice oxygenation. For many years, AutoMate Scientific's Pressure Upgrade Kit was incompatible with bubbling because the syringe reservoirs are closed air-tight. However, we have created the Oxygen8™ Bubbled Pressure Upgrade which simultaneously bubbles and pressurizes all of the solutions.

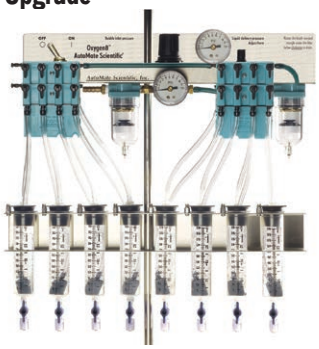
Perfusion Pencil

04-08-250 Perfusion Pencil

Perfusion Pressure Upgrade

09-08 Perfusion Pressure Upgrade

Oxygen8 Bubbled Pressure Upgrade



09-18 Oxygen8 Bubbled Pressure Upgrade

Pressurized Local Drug Application Ordering Information

Part No.	4 Channels
04-04-xxx	Perfusion Pencil with 100, 250 or 360µm tip
09-04	Perfusion Pressure Upgrade
09-14	Oxygen8 Bubbled Pressure Upgrade

Part No.	8 Channels
04-08-xxx	Perfusion Pencil with 100, 250 or 360µm tip
09-08	Perfusion Pressure Upgrade
09-18	Oxygen8 Bubbled Pressure Upgrade

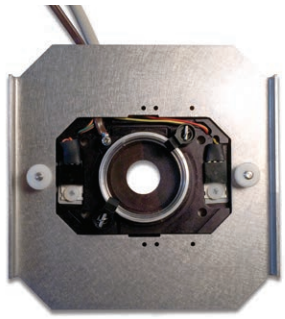
ThermoClamp Heater

03-18-xxx ThermoClamp
Inline Heater

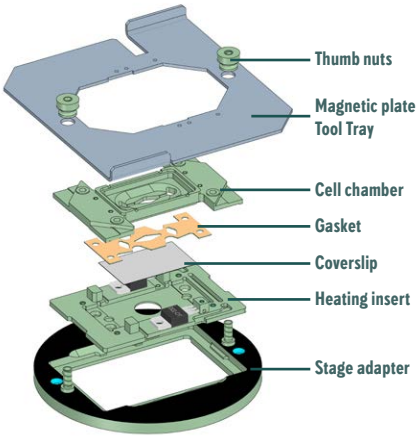
BubbleStop

10-8-60-G BubbleStop Syringe
Heater - Gravity

QuickStage Chamber



QS-H-35W-TT-UU
QuickStage Heated 35mm WillCo
Petri perfusion chamber



QS-H-12UP-TT-N
QuickStage Heated 12mm diamond
perfusion chamber

3. Temperature control

AutoMate Scientific's standard perfusion systems are all room-temperature by default, but we offer several temperature control options: 1) ThermoClamp® inline heater, 2) BubbleStop® syringe reservoir heater, 3) QuickStage™ stage heaters, 4) Cool Solutions peltier heater/cooler, and 5) objective heaters. Most of the thermal mass your cells experience originates from the liquids flowing over them. Therefore, the most effective temperature control is a good inline solution heater (or cooler) which is positioned as close to the prep as possible. Our ThermoClamp-1 maintains your solution and bath temperature to within 1.0°C (often within 0.1°C) using a thermocouple in your perfusion chamber and another in the heater. It shares a similar design to our Perfusion Pencils mentioned previously, allowing for rapid solution switching from a fine removable tip while also maintaining 37°C or any desired temperature between ambient and 50°C.

When used with cold solutions (i.e. stored in the refrigerator overnight), inline heaters can create bubbles inside their tubing. Many people mistakenly believe these bubbles come from air leaking into the tubing, but they actually form because warm liquids cannot hold as much gas as cold solutions. The solutions release gas when heated, and cause bubbles which can interrupt your perfusion flow. AutoMate Scientific has designed an economical syringe heater block called the BubbleStop which pre-heats the liquids so they off-gas before entering your tubing.

The AutoMate Scientific QuickStage is designed to fit directly into your microscope stage or platform to hold a perfusion chamber or 35mm Petri dish. The heated version of the QuickStage uses AutoMate Scientific's popular ThermoClamp temperature controller to maintain your set temperature from ambient to 50°C.

Temperature Control Ordering Information

Part No.	4 Channels
03-14-xxx	ThermoClamp Inline Heater
10-4-60-G	BubbleStop Syringe Heater - Gravity
10-4-60-P	BubbleStop Syringe Heater - Pressure

Part No.	8 Channels
03-18-xxx	ThermoClamp Inline Heater
10-8-60-G	BubbleStop Syringe Heater - Gravity
10-8-60-P	BubbleStop Syringe Heater - Pressure

Part No.	QuickStage Chamber and Heater
QS-H-35W-TT-UU	QuickStage Heated 35mm WillCo Petri perfusion chamber
QS-H-12UP-TT-N	QuickStage Heated 12mm diamond perfusion chamber

4. Putting it all together

To order a pressurized or temperature-controlled perfusion system, you should start with one of our unheated gravity systems, and add the additional pieces you need. Here are some examples:

Example Simple Systems Ordering Information

Part No.	4-Channel Pressurized Perfusion System
17-01-23	ValveLink8 PTFE-inert Perfusion System
09-04	Perfusion Pressure Upgrade
04-04-100	Perfusion Pencil with 100µm tip
01-29	USB cable

Part No.	8-Channel Heated Perfusion System
13-11-57	ValveBank8 Lee Valve Perfusion System
03-18-360	ThermoClamp Inline Heater with 360µm tip
10-8-60-G	BubbleStop Syringe Heater - Gravity
VB-1600	Heka EPC-10 ValveBank Interface Cable

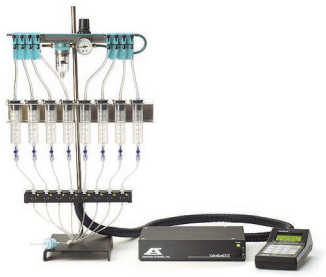
Example Advanced Systems Ordering Information

Part No.	8-Channel Heated Imaging System
13-01-53	ValveBank8 PTFE-inert Perfusion System
01-03-2000	EasyCode ValveBank Programming Software
09-T18	Oxygen8 Bubbled Pressure Kit - Top Half
10-8-60-G	BubbleStop Syringe Heater - Bottom
03-18-250	ThermoClamp Inline Heater with 250µm tip
01-15	ValveBank Parallel Port Cable to MetaMorph
QS-H-12IN	QuickStage heated 12mm diamond chamber and stage adapter
vac	Vacuum Pump
canister	Vacuum Trap

Part No.	8-Channel Slice Electrophys System
17-11-57	ValveLink8 Lee Valve Perfusion System
01-05 x 2	Low-noise Grounding Packages
01-20	Full BNC cable to DigiData
09-T18	Oxygen8 Bubbled Pressure Kit - Top Half
10-8-60-G	BubbleStop Syringe Heater - Bottom
03-18-250	ThermoClamp Inline Heater with 250µm tip
S-BSC1	Brain Slice Chamber-1: Interface and Submerged
S-PTC03	Chamber Temperature Controller
canister	Vacuum Trap

We offer a great web form to help build you own perfusion system. Just answer a few questions, enter your contact info, and click Submit for a customized quote at: https://www.autom8.com/build-your-own/.

Perfusion Packages



13-11-57 ValveBank8 Lee Valve Perfusion System
01-05 Low-noise grounding package
09-08 Perfusion Pressure Kit

Brain Slice Chambers

S-BSC1 Brain Slice Chamber-1: Interface and Submerged

Accessories

Custom BNC cables

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