

Pumps & Fluid Handling

Peristaltic Pumps



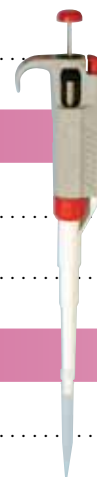
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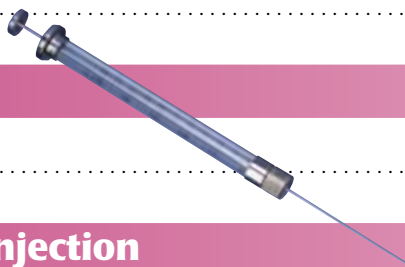
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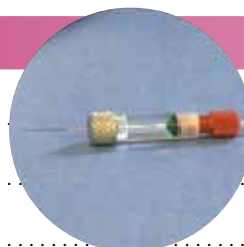
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Prices shown are in U.S. dollars. Actual charges will vary because of import duty, freight, and currency fluctuations. To obtain an exact quotation, contact your WPI office.

Which pump is right for you?

WPI carries a wide variety of fluid handling tools utilizing three different technologies: **peristaltic pumps**, **syringe pumps** and **pneumatic injectors**. The range of applications and the criteria by which one selects a particular pump or injector is broad and complex and we

encourage you to phone or email us and speak to a tech support specialist. In the meantime, we have tried to simplify the process by listing all of the pumps and injectors in a chart that sorts them by technology, flow range and special features. Special features tell you about

applications of the pump or technical aspects that are more properly discussed in a technical manual than a catalog entry. We frequently use the terms Infuse/Withdraw (I/W), Push/Pull and RS232, and these terms are defined below. Many of the syringe pumps can be had with an **alarm option** that alerts the user to end of travel or blocked flow and a **"P" option** that allows programmable flow and volume profiles without using the RS232 computer interface.

Infuse/Withdraw: Describes a feature of a syringe pump whereby the syringe plunger is held by the pusher so the motor can pull the plunger back, withdrawing fluid as well as pushing the plunger to infuse it.

Push/ Pull: Again, a feature of syringe pumps which use two syringes mounted back to back so movement of the pusher block will simultaneously withdraw fluid into one syringe and infuse an equal amount from the other.

RS232: This is a serial interface. Some pumps in the WPI line can be addressed by computer. Simple programs can be created to control the pump rate, the overall volume. Flow ramps or other profiles and temporal sequences can be written. In addition, pumps can be daisy-chained together to create a pump network. In such a network, each pump has its own address and can be addressed separately by the program.



	Pump Type	Fluid Range	Number of Channels	Special features
Peripro-2HS	Peristaltic	0.8 - 300 mL/min	2	Calibrated output Replaceable tubing cartridges
Peripro-4HS	Peristaltic	0.8 - 300 mL/min	4	Calibrated output Replaceable tubing cartridges
Peripro-4LS	Peristaltic	0.01-80 mL/min	4	Calibrated output Replaceable tubing cartridges
Peripro-8LS	Peristaltic	0.01-80 mL/min	8	Calibrated output Replaceable tubing cartridges
MityFlex	Peristaltic	1.7-800 mL/min	1	High Volume
MINISTAR	Peristaltic	0.006- 37 mL/min	1	Compact design, Remote control
AL-1000	Syringe	0.000073-1699 mL/hr	1	Push/pull
AL-2000	Syringe	0.000073-1699 mL/hr	2	Push/pull (2 networked pumps)
SP100i	Syringe	0.0001-519 mL/hr	1	Basic 1 Channel
SP101i	Syringe	0.001 µL/hr – 35mL/min	2	Micro Dialysis application
SP200i	Syringe	0.001µL/hr - 145 mL/min	2	RS232 TTL/Footswitch
SP220i	Syringe	0.001µL/hr - 21 mL/min	10	RS232 Infuse Only
SP250i	Syringe	0.001µL/hr - 21 mL/min	4	RS232 Infuse Only
SP210iw	Syringe	0.001µL/hr - 145 mL/min	2	RS232 Infuse/Withdraw
SP230iw	Syringe	0.001µL/hr - 21 mL/min	10	RS232 Infuse/Withdraw
SP120p	Syringe	0.1 µL/hr – 127 mL/hr	1+1	push pull, single cycle
SP260p	Syringe	0.001µL/hr - 86 mL/min	2+2	RS232 push pull, single cycle
SP210c	Syringe	0.001µL/hr - 86 mL/min	2+2	RS232 push pull, continuous
VSP1	Syringe	0.1 mL/hr - 600 mL/hr	1	\$1299 Safety features include two-hour battery operation
UMP2	Syringe	0.03nL/min - 10 µL/sec	1	Ultra Micro Infuse/Withdraw RS232
B203XV	Syringe	Bolus, 2.3-69 mL/Injection	1	Oocyte Injector, Infuse only
MMP	Syringe	Manual 100 µL-1mL syringe	1	Manual
DMP	Syringe	Manual 100 µL-1mL syringe	1	Digital readout Micrometer
PV820	Pneumatic	Bolus/Continuous Pressure, Duration and Pipette dependent	1	Injection Pressure and Holding Pressure
PV830	Pneumatic	Bolus/Continuous Pressure, Duration and Pipette dependent	1	Injection Pressure and Holding Pressure and Vacuum

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Peri-Star™ Pro

High performance digital peristaltic pump at an affordable price!

- **Display either rotation speed (RPM) or flow rate (mL/min)**
- **Wide flow range: 0.01 - 280 mL/min**
- **Accuracy of flow rate: 0.5% using self calibration function**
- **Accuracy of speed: 0.1 rpm**
- **Large backlit digital LCD display**
- **Programmable for all tubing sizes between 0.8 mm and 6.4 mm ID**
- **Easy and fast tubing replacement using snap-on cartridges**
- **Membrane keypad allows easy programming while protecting controls from fluid entry**
- **Actively driven rollers by planetary gears for long lasting tubing life.**



Peri-Star™ Pro peristaltic pumps provide accurate and precise pumping with convenience and versatility. Peri-Star Pro can be run in either flow rate mode (mL/min) or rotation speed mode (rpm). For good laboratory practice, pumps must be calibrated after changing the tubing and solution. Users can easily calibrate Peri-Star Pro to deliver flow as accurate as 0.5% in a wide flow range from 0.01 mL/min to 280 mL/min. Under rotation speed mode, the digitally controlled stepping motor provides accurate and reproducible operation with 0.1% rpm both forward and in reverse.

Large backlit digital LCD display provides readouts of rotation direction, flow rate or rotation speed, tubing ID, drive status and

remote control mode simultaneously. Water resistant membrane keypad allows easy programming while protecting LCD display and controls from fluid entry.

Built-in Human Machine Interface (HMI) with screen instructions in plain English steps users through initial setup, calibration and operating procedures. The user-friendly interface reduces the need to frequently check the printed manual for instruction and reference.

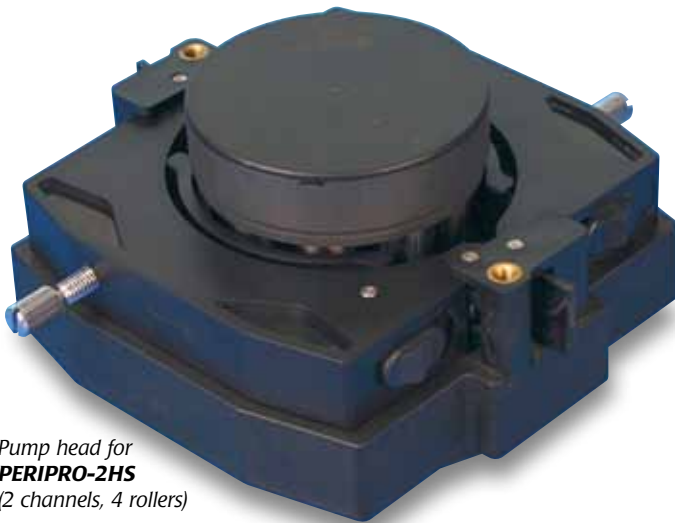
Peri-Star Pro is available in two versions: a

4-roller version for high flow and an 8-roller version for lower volumes while providing high pressure with minimal pulsations.

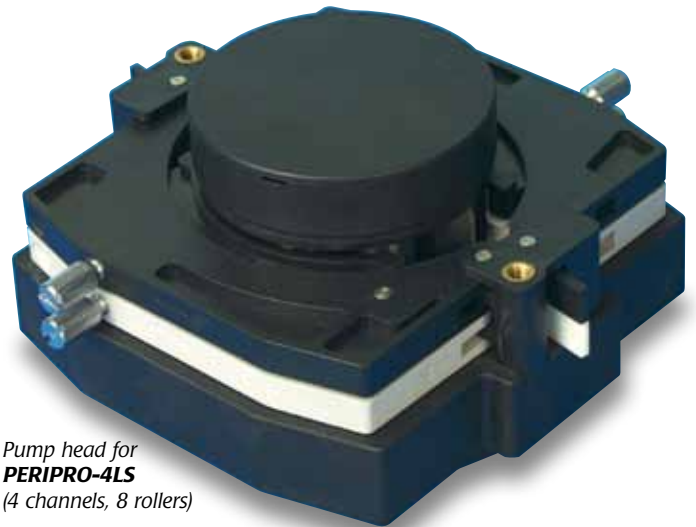
A unique planetary gear design with eight actively driven rollers (four rollers for higher flow rate model), together with independent tubing compression fine adjustment, greatly increases flow accuracy and prolongs tubing life. Snap-on cartridges allow tubing to be changed quickly without cross contamination of solutions.

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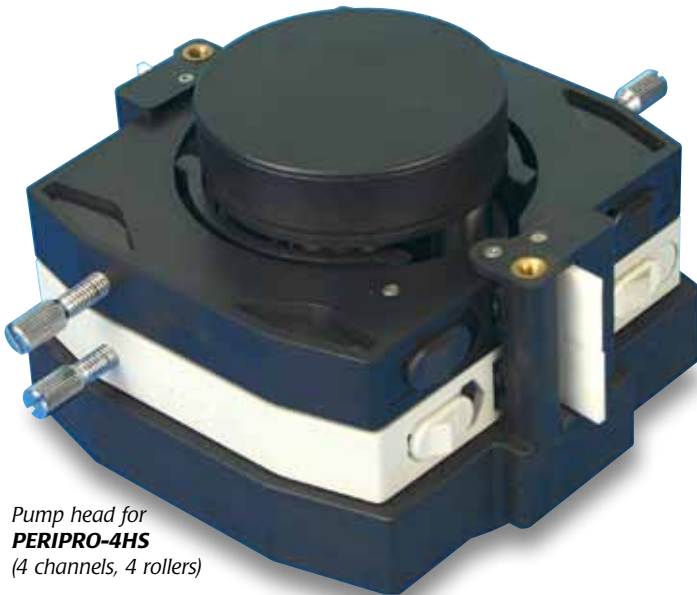
Available in 2-, 4- and 8-channel versions



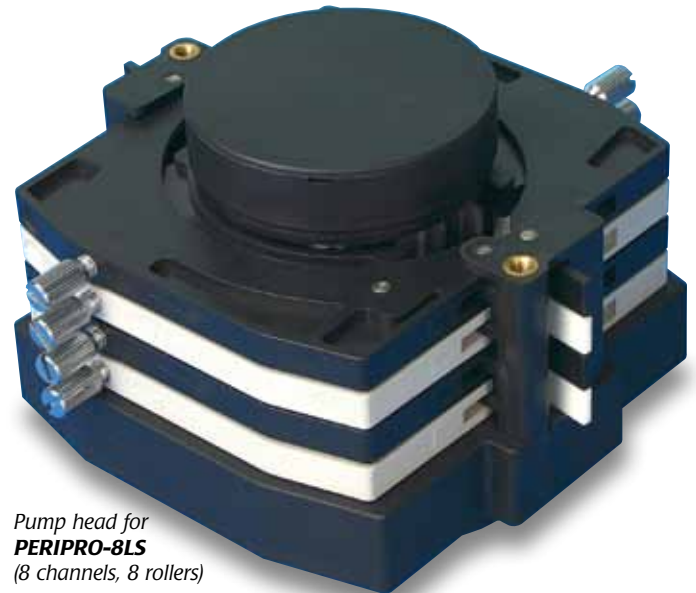
Pump head for
PERIPRO-2HS
(2 channels, 4 rollers)



Pump head for
PERIPRO-4LS
(4 channels, 8 rollers)



Pump head for
PERIPRO-4HS
(4 channels, 4 rollers)



Pump head for
PERIPRO-8LS
(8 channels, 8 rollers)

PERI-STAR PRO SPECIFICATIONS

	Peri-Star Pro 2H / 4H (High Rate)	Peri-Star Pro 4L / 8L (Low Rate)
NUMBER OF ROLLERS	4	8
NUMBER OF CHANNELS	2-4	4-8
ROTOR SPEED RANGE	1-100 rpm	1-100 rpm
FLUID FLOW RANGE	0.8-280 mL/min #17 Tubing: 3.5-280 mL/min	0.01-80 mL/min #14 Tubing: 0.2-18 mL/min
TUBING RANGE	3.1-6.4 mm ID	0.5-2.4 mm ID
SELF-CALIBRATION	Yes	Yes
WORKING ENVIRONMENT	0-45°C, Humidity < 80%	0-45°C, Humidity < 80%
POWER	110 V or 220 V AC, 50 - 60 Hz	110 V or 220 V AC, 50 - 60 Hz
DIMENSIONS	190 x 162 x 275 mm	190 x 162 x 275 mm
SHIPPING WEIGHT	11 lb / 5 kg	11 lb / 5 kg

NEW PERI-STAR PRO PUMPS

PERIPRO-2HS Peri-Star™ Pro, 2-channel, High Rate, Large Tubing (110-220V)

PERIPRO-4HS Peri-Star™ Pro, 4-channel, High Rate, Large Tubing (110-220V)

PERIPRO-4LS Peri-Star™ Pro, 4-channel, Low Rate, Small Tubing (110-220V)

PERIPRO-8LS Peri-Star™ Pro, 8-channel, Low Rate, Small Tubing (110-220V)

OPTIONAL ACCESSORIES

503049 Replacement Tubing Cartridge, Large

503050 Replacement Tubing Cartridge, Small

503022 Replacement Silicone Tubing, 1m, 1.6 mm I.D., #14, with stops

503023 Replacement Silicone Tubing, 1m, 6.4 mm I.D., #17

503120 TTL Control Module

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MityFlex Peristaltic Pump



Included with the MityFlex are four short lengths of Norprene™ tubing to fit into the roller mechanism — 1/16", 1/8", 3/16", 1/4" — and black rollers for use with 3/16" to 1/4" tubing. The optional MITY-KIT includes replacement tubing and a set of red rollers for use with 1/16" and 1/8" tubing. *Norprene is a trademark of Saint-Gobain Performance Plastics Corp.*

The MityFlex is an economical, variable speed, peristaltic pump that can handle a wide variety of viscosities from air to gases to heavy slurries, with consistent displacement.

This pump can be used for fluid transfer or for metering applications. By varying the tubing a wide range of flow rates can be achieved. This is a great value for medium to high flow applications.

MITYFLEX SPECIFICATIONS

NUMBER OF ROLLERS	2		
FLOW RATE	1.7 to 800 mL/min. Variable speed-reversible		
RPM RANGE	8-228		
FLOW RATES	Tubing I.D.	Flow Rate	Masterflex Equiv.
	1/16 in.	1.7-48 mL/min*	#14
	1/8 in.	7-190 mL/min	#16
	3/16 in.	16-456 mL/min	#25
	1/4 in.	28-800 mL/min	#17
POWER	115 VAC / 60 Hz or 220 VAC / 50 Hz		
DIMENSIONS	22.6 x 14.2 x 19 cm (8.9 x 5.6 x 7.5 in.)		
SHIPPING WEIGHT	3.6 kg (8 lb)		

* To use 1/8-in. or 1/16-in. tubing, MITY-KIT is required.

500282 MityFlex Peristaltic Pump (110 V)

500283 MityFlex Peristaltic Pump (220 V)

MITY-KIT Replacement Parts Kit with Rollers

MITY-KIT includes 4 short lengths of Norprene™ tubing to fit into the roller mechanism — 1/16", 1/8", 3/16", 1/4" — and red rollers for use with 1/16" tubing.

Mini★Star™

Miniature DC Peristaltic Pump

This compact and lightweight peristaltic pump fits just about anywhere. It can be mounted directly on the bench, in a regular rack or to a post. The MiniStar's speed can be adjusted from 1rpm to 50 rpm. With recommended silicone tubing, the volume can be set from 0.06 mL/min to 14.0 mL/min. The MiniStar also features a hand held remote control that allows users to start and stop the pump, purge or adjust its speed and direction.

MINISTAR SPECIFICATIONS

CHANNEL	1
SPEED	1-50.0 rpm, forward/reverse
FLOW RANGE	0.06~14.0 mL/min
RESOLUTION	1 rpm (0.1 rpm computer control)
SPEED CONTROL	Remote control
DISPLAY	Indicators for status and speed
POWER	12 V DC (110/220 VAC adapter incl.)
WORKING CONDITION	Temperature 0-40°C, humidity < 80%
TUBING	Two-stop Silicone
Wall Thickness	0.8~1.0 mm
Outer Diameter	≤ 4.8mm
DIMENSION OF DRIVER	135×72×72 mm (L×W×H)
DIMENSION OF REMOTE CONTROL	105×50×16 mm (L×W×H)
WEIGHT OF DRIVER	0.5 Kg

MINISTAR Miniature Peristaltic Pump, 1-channel

503120 TTL Control Module

503121 Silicone Tubing w stops, 2.4mm ID x 0.8mm wall x 1 m (5-pk)

503122 Silicone Tubing w stops, 1mm ID x 1mm wall x 1 m (5-pk)



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Aladdin

Programmable Syringe Pump



CE

- **Economical**
- **Versatile**
- **More Features**
- **Dual Pumping Action**

ALADDIN SPECIFICATIONS

SYRINGE SIZES	1-60 mL, or 0.5-5 µL micro syringes
NUMBER OF SYRINGES	1
MOTOR TYPE	Step Motor, 1/8 to 1/2 step modes
STEPS PER REVOLUTIONS	400
STEPPING (max./min.)	0.21 µm to 0.850 µm
MOTOR TO DRIVE SCREW RATIO	15/28
SPEED (max./min.)	5.1 cm/min / 0.0042 cm/hr
PUMPING RATES	1699 mL/hr with 60 mL syringe, to 0.73 µL/hr with 1 mL syringe
MAXIMUM FORCE	35 lb at min. speed, 18 lb at max. speed
NUMBER OF PROGRAM PHASES	41
RS-232 PUMP NETWORK	100 pumps maximum
POWER SUPPLY	Wall adapter 12V DC @ 850 mA
DIMENSIONS	22.9 x 14.6 x 11.4 cm (8.75 x 5.75 x 4.5 in.)
WEIGHT	1.6 kg (3.6 lb)

Need a pump for two syringes? Two Aladdin pumps when daisy-chained are more efficient and affordable than any competitor's dual syringe models. Two Aladdins (**AL-2000**) will perform as a dual infusion/withdrawal pump, a double pump for infusing at different rates, a push/pull pump with one infusing and one withdrawing at the same or different rates, two independent pumps, or a master/slave pump. One Aladdin can even control the second for continuous pumping with optional check valve set.

The Aladdin pump series will accept syringes from Becton Dickinson, Monoject, Terumo, and Air-Tite.

AL-1000 Programmable Syringe Pump

AL-2000 Two AL1000 Syringe Pumps

Includes GN-TTL Interconnecting Cable for push/pull or continuous pumping. Valves not included.

Specify line voltage

When ordering 220V models, specify UK, Euro or Australian line cord.

OPTIONAL ACCESSORIES

GN-PC7 PC to pump cable, 7 ft

GN-PC25 PC to pump cable, 25 ft

GN-NET7 Pump-to-pump network cable, 7 ft

GN-NET25 Pump-to-pump network cable, 25 ft

GN-TTL Pump-to-pump reciprocating cable

ADPT2 Footswitch

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Syringe Pumps

Microprocessor-controlled syringe pumps for applications requiring high metering precision at low, pulse-free rates

Sturdy and reliable, extremely simple to set up and use — and surprisingly affordable. Liquid crystal displays (LCDs) prompt you through setup:

1. Select syringe from table stored in the pump's memory and displayed on the LCD.
2. Enter the volume to be dispensed.
3. Enter the flow rate, press "start."

It's fast and simple. Your settings are permanently stored in memory — there's no need to re-enter them each day. SP pumps feature preset rate and volume control. Just set the volume you want dispensed. Volume is tracked continuously on the LCD display. Then, when the preset volume has been dispensed, the pump shuts off automatically. The easy-to-read digital display provides real-time readings using both parameters and values for clearer, mistake-free readings. The SP200 Series pumps offer TTL and RS-232C interfaces and automatic shutoff under stall conditions.

Single-Syringe Infusion Pump

SP100i

This inexpensive single-syringe infusion pump combines precision and simplicity with outstanding ease of use and durability.

- Holds any size syringe, 10 μ L to 50 mL
- Automatic volume control and shutoff
- Simple menu-driven setup: dispense volume, dispense flow rate, syringe diameter (selected from displayed table)
- Last settings stored in permanent memory
- Continuous dispense volume display



CE

SP100i SPECIFICATIONS

Mode	Infusion
Syringe Size	10 μ L to 60 mL (one)
Maximum Flow Rate	519 mL/hr
(60 mL Syringe)	
Minimum Flow Rate (10 μ L Syringe)	0.1 μ L/hr
Linear Force	20 lb (9 kg)
Advance Per Microstep	0.529 micron (1/2-step)
Maximum Step Rate (1/2-step)	400 steps/sec
Minimum Step Rate	1 step/30 sec
Accuracy	< 1% error
Reproducibility	\pm 0.1%
Dimensions	9 x 6 x 5.5 in. 23 x 15 x 14 cm
Shipping Weight	7.5 lb (3.4 kg)

Available 95-135 V or 220-240 V, 50/60 Hz

Two-Syringe Microdialysis Pump

SP101i

Developed especially for use in microdialysis experiments, these pumps produce very fine syringe movement. The modified SP100i gearing features a sixfold gear reduction compared to standard models, allowing pumping at much smaller flow rates. (See sensors such as ISO-NO and Micro-C for detection of dialysates.) The SP101i is a dual barrel infusion only pump.

- Holds two syringes, 10 μ L to 10 mL



CE

SPECIFICATIONS

SP101i

Mode	Infusion (Microdialysis)
Syringe Size	10 μ L to 10 mL (two)
Maximum Flow Rate	0.351 mL/min. (10 mL Syringe)
Minimum Flow Rate	0.001 μ L/min (10 μ L Syringe)
Linear Force	40 lb (18 kg)
Advance Per Microstep	0.088 micron (1/2-step)
Maximum Step Rate (1/2-step)	400 steps/sec
Minimum Step Rate	1 step/30 sec
Accuracy	< 1% error
Reproducibility	\pm 0.1%
Dimensions	9 x 6 x 5.5 in. 23 x 15 x 14 cm
Shipping Weight	7.5 lb (3.4 kg)

Available 95-135 V or 220-240 V, 50/60 Hz

SP100i	Syringe Pump, Infusion (single), 95-135 V
SP100iZ	Syringe Pump, Infusion (single), 220-240 V
SP101i	Syringe Pump, Microdialysis (double, slow speed), 95-135 V
SP101iZ	Syringe Pump, Microdialysis (double, slow speed), 220-240 V

All 240-volt pumps are CE-approved.

###-A Audible Alarm (add "A" to end of pump part number when ordering)

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Two-Syringe Infusion Pump

SP200i

SP200i SPECIFICATIONS

SP200i	
Mode	Infusion
Syringe Size	10 µL to 140 mL (two)
Maximum Flow Rate (140 mL syringe)	145 mL/min
Minimum Flow Rate	0.001 µL/hr
Linear Force	40 lb (18 kg)
Advance Per Microstep	0.165 micron
Maximum Step Rate	1600 steps/sec
Minimum Step Rate	1 step/100 sec
Accuracy	< 1% error
Reproducibility	± 0.1%
Dimensions	11 x 9 x 5.5 in. 28 x 23 x 14 cm
Shipping Weight	12 lb (5.4 kg)

Available 95-135 V or 220-240 V, 50/60 Hz

This feature-laden two-syringe infusion pump combines a broad speed range and holds a wide range of syringe sizes to meet the requirements of virtually any laboratory application.

- Holds two syringes, 10 to 140 mL
- Backlit LCD display
- Knob locks/unlocks drive block for effortless, drag-free adjustment
- Simple menu-driven setup: Syringe diameter (selected from displayed table), Dispense volume, Dispense flow rate
- Continuous dispense volume display
- Preset volume control and automatic shutoff
- Settings can be reviewed or changed during operation
- Optical encoder stall detection
- Choice of unit selection
- Last settings stored in permanent memory
- Built-in RS-232C interface for computer linking or "daisy chaining" up to 100 pumps.
- TTL interface for foot switch, timer, relay control; outputs for run indicator, valve control.



Multi-Syringe Infusion Pump

SP220i

Ideal for applications requiring multiple syringes, the SP220i is an adaptation of the SP200i and has been modified to hold up to 10 syringes.

- SP220i has all features of SP200i
- The multiple syringe holder accommodates 10 syringes up to 10 mL, or six syringes up to 50 mL, or four syringes up to 140 mL.



Four-Syringe Nanoliter Infusion Pump

SP250i

SP250i SPECIFICATIONS

SP250i	
Mode	Infusion
Syringe Size	10 µL-10 mL (four) (syringes may be different sizes)
Maximum Flow Rate (10 mL syringe)	20.91 mL/min
Minimum Flow Rate	0.001 µL/hr
Linear Force	40 lb (18 kg)
Advance Per Microstep	0.165 micron
Maximum Step Rate	1600 steps/sec
Minimum Step Rate	1 step/100 sec
Accuracy	< 1% error
Reproducibility	± 0.1%
Dimensions	11 x 9 x 6 in. 28 x 23 x 15 cm
Shipping Weight	12 lb (5.4 kg)

Available 95-135 V or 220-240 V, 50/60 Hz

Each syringe can be sized differently and is clamped independently

- Holds four syringes, up to 10 mL each.
- Separate clamping accommodates different sizes.
- Syringes may be positioned independently for sequential dispensing by the pusher block.



SP200i	Syringe Pump, Infusion (double), 95-135 V
SP200iZ	Syringe Pump, Infusion (double), 220-240 V
SP220i	Syringe Pump, Infusion (multiple), 95-135 V
SP220iZ	Syringe Pump, Infusion (multiple), 220-240 V
SP250i	Syringe Pump, Infusion (multiple, mixed volumes), 95-135 V
SP250iZ	Syringe Pump, Infusion (multiple, mixed volumes), 220-240 V

All 240-volt pumps are CE-approved.

###-A	Audible Alarm (add "A" to end of pump part number when ordering)
###-P	Programmable Ramp Option (SP200 Series) (add "P" to pump part number when ordering)

OPTIONAL CABLES

15623	Serial cable and adapter, SP Pump-to-IBM 9-pin "D" connector
15624	Serial cable and adapter, SP Pump-to-Macintosh connector
13685	SP Pump-to-Pump "Daisy-Chain" linking cable, 7 ft
13962	Footswitch for SP200 Series Pumps

SP220i SPECIFICATIONS

SP220i	
Mode	Infusion
Syringe Size	10 µL to 10 mL (ten) 10 µL to 60 mL (six) 10 µL to 140 mL (four)*
Maximum Flow Rate	21 mL/min (10 mL syringe)
Minimum Flow Rate	0.001 µL/hr (10 µL Syringe)
Linear Force	40 lb (18 kg)
Advance Per Microstep	0.165 micron
Maximum Step Rate	1600 steps/sec (1/2-step)
Minimum Step Rate	1 step/100 sec
Accuracy	< 1% error
Reproducibility	± 0.1%
Dimensions	11 x 12 x 5.5 in. 28 x 30 x 14 cm
Shipping Weight	12.5 lb (5.7 kg)

Available 95-135 V or 220-240 V, 50/60 Hz

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Two-Syringe Infusion/Withdrawal Pump

SP210iw

The SP210iw offers you more advanced features than any other infusion/withdrawal pump in its price range—including five operating modes plus independent rate and volume settings for both infusion and withdrawal.

- All features of SP200i
- Independent rate and volume settings for infusion and withdrawal
- Multiple mode selection: infusion, withdrawal, infusion then withdrawal, withdrawal then infusion, or continuous cycle.



SP210iw SPECIFICATIONS

Mode	Infusion/Withdrawal
Syringe Size	10 µL to 140 mL (two)*
Maximum Flow Rate	145 mL/min (140 mL syringe)
Minimum Flow Rate	0.001µL/hr
Linear Force	40 lb (18 kg)
Advance Per Microstep	0.165 micron
Maximum Step Rate	1600 steps/sec
Minimum Step Rate	1 step/100 sec
Accuracy	< 1% error
Reproducibility	± 0.1%
Dimensions	11 x 9 x 5.5 in. 28 x 23 x 14 cm
Shipping Weight	12 lb (5.4 kg)

Available 95-135 V or 220-240 V, 50/60 Hz

Multi-Syringe Infusion/Withdrawal Pump

SP230iw

Ideal for applications requiring multiple syringes, the SP230iw is an adaptation of the SP210iw, and has been modified to hold up to 10 syringes.

- SP230iw has all features of SP210iw
- The multiple syringe holder accommodates 10 syringes up to 10 mL, or six syringes up to 50 mL, or four syringes up to 140 mL.



SP230iw SPECIFICATIONS

	SP230iw
Mode	Infusion/Withdrawal
Syringe Size	10 µL to 10 mL (ten) 10 µL to 60 mL (six) 10 µL to 140 mL (four)*
Maximum Flow Rate	21 mL/min (10 mL syringe)
Minimum Flow Rate	0.001µL/hr (10 µL Syringe)
Linear Force	40 lb (18 kg)
Advance Per Microstep	0.165 micron
Maximum Step Rate	1600 steps/sec (1/2-step)
Minimum Step Rate	1 step/100 sec
Accuracy	< 1% error
Reproducibility	± 0.1%
Dimensions	11 x 12 x 5.5 in. 28 x 30 x 14 cm
Shipping Weight	12.5 lb (5.7 kg)

Available 95-135 V or 220-240 V, 50/60 Hz

SP210iw	Syringe Pump, Infusion & Withdrawal (double), 95-135 V
SP210iwZ	Syringe Pump, Infusion & Withdrawal (double), 220-240 V
SP230iw	Syringe Pump, Infusion & Withdrawal (multiple), 95-135 V
SP230iwZ	Syringe Pump, Infusion & Withdrawal (multiple), 220-240 V

All 240-volt pumps are CE-approved.

####-A	Audible Alarm (add "A" to pump part number when ordering)
####-P	Programmable Ramp Option (SP200 Series)

OPTIONAL CABLES

15623	Serial cable, SP Pump-to-IBM 9-pin "D" connector
15624	Serial cable, SP Pump-to-Macintosh connector
15676	Serial cable, SP Pump-to-IBM 25-pin "D" connector
13685	SP Pump-to-Pump "Daisy-Chain" linking cable, 7 ft
13962	Footswitch for SP200 Series Pumps

Syringes with Luer Fitting (no needle)

WPI Part #	Volume	Description	O.D.
ILS005LT	5 µL	ILS 5 µL Gas-tight Luer tip	6.5 mm
ILS010LT	10 µL	ILS 10 µL Gas-tight Luer-tip	6.5 mm
ILS025TLL	25 µL	ILS 25 µL Gas-tight Luer tip*	8.0 mm
ILS050TLL	50 µL	ILS 50 µL Gas-tight Teflon Luer Lock*	8.0 mm
ILS100TLL	100 µL	ILS 100 µL Gas-tight Teflon Luer Lock*	8.0 mm
ILS250TLL	250 µL	ILS 250 µL Gas-tight Teflon Luer Lock*	8.0 mm
ILS500TLL	500 µL	ILS 500 µL Gas-tight Teflon Luer Lock*	8.0 mm
300035		6/32 stability button for SP200 Series pumps	

*Has 6/32 button thread. The 6/32 stability button allows the SP series pumps to drive the syringe plunger in a precise direction to minimize variations in the syringe body/plunger offset.

ILS is a trademark of Innovative Labor Systeme.

Prices shown are in U.S. dollars. Actual charges will vary because of import duty, freight, and currency fluctuations. To obtain an exact quotation, contact your WPI office.

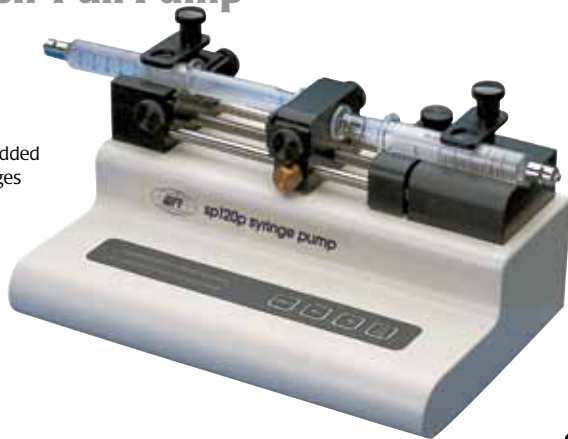
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Two-Syringe Push-Pull Pump

SP120p

A second syringe mount has been added to the basic SP100i, with both syringes activated by a single pusher block for simultaneous infusion and withdrawal. This pump has all the features of the SP100i, plus:

- Holds two syringes, from 10 μ L to 10 mL.



CE

SP120p SPECIFICATIONS

Mode	Infusion/Withdrawal
Syringe Size	10 μ L to 10 mL (two)
Maximum Flow Rate (10 mL syringe)	125 mL/hr
Minimum Flow Rate (10 μ L Syringe)	0.1 μ L/hr
Linear Force	20 lb (9 kg)
Advance Per Microstep	0.529 micron
Maximum Step Rate (1/2-step)	400 steps/sec
Minimum Step Rate	1 step/30 sec
Accuracy	< 1% error
Reproducibility	\pm 0.1%
Dimensions	9 x 6 x 5.5 in. 23 x 15 x 14 cm
Shipping Weight	8 lb (3.6 kg)

Available 95-135 V or 220-240 V, 50/60 Hz

Four-Syringe Push-Pull Pump

SP260p single cycle

The SP260p can hold up to four syringes. As two syringes are infusing, two other syringes are withdrawing at the same rate. The **SP260p** is used for single-cycle applications only.

- Knob locks/unlocks drive block for effortless, drag-free adjustment
- Simple menu-driven setup: Syringe diameter (selected from displayed table), Dispense volume, Dispense flow rate
- Continuous dispense volume display
- Preset volume control and automatic shutoff
- Settings can be reviewed or changed during operation
- Optical encoder stall detection
- Choice of unit selection
- Last settings stored in permanent memory
- Built-in RS-232C interface for computer linking or "daisy chaining" up to 100 pumps.
- TTL interface for foot switch, timer, relay control; outputs for run indicator, valve control



CE

Continuous Cycle Syringe Pump

SP210c

The SP210c can hold up to four syringes and can cycle continuously back and forth in a push-pull

action. As two syringes are infusing, two other syringes are withdrawing at the same rate. At the end of the set volume the direction is automatically reversed and the next cycle begins. With the use of 2-way valves, the pump can empty and refill syringes for a continuous dispense.

- Holds four syringes, 10 mL to 60 mL each. With larger syringes the full volume may not be usable. [With a 60 mL syringe, 40 mL is usable; with a 30 mL syringe, the full volume is usable.]



CE

SP260p & SP210c SPECIFICATIONS

Mode	SP260p	Push-Pull (single cycle)
	SP210c	Infusion/Withdrawal (continuous)
Syringe Size	SP260p	10 μ L-60 mL (four)
	SP210c	10 μ L-60 mL (four)
Maximum Flow Rate	SP260p	86 mL/min (60 mL syringe)
	SP210c	86 mL/min (60 mL syringe)
Minimum Flow Rate	0.001 μ L/hr	
Linear Force	40 lb (18 kg)	
Advance Per Microstep	0.165 micron	
Maximum Step Rate	1600 steps/sec	
Minimum Step Rate	1 step/100 sec	
Accuracy	< 1% error	
Reproducibility	\pm 0.1%	
Dimensions	11 x 9 x 5.5 in. 28 x 23 x 14 cm	
Shipping Weight	12 lb (5.4 kg)	

Available 95-135 V or 220-240 V, 50/60 Hz

SP120p	Syringe Pump, Infusion-Withdrawal (double), 95-135 V
SP120pZ	Syringe Pump, Infusion-Withdrawal (double), 220-240 V
SP260p	Syringe Pump, Infusion-Withdrawal (double) Single Cycle Action, 95-135 V
SP260pZ	Syringe Pump, Infusion-Withdrawal (double) Single Cycle Action, 220-240 V
SP210c	Syringe Pump, Infusion & Withdrawl (Continuous Action), 95-135 V
SP210cZ	Syringe Pump, Infusion & Withdrawl (Continuous Action), 220-240 V

All 240-volt pumps are CE-approved.

###-A	Audible Alarm (add "A" to pump part number when ordering)
###-P	Programmable Ramp Option (SP200 Series) (add "P" to end of pump part number when ordering)

OPTIONAL CABLES

15623	Serial cable and adapter, SP Pump-to-IBM 9-pin "D" connector
15624	Serial cable and adapter, SP Pump-to-Macintosh connector
13685	SP Pump-to-Pump "Daisy-Chain" linking cable, 7 ft
13962	Footswitch for SP200 Series Pumps

Prices shown are in U.S. dollars. Actual charges will vary because of import duty, freight, and currency fluctuations. To obtain an exact quotation, contact your WPI office.

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UltraMicroPump III

Three prong
syringe holder for
more stability

Micro syringes are easily installed –
just snap the barrel into the clamps.
UMP3 accepts a range of syringes from
0.5 μ L to 1 mL.

Now with
microstepping

Controller now has higher resolution
and is virtually pulse-free

This versatile injector uses microsyringes to deliver picoliter volumes

Perfect for a wide range of applications including intracellular injection, micro delivery of biochemical agents or dyes, cell separation, and in vitro fertilization.

See "Reproducible and Efficient Murine CNS Gene Delivery Using a Microprocessor Controlled Injector," A.I. Brooks et al., *Journal of Neuroscience Methods*, 80 (1998) 137-147.

ULTRAMICROPUMP SPECIFICATIONS

(based on 10 μ L syringe)

NORMAL MODE

TOTAL # OF STEPS	20,000 (63 mm travel)
MINIMUM DISPENSING VOLUME	0.58 nL/step
LINEAR MOTION PER STEP	3.175 microns
WEIGHT	325 g (11.5 oz)
MOUNTING ROD DIAMETERS	7.9 mm (0.31 in.)
MAINS POWER SUPPLY	90-264VAC @ 47-63Hz
DIMENSIONS	\varnothing 32 mm x 190 mm (\varnothing 1.3 in. x 7.5 in.)

MICROSTEPPING MODE

Precision is increased eight fold

Prices shown are in U.S. dollars. Actual charges will vary because of import duty, freight, and currency fluctuations. To obtain an exact quotation, contact your WPI office.

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The world's leading ultramicropump!

With its digital controller, **UltraMicroPump III** can dispense as little as 600 picoliters per incremental advance of the syringe piston (using a 5- μ L syringe). Syringes may be filled externally and then inserted into the pump or filled while mounted in the pump. Fluids injected or withdrawn are held entirely within the micro syringe to maintain a low fluid dead volume.



For positioning, the **UltraMicroPump III** may be attached to any of several WPI micro-positioners such as the **M3301** (manual), **DC3001** (motorized), or any manual stereotaxic manipulator.

UMPIII shown mounted to stereotaxic frame (not included).

Smart Controller

An Integral component in the **UMPIII** system is a microprocessor-based controller, **SYS-Micro4**, which provides an "intelligent" and easy-to-use interface to up to four syringe pumps. Operating parameters are set with the membrane keypad and LCD display. From the keypad the user can select the following functions: set pump to infusion or withdrawal mode, enter the volume to be infused or withdrawn, rate of delivery, and syringe type as well as synchronize the starting and stopping of any combination of syringe pumps.

User parameters can be stored in the device's "non-volatile" memory for instant recall when the unit is powered on.

An optional footswitch can be plugged into a connector on the rear of the controller for "hands free" start/-stop operation.

Computer Control—An **RS-232 port** on the rear of the controller can be used to connect it to a computer for use with computer control programs.

UMPIII ACCEPTS: glass syringes with barrel diameters from 5.5 to 9 mm.

UMP3-1	UltraMicroPump III (one) and Micro4 Controller
UMP3-2	UltraMicroPump III (two) and Micro4 Controller
UMP3-3	UltraMicroPump III (three) and Micro4 Controller
UMP3-4	UltraMicroPump III (four) and Micro4 Controller
UMP3	UltraMicroPump III (without controller)
SYS-MICRO4	Micro4 Controller, Four-Channel

OPTIONS AND ACCESSORIES

15867	Footswitch for Micro4
40500	RS-232 Cable, 9-pin "D" connector
502201	V-clamp for Stereotaxic Frame
503301	Extension Cable, miniDIN (male-female) 8 ft

Microvolume Syringes

Syringes with Luer Fitting (no needle)

WPI P/N	Volume	Description	O.D.	UMP2	UMP1
ILS005LT	5 μ L	ILS 5 μ L Gas-tight Luer tip	6.5 mm	Y	N
ILS010LT	10 μ L	ILS 10 μ L Gas-tight Luer tip	6.5 mm	Y	N
ILS025LT	25 μ L	ILS 25 μ L Gas-tight Luer tip	8.0 mm	Y	N
SGE050TLL	50 μ L	SGE 50 μ L Gas-tight Teflon Luer Lock	8.0 mm	Y	Y
SGE100TLL	100 μ L	SGE 100 μ L Gas-tight Teflon Luer Lock	8.0 mm	Y	Y
SGE250TLL	250 μ L	SGE 250 μ L Gas-tight Teflon Luer Lock	8.0 mm	N	N

Syringes with Replaceable Beveled Needles

WPI P/N	Volume	Description	O.D.	UMP2	UMP1
SGE0005RN*	0.5 μ L	SGE 0.5 μ L 23 ga (0.63 mm) 70 mm long	8.0 mm	Y	Y
SGE001RN*	1.0 μ L	SGE 1.0 μ L 26 ga (0.47 mm) 70 mm long	8.0 mm	Y	Y
SGE005RN	5 μ L	SGE 5 μ L 23 ga (0.63 mm) 50 mm long	8.0 mm	Y	Y
SGE010RNS	10 μ L	SGE 10 μ L 26 ga (0.47 mm) 50 mm long	8.0 mm	Y	Y
SGE025RN	25 μ L	SGE 25 μ L 25 ga (0.50 mm) 50 mm long	8.0 mm	Y	Y
SGE050RN	50 μ L	SGE 50 μ L 25 ga (0.50 mm) 50 mm long	8.0 mm	Y	Y
SGE100RN	100 μ L	SGE 100 μ L 25 ga (0.50 mm) 50 mm long	8.0 mm	Y	Y

* The plunger extends to the tip of the needle, displacing the full sample during injection - which gives the syringe zero dead volume.

The barrel length of this syringe is 17 cm long vs. the usual 8-9 cm.

SGE and ILS are respective trademarks of Scientific Glass Engineering and Innovative Labor Systeme.

Replacement Needles

RN0005	For syringe SGE0005RN, 23 ga (0.63 mm) 70 mm long
RN001	For syringe SGE001RN, 26 ga (0.47 mm) 70 mm long
RN005	For syringe SGE005RN, 23 ga (0.63 mm) 50 mm long
RN010	For syringe SGE010RN(S), 26 ga (0.47 mm) 50 mm long, 5-pack
RN025	For syringes SGE025RN, SGE050RN, SGE0100RN, 26 ga (0.47 mm) 50 mm long, 5-pack



PUMPS, MICROINJECTION

Prices shown are in U.S. dollars. Actual charges will vary because of import duty, freight, and currency fluctuations. To obtain an exact quotation, contact your WPI office.

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Eagle™ Adjustable Pipetters

Comfortable ergonomic design.
Lasts 20 times Longer.

- Superior WPI seals give reliable and accurate experimental results.
- Calibration interval can be significantly increased.

- Priced so affordably that everyone in the lab can have a set.
- Customize your set by selecting only the pipetters you need.



**Buy any set of 5 or 6
and get one free!**

Sets ES5, ES6, and ES7 include your selection of pipetters, along with a stand (#14239) for convenient storage. Simply specify the pipetters you want by including the letter designation from the chart on the right. For example, ES5-AABCD would include two E2s and one each E10, E20 and E100.

ES5	Pipetters (set of any 5) and Stand	US\$569
ES6	Pipetters (set of any 6) and Stand	US\$661
ES7	Pipetters (set of any 7) and Stand	US\$748
500801	Filters for E5000 (5-pack)	US\$17

STORAGE

500876	6 Pipetter Rack Stand	US\$40
500877	Pette-Clamp, 3/pkg	US\$40
14239	Original Pipetter Stand	US\$91

Replacement parts

Replacement parts for the Eagle Pipetters are available from our website at www.wpiinc.com or call us for details.

	Model	Volume Range	Price
A	E2	0.2 - 2.0 µL	US\$114
B	E10	0.5 - 10 µL	US\$114
C	E20	2 - 20 µL	US\$114
D	E100	20 - 100 µL	US\$114
E	E200	50 - 200 µL	US\$114
F	E1000	100 - 1000 µL	US\$114
G	E5000	1000 - 5000 µL	US\$114

Prices shown are in U.S. dollars. Actual charges will vary because of import duty, freight, and currency fluctuations. To obtain an exact quotation, contact your WPI office.

Same as leading brands
- at about half the price!



Universal Pipette Tips

Ultra-clear and certified RNase/DNase-free

Universal Tips

Tip Volume	For Pipetter	Bulk	Part No.	Price	Rack	Part No.	Price
0.1 - 10 µL	Eagle E2 Eagle E10 Eagle E20	Bag of 1000	500191	US\$17	960 (10 racks of 96)	500192	US\$35
5 - 200 µL	Eagle E20 Eagle E100 Eagle E200	Bag of 1000	500193	US\$17	960 (10 racks of 96)	500194	US\$35
100 - 1000 µL	Eagle E1000	Bag of 1000	500195	US\$20	1000 (10 racks of 100)	500196	US\$40
500 - 5000 µL	Eagle E5000	Bag of 250	500197*	US\$17	500 (10 racks of 50)	500198*	US\$63

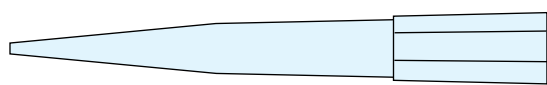
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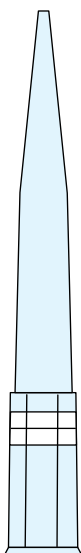
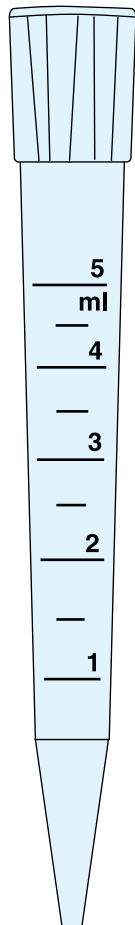
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500193, 500194



500195, 500196



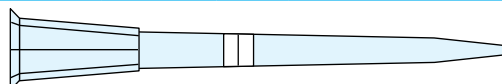
500201

Universal Filter Tips (sterile)

Tip Volume	For Pipetter	Bulk	Part No.	Price	Rack	Part No.	Price
0.1 - 10 µL	Eagle E2 Eagle E10 Eagle E20				960 (10 racks of 96)	500199	US\$69
10 - 200 µL	Eagle E20 Eagle E100 Eagle E200				960 (10 racks of 96)	500200	US\$75
100 - 1000 µL	Eagle E1000				1000 (10 racks of 100)	500201	US\$75



500199



500200

Universal Gel Loader Tips (flexible)

Tip Volume	For Pipetter	Bulk	Part No.	Price	Rack	Part No.	Price
0.1 - 10 µL (Flat) 0.17 mm OD	Eagle E2 Eagle E10 Eagle E20				200	500202	US\$46
0.1 - 10 µL (Flat) 0.37 mm OD	Eagle E2 Eagle E10 Eagle E20				200	500203	US\$46
0.1 - 10 µL (Round) 0.57 mm OD	Eagle E2 Eagle E10 Eagle E20				200	500204	US\$23
0.5 - 200 µL (Round) 0.57 mm OD	Eagle E20 Eagle E100 Eagle E200	Bag of 1000	500205	US\$35	200	500206	US\$23
0.5 - 200 µL (Flat) 0.37 mm OD	Eagle E20 Eagle E100 Eagle E200				200	500207	US\$46



500202



500203



500204



500205
500206



500207

WPI's Universal Pipette Tips are for use with Eagle and most other pipettors, including Gilson, Oxford Benchmate, Socorex, and SealPette.

* Tips 500197 and 500198 fit Eagle, Eppendorf, and BioHit pipettors.

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Pneumatic PicoPumps

Repeatable microinjection in volumes ranging from picoliters to nanoliters

Designed to simplify intracellular injection and a variety of other microinjection tasks, WPI's PicoPumps use carefully regulated air pressures for securing cells and injecting them with fluid. Injected volumes range from picoliters to nanoliters. Separate ports supply positive and negative pressure—positive pressure for high-pressure ejection, and suction for supporting the cell or for filling the pipette from the tip. A second pressure port maintains a low positive "holding" pressure to the injecting pipette between injection pulses, to prevent fluid uptake through capillary action or diffusion. Timing, ejection pressure, holding pressure, and suction

are adjusted independently by control knobs and indicator gauges on the front panel. Injection pressure is controlled by a 20-turn regulator on the front panel. A built-in timing circuit allows precise control of the amount of time that the injection pressure is applied to the output port. Time intervals can range from 10 seconds down to 10 ms or less, depending on the eject pressure setting. The injection pressure interval can be triggered manually on the front panel, by footswitch, or by computer controlled TTL pulse. A 5-volt monitor output provides a logic-level pulse for your computer or other monitoring device.

The most recognized picopump in the world!



For a complete list of pre-pulled micropipettes, see μ Tips™, or call us with your special requirements.

PV830 — Eject pressure, Hold pressure, and Vacuum are all available, controlled by separate regulators on the front panel. Eject pressure supplies a high-pressure pulse for injecting fluid. Hold pressure, which is not sufficient to cause fluid ejection, is used to prevent back filling of the pipette by capillary action or diffusion when the solenoid is inactive. Pressure in the injection pipette is automatically switched between Eject

and Hold pressure by a precision timing circuit that controls a solenoid valve. Vacuum is used to fill pipettes from the tip or to secure a floating cell during microinjection. Vacuum is regulated the same way, by a 20-turn knob on the front panel. Vacuum may be switched from regulated vacuum to atmosphere by using the pneumatic toggle on the front panel. Vacuum can also be routed to the eject port.



New PicoNozzle Kit 5430-ALL (included) allows micropipettes to be securely mounted in micropositioners for stable axial air delivery. Because air enters the pipette axially, lateral whipping during injection is eliminated.

Each PicoPump is supplied with two PicoNozzle Kits (5430-ALL) plus tubing to connect the holders to the pressure and vacuum ports.

SYS-PV820 PicoPump w/ hold pressure

SYS-PV830 PicoPump w/ hold pressure and vacuum

Specify line voltage All PicoPumps require external vacuum source — see below.

OPTIONAL ACCESSORIES

3260	Foot Switch
2932	Rack Mount Kit, 3½-in. high (PV820)
2933	Rack Mount Kit, 5¼-in. high (PV830)
5430-10	PicoNozzle Kit (MPH6S for 1.0 mm pipette & 5-ft tubing assembly)
5430-12	PicoNozzle Kit (MPH6S for 1.2 mm pipette & 5-ft tubing assembly)
5430-15	PicoNozzle Kit (MPH6S for 1.5 mm pipette & 5-ft tubing assembly)
5430-20	PicoNozzle Kit (MPH6S for 2.0 mm pipette & 5-ft tubing assembly)
5430-ALL	PicoNozzle Kit (for 1.0, 1.2, 1.5, and 1.65 mm pipettes & 5-ft tubing assembly)
MPH6S	Micropipette Holder (specify 1.0, 1.2, 1.5 or 2.0 mm)
MPH6R	Micropipette Holder (specify 1.0, 1.2, 1.5 or 2.0 mm)
3316	Replacement Input Kit

See NanoFil™ — page 260

Prices shown are in U.S. dollars. Actual charges will vary because of import duty, freight, and currency fluctuations. To obtain an exact quotation, contact your WPI office.

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CE

PV820 offers separate regulated Hold and Ejection pressure, used to maintain a low pressure in the pipette between injections to prevent unwanted fluid uptake by capillary action or diffusion. A precision timing circuit switches from Eject pressure to Hold pressure automatically, once

timing has been set. Although regulated vacuum is not provided in this model, suction can be provided by connecting a vacuum source to the vacuum port on the rear panel. Suction is then available through the pressure ports.

PICOPUMP SPECIFICATIONS

PRESSURE

	PV820	PV830
PRESSURE INPUT	0 to 150 psi	0 to 150 psi
PRESSURE OUTPUT	0.3 to 90 psi *	0.3 to 90 psi
LOWEST REGULATED PRESSURE	12 in. water *	12 in. water
REGULATOR ACCURACY	0.1% (20-turn dial) *	0.1% (20-turn dial) *
REGULATOR REPEATABILITY	0.05 psi *	0.05 psi *
GAUGE ACCURACY	3% at full scale *	3% at full scale *
INPUT CONNECTOR	Quick Connect (1/4 in. OD Tubing)	Quick Connect (1/4 in. OD Tubing)
OUTPUT CONNECTOR	Barbed (1/16 in. ID Tubing)	Barbed (1/16 in. ID Tubing)
CONTROL	Solenoid	Solenoid
	* Both Hold and Eject Pressures	* Both Hold and Eject Pressures

VACUUM

	PV820	PV830
VACUUM INPUT	0 to 30.0 in. Hg	0 to 30.0 in. Hg
VACUUM OUTPUT	Unregulated	0.2 to 29.9 in. Hg
LOWEST REGULATED VACUUM	Unregulated	3 in. water
REGULATOR ACCURACY	Unregulated	0.1% (20-turn dial)
REGULATOR REPEATABILITY	Unregulated	0.03 in. Hg
GAUGE ACCURACY	None	3% at full scale
INPUT CONNECTOR	Quick Connect (1/4 in. OD Tubing)	Quick Connect (1/4 in. OD Tubing)
OUTPUT CONNECTOR	Barbed (1/16 in. ID Tubing)	Barbed (1/16 in. ID Tubing)
CONTROL	Manual	Manual
VENT	Atmosphere	Atmosphere

CONNECTIONS INCLUDED

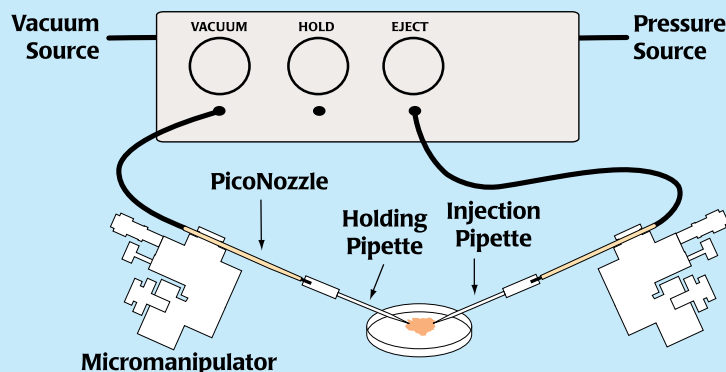
INPUT KIT	10 ft nylon tubing (0.25" OD, 1000 psi), one 1/2" female NPT adapter
OUTPUT KIT	Two PicoNozzle assemblies, each consisting of one MPH6S pipette holder, 60-in. of PVC tubing (200 psi), and a luer-fitted aluminum handle.

PHYSICAL SPECIFICATIONS

POWER	95-135 V or 220-240 V, 50/60 Hz	95-135 V or 220-240 V, 50/60 Hz
DIMENSIONS	17 x 3.5 x 9.5 in. (43 x 9 x 24 cm)	17 x 5.25 x 9.5 in. (43 x 13 x 24 cm)
SHIPPING WEIGHT	11 lb (5 kg)	14 lb (6.3 kg)

Application Example:

Using PV830 for holding and injection of cells



Pressure Manometers
—see page 259

Luer-to-Tubing Coupler Assortment Kits
—see page 184



Prices shown are in U.S. dollars. Actual charges will vary because of import duty, freight, and currency fluctuations. To obtain an exact quotation, contact your WPI office.

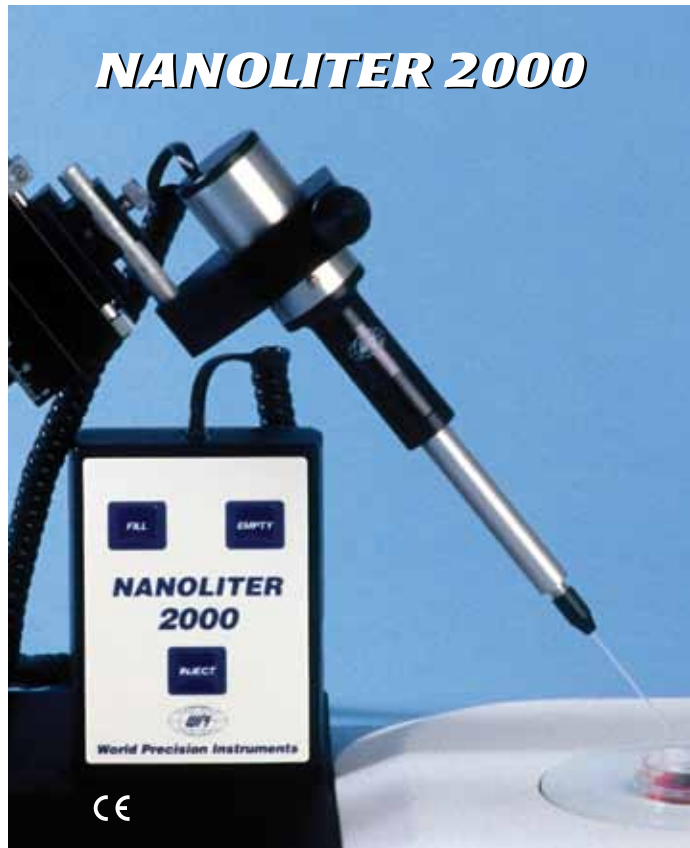
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257

Nanoliter Injector

For oocyte injection and applications in the 2 to 70 nanoliter range

NANOLITER 2000



Micromanipulator not included.



Shaft diam.
8.2 mm

Adapter #500778 (included free) extends the "reach" of a manipulator-mounted injector.

WPI's microprocessor-controlled **Nanoliter 2000** uses direct piston displacement. By either pushing the injection button on the control box or pressing on the optional footswitch, a calibrated volume will be smoothly injected. The process is quiet and vibration free. Capillary filling and injection speeds are 23 nL/sec and 46 nL/sec (emptying speeds are 92 nL/sec and 230 nL/sec). Maximum fluid ejection is 5 µL. Each unit comes with sufficient glass to pull at least 300 tips. Glass is 1.14 mm O.D. (nominal) and 0.5-mm I.D.

By setting the DIP switch, the

injection volume can be changed from 2.3 to 69.0 nL in 16 steps. Up to 100 injections may be triggered per filling. Since the volume of a normal *Xenopus* oocyte is about 500 nL, the instrument has the capability to inject from less than 1% to over 10% of the total volume of the oocyte in one preset step increment.

Included: 1 vial 3.5 in. capillaries (100); 1 vial 7 in. capillaries (100); replacement "O" rings; Allen wrench; MicroFil™ MF34G backfilling needle; and two sample µTip™ pre-pulled micropipettes.

Smart Controller: Micro4, an optional microprocessor-based controller, can provide an "intelligent" and easy-to-use interface to up to four Nanoliter Injectors. Operating parameters are set with the membrane keypad and LCD display. From the keypad the user can set pump to infusion or withdrawal mode, enter the volume to be infused or withdrawn, and rate of delivery, as well as synchronize the starting and stopping of a combination of Injectors. User parameters can be stored in the device's "non-volatile" memory for instant recall when the unit is powered on. An optional footswitch can be plugged into a connector on the rear of the controller for "hands free" start/stop operation. An **RS-232 port** on the rear of the controller can be used to connect it to a computer for use with computer control programs.



Optional smart controller for Nanoliter 2000 (order as B203MC4)

NANOLITER 2000 SPECIFICATIONS

INJECTION VOLUME	Variable
REMOTE CONTROL	Yes
GLASS OD	1.14 mm
GLASS ID	0.5 mm
STEP	12.7 µ/step
INJECTION SPEED	
Slow	23 nL/sec
Fast	46 nL/sec
FILL SPEED	
Slow	23 nL/sec
Fast	46 nL/sec
EMPTY SPEED	92 nL/sec
VARIABLE VOLUME RANGE	2.3 - 69.0 nL
SMALLEST VOLUME	2.3 nL
TO CHANGE VOLUME	Set switch
INJECTIONS PER FILLING, MAX.	100 injections
SHIPPING WEIGHT	3 lb. (1.1 kg)

WPI recommends the following equipment for a complete system: **PZMIII** stereo microscope • **MMJ** joystick micromanipulator • **M10** magnetic base • **µTip™** micropipettes.

B203XVY	Nanoliter 2000 (120 V, U.S. plug)
B203XVZ	Nanoliter 2000 (240 V, Continental plug)
B203XVB	Nanoliter 2000 (240 V, British plug)
B203MC4	Nanoliter Injector & Micro4 Controller (<i>small controller not included</i>)

OPTIONAL ACCESSORIES

13142	Footswitch for Nanoliter 2000
15867	Footswitch for Micro4 Controller
4878	Replacement 3.5-in. glass capillaries (300)
4879	Replacement 7-in. glass capillaries (300)
TIP10XV119	Micropipettes for Nanoliter Injector (10)
SYS-MICRO4	Micro4 Controller, Four-Channel
300033	Adapter for Micro4
5340	Spare Parts Kit (<i>includes MicroFil™ MF34G, displacement piston, five O-ring sets</i>)
500778	Replacement Nanoliter Injector Universal Adapter
502859	Flared O-Ring Kit
500299	Pistons, 5-pack
503066	Flared Glass, 100 pieces

Prices shown are in U.S. dollars. Actual charges will vary because of import duty, freight, and currency fluctuations. To obtain an exact quotation, contact your WPI office.

Manual Microsyringe Pump

The **MMP** and **DMP** are convenient tools for precise manual injection of fluid using glass pipettes or similar injection devices. The design allows visual feedback of flow at the pipette tip. They can also be used as a manual micro syringe pump for perfusion or withdrawal of liquids. The resolution of the injection volume can be continuously varied from 10 nanoliters to the microliter range, depending on the syringe used. Either oil or air can be used as the transfer media to assist the injection of fluid. The DMP comes with an exclusive digital micrometer that will allow the reading of piston advancement easily with a 0.001-millimeter resolution. The optional software and cable kit can transmit advancement data directly into computer. Model MMP has the traditional mechanical micrometer head with a resolution of 10 microns per division and advances 500 micrometers per revolution. The entire frame body of the injector is constructed with polished



solid stainless steel frame

stainless steel for excellent stability and durability. The piston of the micrometer can be slid across the rail to the syringe's plunger position. Small diameter PTFE tubing is used to improve the accuracy and solution compatibility. The unique design of the pipette holder can securely hold any pipette with an outer diameter of between 1.0 mm and 1.5 mm. All necessary accessories for removing air and filling the syringe and tubing with liquid are included. The system comes complete with a 100 μ L gas tight syringe and other syringe sizes can be purchased.

DMP & MMP SPECIFICATIONS

Travel Distance	25 mm
Advances Resolution	0.001 mm for DMP and 0.01 mm for MMP
Syringe Size	10 μ L to 1 mL gas tight luer tip syringe
Tubing	1.5 m of PTFE tubing with 0.5 mm ID
Pipette Holder	0.24" x 5.2"
Pipette Holder Fits	1.0 to 1.5 mm OD pipette

MMP	Manual Microsyringe Pump
DMP	Manual Microsyringe Pump with Digital Display
ACCESSORIES	
MMP-KIT	Injection Assembly Parts Kit <i>Not including valve—see #14057-10, page 161</i>

Pressure Manometer

For measuring hydrostatic pressures



Hand-held and battery operated, PM Series pressure manometers monitor vacuum and pressure in nonaqueous fluids. An integral transducer and digital display allow easy and accurate pressure readings. Three versions measure pressures in the range of ± 1 psi, ± 15 psi or ± 100 psi. A range switch allows measurement in units of psi or kPa for the 100 psi version, and psi or mm

Hg for the 15 psi version. Pressure can be read on the built-in LCD display or relayed to a chart recorder, oscilloscope, or computer.

PM Series pressure manometers come with 4 feet of $\frac{1}{8}$ -inch ID soft vinyl tubing. A mini-phone-to-BNC cable for the recorder output is also available (Part #CBL102). Standard versions are equipped with a nine-volt alkaline battery.

SYS-PM01D	Pressure Manometer (1 psi)
SYS-PM01R	Pressure Manometer (1 psi), Rechargeable*
SYS-PM015D	Pressure Manometer (15 psi)
SYS-PM015R	Pressure Manometer (15 psi), Rechargeable*
SYS-PM100D	Pressure Manometer (100 psi)
SYS-PM100R	Pressure Manometer (100 psi), Rechargeable*
CBL102	Mini-Phone-to-BNC Cable

Specify line voltage

*Rechargeable versions come with nickel/cadmium battery and charger

PRESSURE MANOMETER SPECIFICATIONS

	PM01	PM015	PM100
PRESSURE RANGES	± 1 psi (± 52 mm Hg)	± 15 psi (± 775 mm Hg)	± 100 psi (± 690 kPa)
MAX. PRESSURE	20 psi (1035 mm Hg)	30 psi (1550 mm Hg)	150 psi (1035 kPa)
RESOLUTION	0.001 psi (0.1 mm Hg)	0.01 psi (1 mm Hg)	0.1 psi (1 kPa)
OUTPUT	1 V/psi	100 mV/psi	10 mV/psi
OUTPUT RANGE	± 1.0 V	± 1.5 V	± 1.0 V
LINEARITY	0.5% full-scale		
TEMPERATURE EFFECT	1.0% full-scale (0-70°C)		
ZERO	Screwdriver-adjust		
RESPONSE TIME	30 ms		
POWER	Nine-volt battery		
BATTERY LIFE	Alkaline, 200 hours; rechargeable, 25 hours		
RECORDER OUTPUT	Mini-phone jack, 0.141 inch (3.5 mm)		
OUTPUT IMPEDANCE	1 k Ω		
PNEUMATIC CONNECTORS	Barbed, for $\frac{1}{8}$ -inch or $\frac{3}{16}$ -inch ID soft tubing		
DIMENSIONS	3 x 6 x 1 inches (8 x 15 x 4 cm)		
SHIPPING WEIGHT	3 lb (1.4 kg)		

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- **The world's smallest dead volume injection syringe**
- **Comes with various needle sizes from 26 ga. to 36 ga.**
- **Versatile research applications – RPE and IO Kits**
- **Custom needle shapes available – blunt, sharp, beveled**
- **Compatible with WPI's UMP3 and PV800 series microinjection systems**

NanoFil is a specially designed 10 microliter syringe developed in response to customer requests for improved microinjection in mice and other small animals. It makes quantitative nanoliter injection much easier and more accurate than any other method currently in use.

NanoFil's low dead volume eliminates the need for oil backfilling, a messy process which risks contamination of the injected sample. Injection is now simpler, and less messy, and there is no possibility of oil contamination in critical applications such as ophthalmology research (see the Retinal Pigment Epithelial (RPE) and Intra Ocular (IO) injection kits listed below).

When the inner tip diameter of a conventional syringe is reduced to less than 100 micron, it is very difficult to backfill the solution at a reasonable speed. NanoFil solves this problem by using a tip coupling mechanism that makes it possible to *change the syringe tip during the experiment*. Simply load the sample using a larger tip, such as the 26 gauge needle

provided with the syringe, and then replace it with a micro tip for sample injection. On a conventional 10 microliter syringe, a solid ring or bushing is permanently bonded to the tubing. Replacing the tip in middle of the experiment is not practical. With the NanoFil, tips can be exchanged by a simple twist of the brass lock, gently pulling out the tip, and replacing with the desired new tip. To secure the tip, NanoFil uses an olive shaped silicon gasket that is similar to, but much sturdier than, some of the microelectrode holders used for electro physiology recording. The silicone gasket makes it possible to hold not only metal tips but also glass and quartz tubing. Many types of

tubing can be easily connected to the syringe as long as the outer diameter (OD) is close to, but not more than, the inner diameter (ID) of the inside barrel. Flexible quartz capillaries used in Gas Chromatography (GC) and Capillary Electrophoresis (CE) can also be easily coupled to the syringe.

Specially designed tips as small as 36 gauge (110 micron OD) are offered in both blunt and beveled styles. Our studies have shown that these tips will cause less trauma to the tissue than any other form of micro syringe currently in use. NanoFil has a unique coupling mechanism that allows many different forms of small tubing and tips to be coupled with the syringe barrel.

NANOFIL	NanoFil Syringe, 10 microliter
NANOFIL-100	NanoFil Syringe, 100 microliter

NanoFil syringe does not contain any injection tips, those must be purchased separately. It does include a 26 gauge beveled needle for backfilling.

REPLACEMENT BACKFILL NEEDLES	
NF26BV-2	26G Beveled Needle (package of 2)

Using NanoFil in different configurations

Direct injection by hand: This is the simplest and most economical way to inject. Any of our tips can be inserted directly into the NanoFil syringe. Even the SilFlex tubing can be inserted to switch from hand injection to the other methods listed below. The limitation of this method is the difficulty achieving sub microliter resolution.

Installed on WPI's UMP-III microsyringe pump: This will allow the user to achieve nanoliter resolution and reproducibility. For neural system injection, mount the UMPII on a stereotaxic frame.

SilFlex tubing and holder: The needle is mounted on a small plastic holder that is connected to the NanoFil by a 35 cm length of flexible tubing. The NanoFil is mounted on the UMP II pump. This configuration allows the user to hold the animal in one hand and insert the needle with the other. When the needle reaches the desired location, activate the pump using the footswitch and the pre-programmed injection volume will be delivered. This configuration gives a nanoliter level of accuracy and reproducibility. It is best suited for applications such as the RPE and IO injection.

Selecting the correct tip for your application

The replaceable needles used with the NanoFil are available with either blunt or beveled tips. The blunt tip is used for injection into soft tissue and when a uniform solution distribution is needed. The beveled style is used for applications that involve the penetration of a tough tissue.

One of the main factors that limit the resolution and accuracy of conventional micro syringes to the upper tens of nanoliters range is diffusion in the large tip ID. When the tip ID is equal or larger than 100 micron, the error caused by tip diffusion is in the nanoliter range level ((100 micron)³ = 1 nanoliter). With a 36 gauge needle installed on the NanoFil, the error caused by diffusion will be reduced to the sub nanoliter level, making accurate injection of a nanoliter possible.

All of WPI's beveled tips have a unique 25 degree tri-surface bevel that is optimized for microinjection. A 10 degree single-surface beveled tip penetrates better than one with a 25 degree angle, however the distance between the upper opening to the tip (see section "F" in Fig. 2) is longer. As a result, it requires a deeper penetration of the tip to achieve the same level of liquid delivery. Deeper penetration means more tissue damage. WPI's unique 25 degree beveled tip solves this problem with two extra beveled surfaces. The tip of a single surface beveled tip is actually a blade instead of a point. It dulls very quickly. In contrast, the tri-surfaced tip has a real point. It not only penetrates much better but is also much more durable. Our tests show that our 33 gauge, 25 degree beveled tip penetrates easier and lasts longer than other manufacturer's 33 gauge, 10 degree single beveled tips. With a 35 gauge tri-surface beveled tip,

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the resistance to the penetration becomes even less. Each of our tips undergo a penetration test before leaving the factory to guarantee the best results for our customers.

Available Tips

33 gauge: This tip is similar to Hamilton's 7762 and 7803 series removable needles in both tip length and outer diameter. However, our beveled tip version is shorter, more durable, and penetrates better due to the special tri-surface grinding technique. In the past, 33 gauge tips were the smallest size sold by other manufacturers and were frequently cited in literature. However, our new 35 gauge tip is much better for injections involving small animals, especially mice. Compared with Hamilton's 33 gauge, 10 degree beveled tip, our 35 gauge 25 degree beveled tip can reduce the depth of penetration by almost 80%. The distance between the tip and the upper rim of the opening (section F on Figure 2) is 1024 microns for the 33 gauge tip. The distance for our 35 gauge tip is only 230 microns. In addition, the smaller tip size significantly reduces the required penetration force. In nearly all applications, a 33 gauge tip can be replaced with our 35 gauge tip and produce better results.

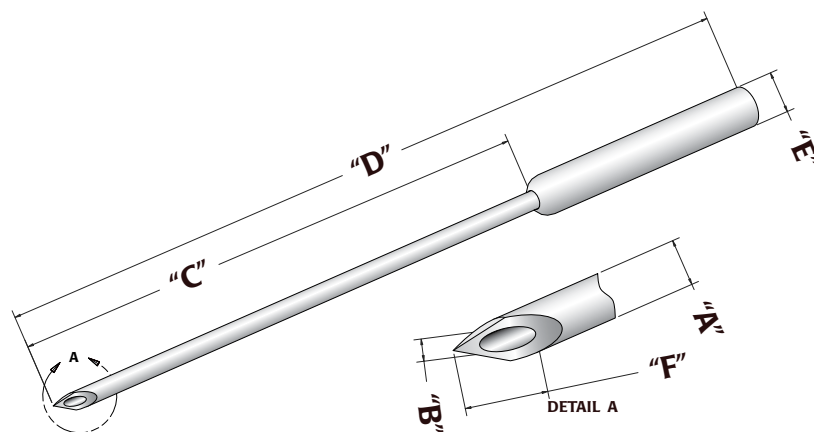
34 gauge: This is a transitional size between the 33 gauge and 35 gauge. If the 35 gauge is too weak and the 33 gauge is too large, this makes a good alternative.

35 gauge: This was the most popular and preferred tip of most scientists during our field trial. The combination of its strength, length, durability, and clogging resistance creates a balance with very little compromising of the individual properties. It is much smaller than the 33 gauge tip offered by other manufacturers. It is only slightly larger than the 36 gauge tip but is much stronger and less likely to be clogged. Samples can be directly loaded with this tip. Its 5 mm length is sufficient enough for almost all injection applications in mice.

36 gauge: This is the smallest tip that is commercially available. The tip is so small that it can be inserted into the opening of the 33 gauge needle tip. Because this is pushing the limits of what current technology can produce, there are some limitations to consider before using. Its thin diameter makes it necessary to limit its length to 2.5 to 3.0 mm and still maintain a usable strength. Since the tip ID is in the 25 to 50 micron range, it is very easily clogged. Therefore, only well filtered solutions can be used. Depending on the viscosity of the sample, the user might also need to pre-load the syringe with a regular tip before switching to this tip for injection. We recommend using the 35 gauge tip instead of the 36 gauge unless it is absolutely necessary.

Flexifil: The Flexifil tip is made of a titanium alloy. The advantage of this tubing is its durability. This "semi-flexible" tip can be bent up to 90 degrees without damage. It is also much more corrosion resistant than the stainless steel tip. Saline solutions left in the tip will be less likely to clog it. Although this tip is specified as a 33 gauge tip, its outer diameter is slightly smaller than our 33 gauge stainless steel tip.

Flexible Quartz Tubing: The flexible quartz



Tip Order Number	Tip O.D. "A"	Tip I.D. "B"	Tip Length "C"	Total Length "D"	Shank O.D. "E"	Bevel Length "F"	Total Dead Volume	Tip Material
NF33BV-2	210 µm	115 µm	10.0 mm	40.0 mm	460 µm	≈348 µm	1.47 nL	Stainless Steel
NF34BV-2	185 µm	85 µm	5.0 mm	35.0 mm	460 µm	≈290 µm	1.39 nL	Stainless Steel
NF35BV-2	135 µm	55 µm	5.0 mm	35.0 mm	460 µm	≈204 µm	1.38 nL	Stainless Steel
NF36BV-2	110 µm	35 µm	3.0 mm	33.0 mm	460 µm	≈156 µm	1.37 nL	Stainless Steel
NF33FBV-2	200 µm	100 µm	5.0 mm	35.0 mm	460 µm	≈322 µm	1.40 nL	Titanium Alloy
NFQ34-5	160 µm	100 µm	55.0 mm	75.0 mm	460 µm	≈280 µm	0.59 nL	Quartz
NF33BL-2	210 µm	115 µm	10.0 mm	34.0 mm	460 µm	≈348 µm	1.47 nL	Stainless Steel
NF34BL-2	185 µm	85 µm	5.0 mm	29.0 mm	460 µm	≈290 µm	1.39 nL	Stainless Steel
NF35BL-2	135 µm	55 µm	5.0 mm	29.0 mm	460 µm	≈204 µm	1.38 nL	Stainless Steel
NF36BL-2	110 µm	35 µm	3.0 mm	27.0 mm	460 µm	≈156 µm	1.37 nL	Stainless Steel
NF33FBI-2	200 µm	100 µm	5.0 mm	29.0 mm	460 µm	≈322 µm	1.40 nL	Titanium Alloy

Above dimensions apply to blunt tips also.

tubing tip is made of 160 micron OD polyimide coated quartz tubing with a special adapter sleeve mounted at the end. It is designed for filling glass capillary electrodes or pipettes, just like WPI's traditional MF34G Microfil. However, unlike the traditional MicroFil, which has about

50 microliters of dead volume in its luer hub, the dead volume of this tip is less than 0.6 microliters. It is useful for loading electrodes with solutions that have a limited volume or are too expensive to waste.

NANOFIL NEEDLES

NF33BL-2	33 G blunt NanoFil needle (pkg of 2)
NF34BL-2	34 G blunt NanoFil needle (pkg of 2)
NF35BL-2	35 G blunt NanoFil needle (pkg of 2)
NF36BL-2	36 G blunt NanoFil needle (pkg of 2)
NF33BV-2	33 G beveled NanoFil needle (pkg of 2)
NF34BV-2	34 G beveled NanoFil needle (pkg of 2)
NF35BV-2	35 G beveled NanoFil needle (pkg of 2)
NF36BV-2	36 G beveled NanoFil needle (pkg of 2)
NF33FBL-2	33 G Flexifil blunt NanoFil needle (pkg of 2)
NF33FBV-2	33 G Flexifil beveled NanoFil needle (pkg of 2)
NF33-36BL	Assortment of 4 blunt NanoFil needles
NF33-36BV	Assortment of 4 beveled NanoFil needles

LUER FITTING NEEDLES

NL33BL-2	33 G blunt needle with luer fitting (pkg of 2)
NL34BL-2	34 G blunt needle with luer fitting (pkg of 2)
NL35BL-2	35 G blunt needle with luer fitting (pkg of 2)
NL36BL-2	36 G blunt needle with luer fitting (pkg of 2)
NL35BLR-2	35 G blunt needle right angle with luer fitting (pkg of 2)
NL33BV-2	33 G beveled needle with luer fitting (pkg of 2)
NL34BV-2	34 G beveled needle with luer fitting (pkg of 2)
NL35BV-2	35 G beveled needle with luer fitting (pkg of 2)
NL36BV-2	36 G beveled needle with luer fitting (pkg of 2)
NL33FBL-2	33 G Flexifil blunt needle with luer fitting (pkg of 2)
NF33FBV-2	33 G Flexifil beveled needle with luer fitting (pkg of 2)

REPLACEMENT PARTS & ACCESSORIES

NFINHLD	NanoFil Injection Holder
SILIFLEX-2	SilIFlex tubing 35 cm long (pkg of 2) (dead volume = 2.74 µL)
NFGSK-5	Spare Silicone Gasket for NanoFil & Holder (pkg of 5)
NFQ34-5	34 Gauge Flexible Quartz Tubing for filling (pkg 5)

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NanoFil Application Kits



RPE-KIT

These kits are specially designed for eye research for injecting retinal pigment epithelium (RPE) and intraocular (IO) in addition to brain injection in mice. They need to be used with a NanoFil syringe and UMP2 to achieve accurate, repetitive, and oil free injection in the submicroliter range. Each kit includes two pieces of Silflex tubing (one for a spare), a holder assembly, spare gaskets, and an assortment of four tips - blunt for the RPE kit and beveled tips for the IO kit. Each kit comes with one each of 33, 34, 35 and 36 gauge tips so that first time users can find the best size for their application.

The Silflex tubing is the most critical component of the kit. This 35 cm long, flexible tubing has a very precise outer diameter for airtight fitting with the syringe. It also has a small inner diameter for minimum dead volume, and is very durable when handled correctly. The SilFlex is coupled to the injection tip with a mechanism similar to that of the NanoFil. The dead volume of the entire kit (including the tubing) is less than 3 microliters. All of the components in the kit are constructed of inert, solvent resistant, and autoclavable materials for easy cleaning after viral injection.



RECOMMENDED ACCESSORIES

RPE-KIT	Retinal Pigment Epithelium (RPE) injection kit (SilFlex tubing, gasket, holder, and blunt tipmix)
IO-KIT	Intraocular (IO) injection kit (SilFlex tubing, holder, gasket, and beveled tipmix)

VSP1 Syringe Pump

Stability and safety

The **VSP1** Syringe Pump offers exceptional accuracy and stability coupled with safety features that are crucial in the animal health care environment. With 7 safety features, this pump alerts the users when syringe is near empty, occlusion occurs, syringe falls off, program ends, bolus completes, AV line fails, battery is under-charged, or operation is interrupted. The built-in rechargeable battery ensures the pump continues



VSP1 SPECIFICATIONS

FLOW RATE	0.1 – 600 mL/h
PURGE RATE	100–600 mL/h
BOLUS RATE	100–600 mL/h
ACCURACY	Nominal $\pm 2\%$ excluding syringe variations
SYRINGE SIZE	5 mL, 10 mL, 20 mL, 30 mL and 50/60 mL
OCCLUSION PRESSURE ALARM LIMITS	900 mmHg, 600 mmHg, 300 mmHg
BATTERY LIFE	2 hours
OPERATION TEMPERATURES	5 to 40° C
ELECTRICAL SAFETY	Class II, Type BF
AC POWER SUPPLY	100–240V at 50/60Hz
DIMENSIONS	25cm X 16cm X 14cm
WEIGHT	2.5 kg

uninterrupted even in the event of an AC line voltage failure for 2 hours. The pump can run under the flow rate (*i.e.*, mL/h), mass rate (*i.e.*, mg/min), or dose rate (*i.e.*, mg/kg/min) and this function can be used in routine infusion, anesthesia, and special drug protocols. This pump can be easily mounted on a vertical or horizontal IV pole or bedrail.

503613 VSP1 Syringe Pump

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