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50+ YEARS empowering scientists

Let us Be Your Partner in Discovery

We are at the dawn of an exciting new day of science—improving the lives of all humanity with breakthroughs like pheno-genomic testing and therapy. Daily, researchers like you are discovering new models, pathways and techniques which impact our health and our environment. These discoveries result in life-changing—and in many cases life-prolonging—therapies and revolutionary protocols. We are also working with researchers in monitoring environmental influences in our oceans and streams. New surgical instruments are being created to assist in specific surgeries and diagnoses. This year, for example, we added a new line of tools specifically for work under a microscope. They are non-reflective and are also modified with special tips to enable surgeries in arteries and veins.

At WPI, our solutions enable pioneers on the cusp of discovery to impact the quality of life for all of us for generations to come. WPI provides solutions for a wide range of disciplines, including electrophysiology, molecular biology, cellular biology, surgical procedures and physiology, to advance the life science knowledge base. As researchers continue the quest for answers to life's mysteries, we provide the instruments to make laboratory research effective, reliable and reproducible. We aim to be your partner in the scientific adventure and instill confidence in your journey of discovery. Your research methods and ideas, combined with our scientists and engineers, help us develop novel solutions for your work.

Our customers' journey of discovery, and the promise it brings of life-changing impact, inspires our team. Let us be your research partner with quality, cost-effective instruments for wherever science takes you.

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All specifications are subject to change.
For research only.

Products at WPI

new

PINPOINT INJECTOR

MICRO-ePORE

Preliminary Design

The new **MICRO-ePORE™** cell penetrator is a simple and versatile pin-point controlled electroporation system that can be used for efficient microinjection of reagents into oocytes and pre-implantation stage mammalian embryos. Patent pending Flutter Electrode Technology assists in small, clean, precise membrane penetration without tearing or damaging the membrane. See page 42.

QUALIFIED OPTICAL FIBERS

The use of qualified optical fibers ensures better fibers, better assemblies, better probes. WPI excels at making optical fibers with high batch-to-batch performance consistency. WPI UV fiber has industry leading degradation resistance to deep UV light. WPI fiber composition and manufacturing is unique so that we can offer you qualified and guaranteed UV performance. Our optical fiber assemblies offer excellent optical performance and low lot-to-lot variation for scientific and process applications. Our manufacturing know-how and optical designs give you the ability to order custom assemblies designed to meet the specifications of your application. See page 162.

FLUORESCENCE PROBE

WPI offers fluorescence probes to match your application, both single and double emission. These probes may be used for the detection of the transient response of free ion concentrations, like calcium, potassium, sodium or magnesium. Fluorescence probes can also be designed to detect pH or membrane potential. Auto-fluorescence like the detection of ATPase activity via NADH or FAD is another application. For details, talk with a WPI application specialist. See page 178.

OPTICAL OXYGEN SENSOR

Now you can detect oxygen in small sample in living tissues using the phase shift between a reference signal and a measured signal. **BioOxy** is a new and innovative technology for measuring oxygen in gaseous and aqueous phase. **BioOxy** is an optical oxygen sensor with important advantages over using common Clark type electrodes. These sensors have a rapid response time with the $t_{90} \leq 3$ seconds (in gas phase). No oxygen is consumed making measurements. These sensors are perfect for bioprocess control and making oxygen measurement in small samples. See page 152.

TEER MEASUREMENT CHAMBERS

ENDOHM-6G

ENDOHM-12G

ENDOHM-24GSNAP

Our new EndOhm chambers are now made of glass, and the new insert holder with 120º tri-supports can accommodate three leg inserts! The crystal clear glass chamber allows visualization of apical electrode positioning. See page 5.

STERILIZATION TRAYS AND BASKETS

With top quality structural integrity, these trays are ideal for the handling and storage of all standard microdissection and surgical instruments. The unique "grid" design of the base makes it easy to install the silicone finger mats required to protect the delicate instruments. They have burr-free edges, and we offer a large selection to fit your needs. See www.wpiinc.com/baskets. See page 211.

OPHTHALMIC KITS AND INSTRUMENTS

We offer kits for specific research and veterinary procedures. And we have over 100 ophthalmic instruments each sold separately. See www.wpiinc.com/eyes. See page 198.

503364

CERAMIC COATED INSTRUMENTS

Our black instruments are coated with titanium nitride (TiN), an extremely hard ceramic material. The TiN coating hardens and protects the cutting edge. Ceramic coated anti-reflective instruments are perfect for microscopy and microsurgical applications. Coating surgical instruments with a black ceramic adds a thin layer to the metal instrument, making the instrument harder and giving you greater precision. This anti-glare surface minimizes reflections off the surface of your instruments. The incredibly smooth coating improves the instruments' resistance to corrosion and minimizes friction. The ceramic coating is virtually impenetrable, because the raw material is bonded to the instrument both physically and chemically. These instruments are much more resilient to the pressure of daily use and chemical processing. Coated instruments last considerably longer. See page 203.

504487

STERI-LITE MICROBEAD STERILIZER

Ideal for the sterilization of small research instruments, the chamber is filled with glass beads and heated up to 300°C. Eliminate bacteria, spores and other microorganisms. Chamber temperature is displayed on the large LED control panel and may be adjusted with the control knob. See page 210.

ST5191

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Cell & Tissue

Comprehensive Products for Cell & Tissue Applications

WPI's cell and tissue products cover a broad range of applications. Our products are tested and optimized to provide you with instruments that are reliable in supporting your research requirements. We offer a range of products for TEER measurement, live cell imaging, microscopy studies and muscle physiology applications. WPI's products have been cited in 100s of reference papers and in many cases are the only products available of their kind. WPI's **EVOM2™** is the original instrument designed specifically to perform non-destructive TEER measurement on epithelial monolayer cell cultures.

Epithelial Volt/Ohm (TEER) Meter

Non-destructively test for epithelial monolayer confluence in 2D cell cultures

Features

- Measures trans-epithelial electrical resistance or trans-epithelilal voltage
- Compatible with 12 and 24 well culture plate systems out of the box

Includes industry standard **STX2** hand held "chopstick" electrodes

- Analog output for recording resistance or voltage measurements
- Auto ranging from 0-10 KΩ
- Battery powered

Benefits

- You can verify performance and calibrate the meter for TEER function using provided test resistor
- Battery powered meter is portable

A variety of accessory electrodes are available for measuring TEER in 6- and 96-well fixed (HTS) and removable well culture systems (See **STX100** series (page 6) and **Endohm** (page **5)** electrodes

Applications

- TEER and trans-epithelial voltage measurements in 2D cell cultures

The **EVOM™** was the first instrument designed specifically to perform routine Trans Epithelial Electrical Resistance (TEER) measurement in tissue culture research. **EVOM2™** is the next generation, redesigned for ease of use. The **EVOM2™** not only qualitatively measures cell monolayer health, but also quantitatively measures cellular confluence. The unique electronic circuit of the **EVOM2™** and the included **STX2** electrode detect the confluence of the cellular monolayer. When combined with WPI's Endohm chamber, the **EVOM2™** can also be used to perform more accurate quantitative measurements or lower resistance measurements like transendothelial electrical resistance measurements.

Isolated battery power for 10 hours of use

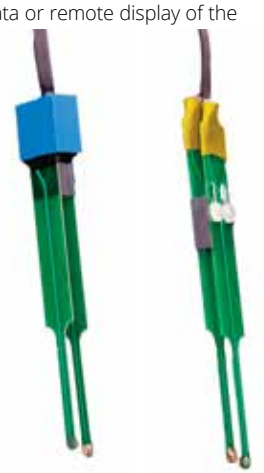
The isolated power source of the **EVOM2™** was specifically designed to avoid adverse effects on tissue and the formation of electrode metal deposits, even when it is plugged into a standard wall outlet. Now, the **EVOM2™** is always on when you need it. In addition, its rechargeable battery allows up to 10 hours of mobile use.

Accurate reading every time

The four-and-a-half digit readout provides a range of 1-10,000 Ω. The included test electrode lets you calibrate the resistance measurements for an accurate reading every time, and the voltage meter never needs calibration. An analog BNC output is standard with the **EVOM2™**, providing an output port for recording data or remote display of the **EVOM2™** output.

Electrode pair to measure voltage, pass current

EVOM2™ comes complete with the popular **STX2** "chopstick" electrodes, 4 mm wide and 1 mm thick. Each stick of the electrode pair contains a silver/silver-chloride pellet for measuring voltage and a silver electrode for passing current. The small size of each electrode is designed to facilitate placement of the electrodes into a variety of standard cell culture wells.



STX2 STX3

References

Di, S., Gujie, M., & Thomas, W. (2016). Magnetic ferri-liposomes for triggered drug release across the blood- brain barrier. *Frontiers in Bioengineering and Biotechnology*, 4. http://doi.org/10.3389/conf.FBIOE.2016.01.00061

Paradis, A., Leblanc, D., & Dumais, N. (2016). Optimization of an *in vitro* human blood-brain barrier model: Application to blood monocyte transmigration assays. *MethodsX*, 3, 25–34. http://doi.org/10.1016/j.mex.2015.11.009

EVOM2™

Meenach, S. A., Tsoras, A. N., McGarry, R. C., Mansour, H. M., Hilt, J. Z., & Anderson, K. W. (2016). Development of three-dimensional lung multicellular spheroids in air- and liquid-interface culture for the evaluation of anticancer therapeutics. *International Journal of Oncology*, 48(4), 1701–9. http://doi.org/10.3892/ijo.2016.3376

Turdalieva, A., Solandt, J., Shambetova, N., Xu, H., Blom, H., Brismar, H., ... Fu, Y. (2016). Bioelectric and Morphological Response of Liquid-Covered Human Airway Epithelial Calu-3 Cell Monolayer to Periodic Deposition of Colloidal 3-Mercaptopropionic-Acid Coated CdSe-CdS/ZnS Core-Multishell *Quantum Dots*. *PloS One*, 11(2), e0149915. http://doi.org/10.1371/journal.pone.0149915

Hirano, M., & Hirano, K. (2016). Myosin di-phosphorylation and peripheral actin bundle formation as initial events during endothelial barrier disruption. Scientific Reports, 6(1), 20989. http://doi.org/10.1038/srep20989

Marvin, S. A., et. al. (2016). Type I Interferon Response Limits Astrovirus Replication and Protects against Increased Barrier Permeability In Vitro and In Vivo. Journal of Virology, 90(4), 1988–1996. http://doi.org/10.1128/JVI.02367-15

Jacobs, M. E., et. al. (2016). SGK1 regulation by miR-466g in cortical collecting duct cells. American Journal of Physiology-Renal Physiology, 310(11), F1251–F1257. http://doi.org/10.1152/ajprenal.00024.2016

Yu, C., et. al. (2015). The Effects of Glucagon-like Peptide-2 on the Tight Junction and Barrier Function in IPEC-J2 Cells through Phosphatidylinositol 3-kinase–Protein Kinase B–Mammalian Target of Rapamycin Signaling Pathway. Asian-Australasian Journal of Animal Sciences, 29(5), 731–738. http://doi.org/10.5713/ajas.15.0415

SPECIFICATIONS

	EVOM2™	300523
MEMBRANE VOLTAGE RANGE	±200 mV	±200 mV
RESOLUTION	0.1 mV	0.1 mV
RESISTANCE RANGE	0 to 9999 Ω	0 to 100 KΩ
RESISTANCE RESOLUTION	1 Ω	10 Ω
AC SQUARE WAVE CURRENT	±10 µA nominal at 12.5 Hz	1 µA nominal at 12.5 Hz
POWER	Internal rechargeable 6V NiMH 2700 mAH battery with external 12 VDC supply for recharging	
NOMINAL BATTERY RUN TIME	10 hours	
BNC OUTPUT	1-10 V (1 mV/Ω)	1-10 V (1 mV/10 Ω)
DIMENSIONS	19 x 11 x 6 cm (7.25" x 4.25" x 2.30")	
WEIGHT	1.4 kg (3 lb.)	
ELECTRODE CONNECTION	RJ-11connector (telephone style)	
TEST RESISTOR	External, 1000 Ω	
ENVIRONMENTAL RANGE	10-38°C (50-100°F) 0-90% non-condensing relative humidity	

ORDERING INFORMATION

EVOM2	Epithelial Tissue Voltohmmeter 9999Ω range (includes STX2)
300523	EVOM2™ 100 KΩ Range (includes STX2)
91799	Epithelial Tissue Voltohmmeter 9999Ω range (includes STX3)

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

STX2	Replacement "Chopstick" Electrode Set
STX3	Adjustable Tip Spread "Chopstick" Electrode Set
3993	Electrode Adapter (for electrodes with 2 mm pins)
91736	Replacement Battery, Rechargeable NiMH
91750	EVOM2™ Test Resistor

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Reproducible Resistance of Endothelial Tissue

TEER measurement of epithelial and endothelial cell cultures

Features

- Compatible with original **EVOM™** and **EVOM2™** meters
- Adjustable apical electrode height
- Crystal clear glass chamber allows visualization of apical electrode positioning
- New insert holder with 120° tri-supports for three leg inserts
- Three sizes cover a range of well cup sizes from a variety of manufacturers

Benefits

- Stability and reproducibility superior to the **STX2** electrodes to 1% tolerance
- Can be used with 6, 12 or 24 well plates with removable inserts
- Symmetrical electrode pattern disperses test current uniformly
- Simple test procedure to verify electrode performance

Applications

- TEER measurement for removable culture cup systems using **EVOM2™** meters for endothelial and epithelial cell cultures

Using WPI's **EVOM2™** resistance meter, Endohm chambers provide reproducible resistance measurements of endothelial and epithelial monolayers in culture cups. Transfer cups from their culture wells to the Endohm chamber for measurement rather than using hand-held electrodes. The chamber and the cap each contain a pair of concentric electrodes: a voltage-sensing silver/silver chloride pellet in the center plus an annular current electrode. The height of the top electrode can be adjusted to fit cell culture cups of different manufacturers.

Make more precise measurements with Endohms

Endohm's symmetrically opposing circular disc electrodes, situated above and beneath the membrane, allow a more uniform current density to flow across the membrane than with **STX2** electrodes. The background resistance of a blank insert is reduced from 150 Ω (when using WPI's hand-held **STX2** electrodes) to less than 5 Ω. With Endohm's fixed electrode geometry, variation of readings on a given sample is reduced from 10-30 Ω with **STX2** electrodes (depending on your experience) to 1-2 Ω. Compared with other resistance measurement methods, Endohm with **EVOM2™** offers a much more convenient and economic solution to "leaky tissue" measurement. Because of the uniform density of the AC square wave current from **EVOM2™**, errors caused by electrode polarization or membrane capacitance are largely eliminated. Endohm together with **EVOM2™** offers the most accurate and economical endothelial ohm meter now available. To date, cups from Costar, Millipore, and Falcon have been tested. Endohm chambers may be sterilized with EtO, alcohol or a bactericide. Do not autoclave.

References

Srinivasan, B., Kolli, A. R., Esch, M. B., Abaci, H. E., Shuler, M. L., & Hickman, J. J. (2015). TEER measurement techniques for in vitro barrier model systems. *Journal of Laboratory Automation*, 20(2), 107–26. http://doi.org/10.1177/2211068214561025

ENDOHM-12 COMPATIBILITY CHART

Corning	Millipore	Membrane Diameter	Growth Surface Area	Membrane Pore Size
3401		12 mm	1.12 cm²	0.4 µm
3402	PITP01250	12 mm	1.12 cm²	3.0 µm
3403	PITT01250	12 mm	1.12 cm²	3.0 µm
3493		12 mm	1.12 cm²	0.4 µm
3494		12 mm	1.12 cm²	3 µm
3460	PIHT15R48* PET Insert	12 mm	1.12 cm²	0.4 µm
	PIRP15R48* PET Insert	12 mm	1.12 cm²	1 µm
3462	PISP15R48* PET Insert	12 mm	1.12 cm²	3 µm
	PIMP15R48* PET Insert	12 mm	1.12 cm²	5 µm
	PIEP30R48* PIEP15R48* PIEP15R48* PET Insert	12 mm	1.12 cm²	8 µm

ENDOHM-6G

ENDOHM-12G

ENDOHM-24GSNAP

ENDOHM-24 COMPATIBILITY CHART

Corning	Millipore	Material	Pore Size (µm)
3407		Polycarbonate	0.4
3801		Polycarbonate	0.4
3802		Polycarbonate	3.0
3412	PIHT30R48*	Polycarbonate	0.4
3414		Polycarbonate	3.0
	PITT03050	Polycarbonate	3.0
3428		Polycarbonate	8.0
3450		Polyester	0.4
3452		Polyester	3.0
3491		Collagen	0.4
3492		Collagen	3.0
	PICMORG50	Organotypic Insert	0.4
	PIHA03050	HA Insert	0.45
	PIHP03050	PCF Insert	0.4
	PICM03050	HA Mixed Cellulose Esters	0.4
	PIHT30R48*	PET Insert	0.4
	PIRP30R48*	PET Insert	1.0
	PISP30R48*	PET Insert	3.0
	PIMP30R48*	PET Insert	5.0
	PIEP30R48*	PET Insert	8

ENDOHM-6 COMPATIBILITY CHART

Corning	Millipore	Membrane Diameter	Growth Surface Area	Membrane Pore Size
3470		6.5 mm	0.33 cm²	0.4 µm
3472	PITP01250	6.5 mm	0.33 cm²	3 µm
3413	PCF Insert	6.5 mm	0.33 cm²	0.4 µm
3415	PITP 01250 PCF Insert	6.5 mm	0.33 cm²	3 µm
3421		6.5 mm	0.33 cm²	5 µm
3422	PIEP 01250 PCF Insert	6.5 mm	0.33 cm²	8 µm
3495	PISP12R48* PIHT12R48* PET Insert	6.5 mm	0.33 cm²	0.4 µm
	PIHA012 50 (HA Insert)	6.5 mm	0.33 cm²	0.45 µm
	PICM012 50 (CM Insert)	6.5 mm	0.33 cm²	0.4 µm
3496	PISP12R48* PET Insert	6.5 mm	0.33 cm²	3 µm
	PIRP12R48* PET Insert	6.5 mm	0.33 cm²	1 µm
	PIMP12R48* PET Insert	6.5 mm	0.33 cm²	5 µm
	PIEP12R48* PET Insert	6.5 mm	0.33 cm²	8 µm
	PIXP01250 PCF Insert	6.5 mm	0.33 cm²	12 µm
	PITT01250 PIHP 01250			1.0 µm 3.0 µm

** New Chambers Support Tri-Leg Inserts*

ORDERING INFORMATION

ENDOHM-6G	Endohm for 6 mm Culture Cup (24 wells per plate)
ENDOHM-12G	Endohm for 12 mm Culture Cup (12 wells per plate)
ENDOHM-24GSNAP	Endohm for 24 mm & Costar Snapwell™ Cup (6 wells per plate) *Requires EVOM2™, EVOM™, EVOMX™ or Millicell ERS-2*
53330-01	Replacement Endohm Cable

HTS Electrodes for Use with EVOM™ & EVOM2™

For High Throughput Screening (HTS) cell culture filter plates

Features

- Designed for use with 24-well HTS plate (Corning Costar and BD Falcon) and with 96-well plates (Millipore)
- Improved accuracy down to 5 Ω
- Sterilize with EtO, alcohol or bactericide

Benefits

- Smaller tip size than the **STX2** electrode constructed for durability fits neatly into the keyhole shaped filter well
- Electrode design reduces chance of contamination

Applications

- **STX-100** Electrodes are designed for TEER measurement in HTS culture plates using the **EVOM2™**

STX100M

Semi-permeable HTS (high throughput screening) culture plates have become a standard tool for pharmaceutical and institutional research in epithelial transport. HTS culture plates have well cups which are bonded together into a single assembly and are not removable. This makes the plates ideal for automated applications, but imposes a significant inconvenience when TEER must be measured in the absence of an automated system. WPI's **STX100** series electrodes provide a cost-effective alternative to automation, allowing HTS well plates to be measured manually using a hand–held electrode.

The spatial orientation of an electrode during TEER measurement can have a significant effect on the resistance reading. When compared to the **STX-2** "chopsticks" electrode, the **STX100** series electrodes offer a technical advantage. The design of the **STX100** series electrodes guarantees spatial repeatability. Each **STX100** electrode is designed to self-align based on the form factor of the apical and basal access ports of the HTS plate. Each manufacturer of HTS culture systems has a unique form factor, so the **STX100** electrodes are manufacturer specific.

WPI developed **STX100** electrodes for 24 and 96 well plates specific to Corning, BD Falcon and Millipore. Refer to the charts for compatibility information or contact your WPI sales representative for assistance. If an automated system is preferable for your application, WPI's automated TEER measurement system (REMS) on page 7 is an affordable solution.

STX100 C COMPATIBILITY CHART

Corning	Description	Pore Size	Membrane
3379	HTS Transwell-24	0.4 µm	PET
3378	HTS Transwell-24	0.4 µm	PET
3396	HTS Transwell-24	0.4 µm	
3397	HTS Transwell-24	0.4 µm	
3398	HTS Transwell-24	3.0 µm	
3399	HTS Transwell-24	3.0 µm	

STX100F COMPATIBILITY CHART

Falcon	Description	Pore Size	Membrane
351180	BD Falcon (24 well) HTS Multiwell Insert System	1.0 µm	PET
351181	BD Falcon (24 well) HTS Multiwell Insert System	1.0 µm	PET
351182	BD Falcon (24 well) HTS Multiwell Insert System	3.0 µm	PET
351183	BD Falcon HTS (24 well) Multiwell Insert System	3.0 µm	PET
351184	BD Falcon HTS (24 well) Multiwell Insert System	8.0 µm	PET
351185	BD Falcon (24 well) HTS Multiwell Insert System	8.0 µm	PET
354803	BD BioCoat (24 well) HTS Fibrillar Collagen Multiwell Insert System	1.0 µm	PET
354804	BD BioCoat (24 well) HTS Fibrillar Collagen Multiwell Insert System	1.0 µm	PC

STX100 M COMPATIBILITY CHART

Millipore	Description	Pore Size	Membrane
PSRP004R1	96-Well Plate	1.0 µm	PET
PSHT004R5	96-Well Plate	0.4 µm	PCF
PSRP004R5	96-Well Plate	1.0 µm	PET
PSHT004S5	96-Well Plate	0.4 µm	PCF
PSHT004R1	96-Well Plate	1.0 µm	PCF

STX100 C96 COMPATIBILITY CHART

Corning	Description	Pore Size	Membrane
3380	HTS Transwell-96 System	1.0 µm	PC
3392	HTS Transwell-96 System	1.0 µm	PET
3381	HTS Transwell-96 System	0.4 µm	PC
3391	HTS Transwell-96 System	0.4 µm	PC
3385	HTS Transwell-96 Well Plate	3.0 µm	PC
3386	HTS Transwell-96 Well Plate	3.0 µm	PC
3387	HTS Transwell-96 Well Plate	5.0 µm	PC
3388	HTS Transwell-96 Well Plate	5.0 µm	PC
3374	HTS Transwell-96 Well Plate	8.0 µm	PET
3384	HTS Transwell-96 Well Plate	8.0 µm	PET

ORDERING INFORMATION

STX100C	STX100 for Corning Costar HTS Transwell-24
STX100F	STX100 for BD Falcon 24 well HTS Multiwell Insert System
STX100M	STX100 for Millipore MultiscreenTM HTS 96-Well Plate
STX100C96	STX100 for Corning HTS 96-Well Plate

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Automated TEER Measurement System

PC-controlled high throughput TEER measurement for epithelial monolayer

Features

- Automates TEER measurement and data logging for use with HTS well plates
- PC controlled positioning
- Data acquisition in LabView
- Manufacturer specific electrodes available for 24- and 96-well HTS plates
- Plate configuration files and sample sequences are user-definable
- Two user-defined rinse locations
- Manual mode

Benefits

- Speed—capable of acquiring TEER data on a 96-well plate in less than five minutes
- Automation reduces the possibility for human error

Applications

- Automated measurement and data logging of TEER for 24 and 96 well HTS culture plates

SYS-REMS

The **REMS** AutoSampler automates measurements of TEER epithelial or endothelial monolayers cultured on HTS well plates. It is a PC controlled tissue resistance measurement system that offers reproducibility, accuracy, flexibility and ease-of-operation. Automated measurement of tissue resistance in cell culture microplates provides the advantages of speed, precision, decreased opportunity for contamination and the rapid availability of measured resistance data.

The main components of the **REMS** AutoSampler include: the robotic sampler that moves the electrode over each well of the microplate, the electrode which is located on the robotic arm, a base plate for the 24- and 96-well tray, a Windows-based data acquisition card, the **REMS** electrode interface unit and the **REMS** software to operate the system on a Windows-based computer.

Automate TEER measurements

The **REMS** AutoSampler automates TEER measurements that would otherwise be performed manually with WPI's **EVOM2™** Epithelial Voltohmmeter. Automated tissue resistance measurements up to 20 kΩ can be performed on 24- or 96-well HTS microplates. See *www.wpiinc.com/REMS* for manufacturer plate compatibility.

Precisely and reproducibly positions electrode

The **REMS** AutoSampler will automatically measure and record tissue resistance from a user-specified matrix of culture wells on the microplate. According to the specified sequence, the robotic arm moves over the identified wells taking TEER measurements. By means of an x-y-z locating system, the electrode is positioned precisely into the well. The ability of the **REMS** AutoSampler to reproducibly position the electrode contributes to consistent TEER measurements. TEER data is incrementally stored as the electrode moves from one well to the next.

Compact electrode pair

The use of AC current to measure resistance provides several advantages over DC current, including:

- Absence of offset voltages on measurements
- There is a zero net current being passed through the membrane and, therefore, it is not adversely affected by a current charge
- No electrochemical deposition of electrode metal.

Rinse and calibration check stations

The **REMS** AutoSampler also features two rinse stations. If occasional rinsing of the **REMS** electrode is required, it may be sent to a rinse station by pressing the rinse station button on the menu bar.

References

Gallego, M., Grootaert, C., Mora, L., Aristoy, M. C., Van Camp, J., & Toldrá, F. (2016). Transepithelial transport of dry-cured ham peptides with ACE inhibitory activity through a Caco-2 cell monolayer. *Journal of Functional Foods*, 21, 388–395. http://doi.org/10.1016/j.jff.2015.11.046

Kamiloglu, S., Grootaert, C., Capanoglu, E., Ozkan, C., Smagghe, G., Raes, K., & Van Camp, J. (2016). Anti-inflammatory potential of black carrot (Daucus carota L.) polyphenols in a co-culture model of intestinal Caco-2 and endothelial EA.hy926 cells. *Molecular Nutrition & Food Research*. http://doi.org/10.1002/mnfr.201600455

Cain, M. D., Salimi, H., Gong, Y., Yang, L., Hamilton, S. L., Heffernan, J. R., … Klein, R. S. (2017). Virus entry and replication in the brain precedes blood-brain barrier disruption during intranasal alphavirus infection. *Journal of Neuroimmunology*, 308, 118–130. http://doi.org/10.1016/j.jneuroim.2017.04.008

REMS AUTOSAMPLER SPECIFICATIONS

MEMBRANE RESISTANCE RANGE	Auto-ranging or 0–2000 Ω and 0–20 kΩ
AC SQUARE WAVE CURRENT	± 20 µA @ 12.5 Hz
ELECTRODE POSITIONING	Resolution in X, Y and Z: ± 1 mm
ELECTRODE ARM SPEED	X- and Y-axis: 250 mm/sec Z-axis: 247.3 mm/sec
TYPICAL MEASUREMENT TIME 24-WELL	1 min., 10 sec.
SCAN PATTERN	Preset or user-defined
LINE VOLTAGE (User Specified)	100/120 V or 220/240 V
DIMENSIONS	53.5 × 43.7 × 37.1 cm (21½ × 17⅛ × 14⅝ in.)
WEIGHT	24 kg (52 lb.)

ORDERING INFORMATION

SYS-REMS Automated Tissue Resistance Measuring System

Includes robot sampler, data acquisition board; computer, display, keyboard, mouse; software for Windows 7 or 10; and electrode (SPECIFY WHEN ORDERING).

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

REMS-24	Replacement Electrode for 24-well HTS Plate
REMS-96	Replacement Electrode for Millipore™ 96-well Plate
REMS-96C	Replacement Electrode for Corning 96-well HTS plate
REMS-24M	Replacement Electrode for Millipore 24-well HTS plate

See www.wpiinc.com/REMS detailed information.

Ussing System for Epithelial Research

Non-destructive TEER measurement for epithelial tissue

Features

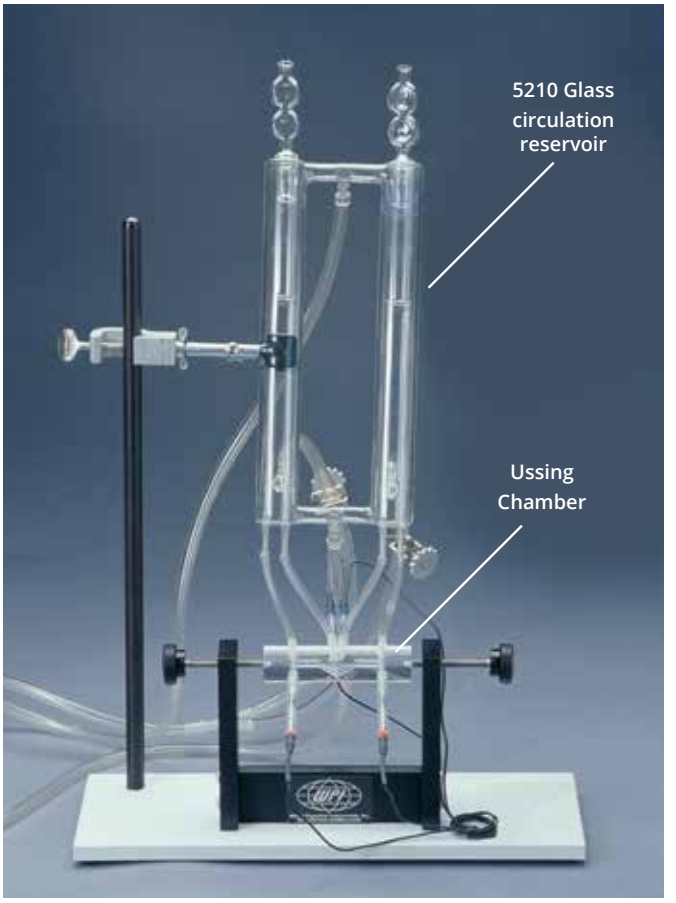
- Direct connect low-resistance electrodes
- Simple operation, easy to control temperature and clean after use
- Luer type leak-free attachment of tubing and electrodes
- Recessed electrode ports avoid bubble formation
- Secure membrane holding by sharp stainless steel pins or O-ring
- Specialized chamber adapts cell culture insert (Costar Snapwell) for monolayer cell culture
- Chambers with rectangular openings for tubular tissues from small animals

Benefits

- Leak free design of Ussing chambers
- Can be used with monolayer cell culture inserts
- Optional drains for quick evacuation of radioactive or toxic substances
- Circulation reservoirs available in two sizes
- Control temperature with a circulating water bath (option) available

Applications

- Ion transport studies
- Nutrient transport studies



Complete Ussing System includes stand, glass reservoir, electrodes, Ussing chamber and tubing.

WPI's Ussing System offers researchers a quick, effective means of making low-resistance electrical connections to the Ussing chamber without need of long agar bridges or Calomel half-cells. Ag/AgCl half-cells screw into short tubes which plug firmly into place in the chamber's Luer ports. These direct-connect electrodes eliminate the inconvenience and expense of Calomel half-cells in open liquids. The system includes one Ussing Chamber (eight sizes available), support stand, electrode kit, glass circulation reservoir (two sizes available), and a tubing start-up kit (25 feet of 0.375-in. tubing, 10 feet of 0.156-in. tubing, plus four male Luer fittings, two compressor clamps, one Y-connector, and one clip). Sixteen possible system configurations are available. Components are also available separately. *(Preamplifier in photo not included.)*

Leak free design of Ussing chambers

WPI's classical Ussing Chambers are well established perfusion chambers that are easy to operate, easy to control temperature, and easy to clean after use. Ussing Chambers are machined from solid acrylic with eight entry ports for fluid lines, electrodes, or agar bridges. For easy, leak-free attachment of tubing and electrodes, all eight ports are Luer type. The four ports for voltage and current electrodes are recessed to prevent formation of air bubbles in the chamber. The fluid compartments in each side of the chamber are separated by the epithelial membrane being studied. Sharp stainless steel pins on one side of the chamber hold the membrane in position and mate with holes in the opposite chamber interface. (In the **CHM4**, tissue is held by an O-ring instead of pins.)

Can be used with monolayer cell culture inserts

The **CHM5** chamber adapts the Costar 12 mm Snapwell, a cell culture insert for monolayer cell culture, into WPI's "classical" epithelial voltage clamp system. Classical Ussing Chambers have not been widely used for monolayer cell culture inserts, because most inserts have a very deep profile, limiting good fluid perfusion at the surface of the membrane and limiting voltage electrodes from measuring the potential close to the surface of the membrane. **CHM5** solves these problems: Perfusion fluid is introduced into the chamber at an angle so that it flows directly to the surface of the membrane. The voltage electrode is also inserted into the chamber at an angle to reduce the distance between the surface of the membrane and the electrode.

Rectangular openings for tubular tissue

Two small chambers with rectangular openings are designed for tubular tissue from small animals such as the mouse intestinal tract membrane (**CHM6**) and rat intestinal tract membrane (**CHM7**). The rectangular opening more closely matches the shape of the tissue than would a circular opening, significantly increasing the membrane area available for testing. The larger membrane area increases the transport rate of low permeability chemicals. It also reduces the electrical resistance of the system for easier current clamping.

Optional drains

Drains may be added to Ussing chambers to allow quick and complete evacuation of radioactive or toxic substances. To have drains added at the time of order, add a "D" to the part number (such as "USS1LD"). The cost of the drain will be added to the cost of the chamber or system ordered.

Cartridge electrodes

The Electrode Kit contains four voltage/current electrodes, plus four Luer-tipped cartridges. Electrodes are threaded and screw securely into the end of each cartridge. The Luer tip then plugs securely into the Luer openings of the chamber. The cable from each electrode terminates with a 2 mm pin which may be plugged into mos voltage/current clamps.

EKV and EKC Cartridge Electrodes

The miniature electrode-gel cartridge is a small plastic tube with a male Luer tip identical to those at the tip of hypodermic syringes. The tube may be filled with different gel materials. Agar is commonly used, but other gel materials may also be satisfactory.

U.S. Patent No. 4,912,060

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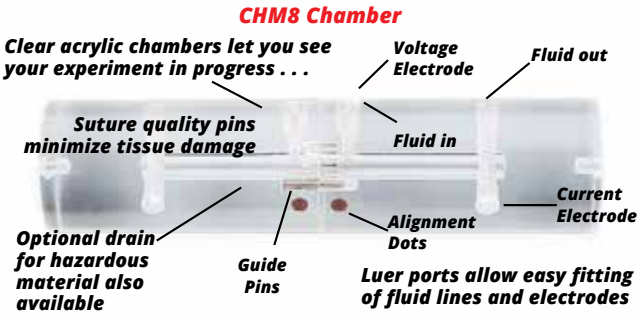


Assembled chambers are 101.6 mm (4 in.) long.

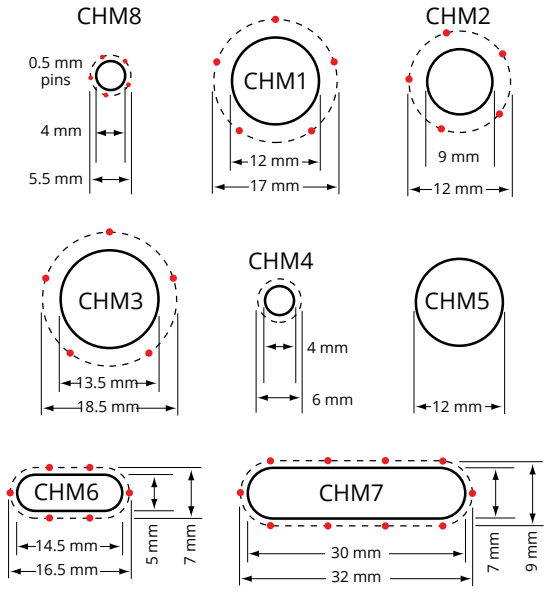
Circulation reservoirs available in two sizes

Hand-blown borosilicate glass reservoirs with jacketed chambers for temperature control are available in two sizes — **5210** holds 20 mL per side, and **5362** (at left) holds 10 mL per side (useful when expensive chemicals are involved). Reservoir condenser caps prevent air bubbles and turbulence in fluid reservoirs.

Control temperature with a circulating water bath

The Julabo circulating bath is ideal for controlling temperatures of external systems. With a powerful 15 L/min flow rate, the pump provides optimum heat exchange. The tap water cooling feature is standard with a range of 20-100ºC.

Reservoir openings and pins



References

M.Khera, G.T. Somogyi, S. Kiss, T.B. Boone, C.P. Smith "Botulinum toxin A inhibits ATP release from bladder urothelium after chronic spinal cord injury" *Neurochemistry International* 45. 2004: 987-993

McLamb, B. L., Gibson, A. J., Overman, E. L., Stahl, C., & Moeser, A. J. (2013). Early Weaning Stress in Pigs Impairs Innate Mucosal Immune Responses to Enterotoxigenic E. coli Challenge and Exacerbates Intestinal Injury and Clinical Disease. *PLoS ONE*, 8(4), e59838. http://doi.org/10.1371/journal.pone.0059838

Khera, M., Somogyi, G. T., Kiss, S., Boone, T. B., & Smith, C. P. (2004). Botulinum toxin A inhibits ATP release from bladder urothelium after chronic spinal cord injury. *Neurochemistry International*, 45(7), 987–93. http://doi.org/10.1016/j.neuint.2004.06.001

ORDERING INFORMATION

USSING SYSTEMS, LARGE RESERVOIR

USS1L	Medium Chamber, Stand, Reservoir, Electrodes, Tubing
USS2L	Small Chamber, Stand, Reservoir, Electrodes, Tubing
USS3L	Large Chamber, Stand, Reservoir, Electrodes, Tubing
USS4L	Extra Small Chamber, Stand, Reservoir, Electrodes, Tubing
USS5L	Snap Chamber, Stand, Reservoir, Electrodes, Tubing
USS6L	Small Rectangular Chamber, Stand, Reservoir, Electrodes, Tubing
USS7L	Large Rectangular Chamber, Stand, Reservoir, Electrodes, Tubing
USS8L	Extra Small Chamber, Stand, Reservoir, Electrodes, Tubing

USSING SYSTEMS, SMALL RESERVOIR

USS1S	Medium Chamber, Stand, Reservoir, Electrodes, Tubing
USS2S	Small Chamber, Stand, Reservoir, Electrodes, Tubing
USS3S	Large Chamber, Stand, Reservoir, Electrodes, Tubing
USS4S	Extra Small Chamber, Stand, Reservoir, Electrodes, Tubing
USS5S	Snap Chamber, Stand, Reservoir, Electrodes, Tubing
USS6S	Small Rectangular Chamber, Stand, Reservoir, Electrodes, Tubing
USS7S	Large Rectangular Chamber, Stand, Reservoir, Electrodes, Tubing
USS8S	Extra Small Chamber, Stand, Reservoir, Electrodes, Tubing

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

System components also available separately:

xxxxD	Drain option (add "D" to part number of chamber or system)
CHM1	Medium Chamber
CHM2	Small Chamber
CHM3	Large Chamber
CHM4	Extra Small Chamber with O-Ring Seal
CHM5	Snap Chamber (fits Costar Snapwell cups)
CHM6	Small Rectangular Chamber
CHM7	Large Rectangular Chamber
CHM8	Extra Small Chamber with Mounting Pins
EK1	Ussing Electrode Kit (2 voltage, 2 current)
EKC	Extra Ussing Current Electrode (red) (each)
EKV	Extra Ussing Voltage Electrode (blue) (each)
5210	Large Glass Circulation Reservoir, (20 mL per side)
5233	Replacement Condenser for 5210
5362	Small Glass Circulation Reservoir, (10 mL per side)
5361	Replacement Condenser for 5362
3955	EKV Cartridges, 35 mm (pkg. of 12)
3960	EKC Cartridges, 58 mm (pkg. of 12)
3669	Tubing Kit (flexible hose and Luer fittings)
3579-20	Replacement Luer fittings for tubing connections (pkg. of 20)
5153	Support Stand
3485	Post Mounting Kit for Preamp
505060	Julabo Circulating Bath, 5L volume, 115V
505061	Julabo Circulating Bath, 13L volume, 115V
505062	Julabo Circulating Bath, 5L volume, 230V
505063	Julabo Circulating Bath, 13L volume, 230V

SPECIFICATIONS

	CHM1 (Medium)	CHM2 (Small)	CHM3 (Large)	CHM4 (Extra Small)	CHM5 (Snap)	CHM6 (Rect., Small)	CHM7 (Rect., Large)	CHM8 (Extra Small)
RESERVOIR OPENING	12 mm	9 mm	13.5 mm	4 mm	12 mm	5 x 14.5 mm	7 x 30 mm	4 mm
HALF-CHAMBER VOLUME	1.0 mL	0.75 mL	1.2 mL	0.5 mL	1.7 mL	0.8 mL	5.5 mL	0.5 mL
PIN CIRCLE DIAMETER	17 mm	12 mm	18.5 mm	6 mm*	N/A	7 x 16.5 mm	9 x 32 mm	5.5 mm
SURFACE AREA	113 mm^2	63.5 mm^2	143 mm^2	12.6 mm^2	113 mm^2	67.1 mm^2	199.5 mm^2	12.6 mm^2

**O-ring diam.*

Muscle Testing Platform

Customizable system for muscle physiology research

Features

- Heated cuvette and micrometer
- Study intact muscle fiber bundles*
- Data recording and analysis included
- Modular design
- Corrosion-free

Benefits

- System is completely customizable with a host of accessories

Applications

- Electrical stimulation, including twitch and tetany, to analyze force response in amplitude; and kinetics, like contraction and relaxation times and velocities
- Intracellular calcium concentration/ distribution and muscle force in intact muscle fiber bundles.* (Requires a Biofluorometer.)

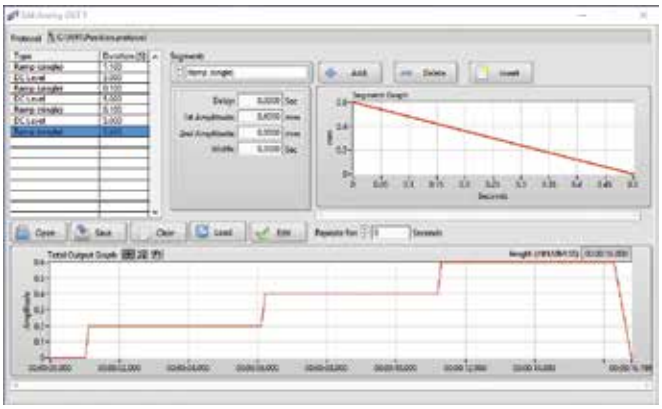
These applications may require specific components or other electronics that are compatible with this system.

SI-MT-L

The **SI-MT-L** is the standard muscle research platform, which can be configured to study intact muscle fiber bundles, muscle strips and small whole muscles. Modular design allows the system to be configured for turnkey solutions for specific applications. The system is built on a solid platform making precise mechanical and optical measurements easy. Like the **Cell Tester** and the **SI-HTB** systems, **SI-MT-L** and **SI-MTM-L** use **SI-KG** optical force transducers and are constructed with corrosion-free materials (stainless steel, anodized aluminum or plastic).

The system is supplied with a **LabTrax-MDAC** data acquisition system to:

- Record signals from the force transducer, the motor position monitor or any further relevant physiological signal using up to eight analog inputs.
- Control the stimulator, or an external stimulus isolator, through an analog output
- Control the position of the linear motor through a second analog output
- Control other devices through two digital outputs
- Program numerous customized protocols



MDAC Protocol segment, showing the combination of basic signal patterns to generate an experimental protocol.

Customize the system to suit your needs

The flexibility of the Muscle Testing Platform allows for complete customization. For example, you can add:

- Linear motor for muscle length perturbation studies
- Isolated constant current stimulator for twitch and tetanus stimulation
- Biofluorometer for intracellular calcium studies
- Additional accessories like force transducers, data acquisition system

ORDERING INFORMATION

SYSTEMS AVAILABLE FOR INTACT MUSCLE SAMPLES INCLUDE:

SI-MTM-L	System with a Univette heated cuvette & linear motor
SI-MT-L	System with a Univette heated cuvette & digital micrometer

Systems include: Base plate; force transducer and stand, digital micrometer or linear motor (optional), micrometer or motor stand, cuvette and table, oxygenation system, evacuation system, signal conditioning system with transducer amplifier and temperature control module, anti-oscillation module and linear motor amplifier (if applicable), LabTrax-MDAC data acquisiton system data acquisition system with MDAC software for recording force and position signals and for controlling stimulation and the movement of the linear motor.

*Contact WPI for help evaluating your specific experimental requirements.

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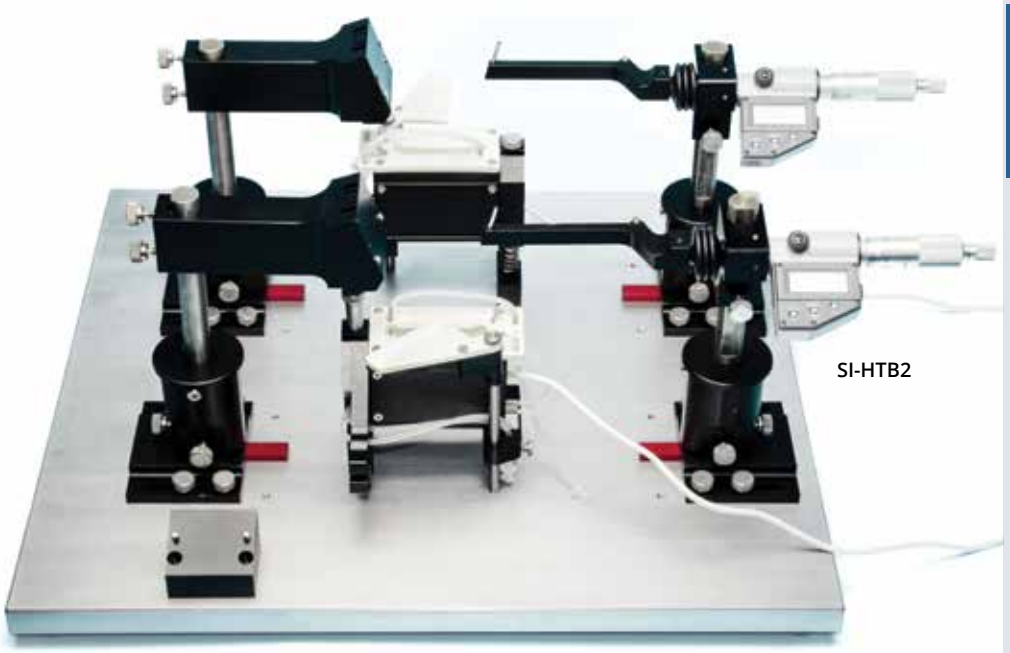
Horizontal Tissue Bath

Research system for higher throughput of complex pharmacological/ physiological assays



SI-HTB2

Features

- Two channel system for increased productivity, easily expanded to add channels
- Fully independent heating and fluid control for each channel
- Low profile/small footprint
- Variable volume, chemically inert Teflon bath with shape configurations from variable to fixed 500 µL–10 mL*
- Modular, space-saving, blade-style electronics
- Large variety of force transducers covering mN–N forces
- Can be combined with automated fluid control systems
- Add an electrometer like the WPI **Duo773** or **Electro705**

Benefits

- Tissue bath for volumes as small as 500 µL
- Low profile, small footprint to reduce bench space requirements
- Versatile system is easy to upgrade with added channels and options

Applications

- Tissue fluorescence (calcium, ATPase via NADH, FAD). (Requires the multi-purpose Biofluorometer* (**SI-BF-100**). See page 20.)

These applications may require specific components or other electronics that are compatible with this system.

The SI-H Horizontal Tissue/Organ Bath system (**SI-HTB**) combines the ease of use and productivity of a traditional vertical organ bath with the more advantageous features of single tissue physiology platforms.

Bath options 500 µL up

The **SI-HTB** system breaks through the (large) volume limitations of the traditional organ bath, allowing volumes as low as 500 µL in an inert, Teflon-based bath. The bath design allows multiple shape options for thick, long, flat and thin tissue. When pharmaceuticals are available in precious, small amounts, you will appreciate this standard feature. A wide range of transducers and tissue mounting supports allow a great variety of tissue shape, volume and size.

Low profile

The low profile and small footprint of the bath system, combined with the modular, space-saving, chassis-mounted design of the electronics, reduces the bench space requirement up to 4-fold when compared with standard 4-channel organ baths.

Versatile system, easy to upgrade

The **SI-HTB** combines advanced physiological techniques with the throughput needed in pharmacological assays in one flexible platform. Upgrades to four or more channels are easy and economical.

The motor option (**SI-MOT**) turns your system into a tissue work-out station with isotonic and eccentric force measurement capabilities. Nearly all established myo-mechanical tests from stretch-release to work-loops and muscle fatigue are now possible in a single organ bath system. Some of these procedures require automated length changing methods, which can be conveniently programmed using WPI's **LabTrax-MDAC** data acquisition system.

Options

The solid horizontal tissue bath design is ideal for combination with electrophysiology on the same platform. Intracellular measurements can share the stable solid base of the bath system.

WPI's new fiber-optic based, multi-channel Biofluorometer allows for tissue fluorescence measurements (calcium, NADH, FAD) on the **SI-HTB** platform.

Now, you can design a system to meet your needs and budget. And, it is fully upgradeable in the future.

WPI's 16-bit, full speed, Labview-based Muscle Data Acquisition system **LABTRAX-MDAC** is perfect for this platform.

*Contact WPI for help evaluating your specific experimental requirements.

ORDERING INFORMATION

SI-HTB2 Horizontal Tissue Bath, 2-Channel System
2-Channel **SI-HTB** *platform for isometric force (1),* **SI-KG** *Force Transducers (2),* **SI-BAM21-LCB** *Optical Force Transducer Amplifiers (2),* **SI-TCM2B** *2-Channel Temperature Controller (1), SI-BMFA power frame enclosure (1), LabTrax 8/16 with MDAC Data Acquisition software*

SI-HTB4 Horizontal Tissue Bath, 4-Channel System
2-Channel **SI-HTB** *platform for isometric force (2),* **SI-KG** *Force Transducers (4),* **SI-BAM21-LCB** *Optical Force Transducer Amplifiers, (4)* **SI-TCM2B** *2-Channel Temperature Controller (2), SI-BMFA power frame enclosure (1), LabTrax 8/16 with MDAC Data Acquisition software (1)*

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

LABTRAX-MDAC	LabTrax 8/16 8-Channel Data Acquisition with MDAC Software
SI-AOSUB	Anti-Oscillation Module
SI-PF100	Programmable Filter
MINISTAR	Miniature Peristaltic Pump, 1-channel
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)
801566	Mini Vacuum Pump (110V)
801963	Mini Vacuum Pump (220V)
SI-COLUB	Constant Load Module
97204	Pinger for the Anti-Oscillation Module

Cell Tester System

Perform muscle physiology tests on single skeletal muscle fibers

Features

- Fits ANY inverted microscope
- Unique rotational stage–improves the experimental throughput
- Two integral piezo manipulators included

Benefits

- Simultaneous use of the multi-purpose biofluorometer* (**SI-BF-100**) for tissue fluorescence (calcium, ATPase via NADH, FAD)
- For use with small multi-cellular preparations or skinned muscle fibers*
- Stimulate and perform perturbations of muscle fibers
- Options available for customization of the system

Applications

- Stretching and relaxation of cells with nanometer resolution
- Classic cross bridge cycling studies in cardiac tissue
- Skeletal muscle fiber axial stretch and isometric force
- Intracellular calcium concentration/distribution in muscle fibers as muscle force is measured
- ATPase activity as muscle force is measured

SI-CTS200

The **SI-CTS200** system, which is the result of blending the latest technologies in electronics, mechanics and optics, permits researchers to investigate living systems at a new level of observation. The Cell Tester provides researchers with the comprehensive ability to investigate and characterize the physiological, biomechanical and biophysical properties of single isolated living cells.

Study multi-cellular or skinned fibers

The **SI-CTS200** systems can be used on small multi-cellular preparations or skinned muscle fibers or strips. It is designed to sit on the stage of any standard, research-level, inverted microscope while maintaining the optical path of the microscope for simultaneous fluorescence or confocal imaging.

Stimulate and perform perturbations of cells

The Cell Tester is an integrated system of components needed to maintain and handle muscle fibers, stimulate and perform pertubations of the cells, and detect, amplify, and record signals, like contractile force.

Customize your system with options

- Optical force transducer for measuring with nanonewton sensitivity and integrated cell attachment system.
- Equipped with a nanomotor for stretching and relaxing cells with nanometer resolution.
- A rotating cuvette system for easy alignment of cells increases productivity. It is designed to orient cells in the XY plane so that no physical manipulation of the position of the tissue itself is required.
- Interchangeable bath inserts provide a range of options for the handling of live fibers.
- **LabTrax-MDAC** data acquisition system records and control your experiments, using up to eight analog inputs.
- Biofluorometer (See page 20.)

References

Prosser BL, Ward CW, Lederer WJ. X-ROS signaling: rapid mechano-chemo transduction in heart. *Science*. 2011 Sep 9;333(6048):1440-5. PMID: 21903813

FORCE TRANSDUCER SPECIFICATIONS

RANGE	0–5 mN (0–0.5 g)
FORCE RESOLUTION	20 nN at 10× gain
COMPLIANCE	10 µm/mN
NOISE	0.3 µN
RESONANCE FREQUENCY	250 Hz (This is eliminated from the measurement by the AOSUB)
TIME RESOLUTION	7 ms

Resolutions were determined while using the SI-AOSUB anti-oscillation filter.

NANOMOTOR SPECIFICATIONS

TOTAL TRAVEL	±90 µm
RESOLUTION	20 nm
SMALLEST STEP	60 nm
INPUT	±10V (calibrated at 10 µm/V)

CELL TESTER PLATFORM SPECIFICATIONS

DISTANCE (bottom of the base plate to the bottom of glass) 0.508mm

ORDERING INFORMATION

SI-CTS200 Complete Cell Tester System

System Includes: Rotating Cuvette System; Micromanipulator System; Signal Conditioning Amplifier with four modules: Optical Transducer Amplifier; Temperature Controller; Anti-Oscillation Unit; Position Controller; data acquisition system with MDAC Software for recording, controlling stimulation and nanomotor position; Force Transducer of choice; Nanomotor; Glass Fiber Cell Mounts (1 set)

SI-CTS200B Cell Tester, Non-Rotating, no Micromanipulator System

SI-CTS200A Cell Tester, Manual Platform, no Micromanipulator System

For additional information, including application notes, go to **wpiinc.com/celltester**

**Contact WPI for help evaluating your specific experimental requirements.*

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Signal Conditioning Amplifier System

Choose the amplifier modules you need to measure nearly anything!

SI-BMFA power frame enclosure plus optional modules (pages 14-17).

Features

- Ergonomic design
- 8-Channel
- Small footprint
- Backplane design includes provision for configurable communication between modules

Benefits

- Up to eight modules connected through the backplane of the chassis allows researchers to assemble the set of electronics they need for their own custom applications
- Standard configuration options are available for Muscle Tester platforms

Applications

- Process transduction of physical signals, displacement and optical force transducer outputs

The transduction of physical signals in the last decade has increasingly moved in the direction of the computer with an electronic amplifier. Further signal conditioning and analysis of sampled raw data is then handled efficiently in software, like WPI's **MDAC** package. The software preserves the raw data and is highly reliable. Operations such as integration, differentiation, filtration and even waveform generation are now efficiently handled in software. On the other hand, however, the transduction of physical signals such as bio-potentials, force, temperature, pressure or ionic concentrations must be measured with an electronic amplifier.

SIH/WPI's physiology amplifier system focuses on this idea and provides a flexible electronic platform intended to process the transduction of physical signals, displacement transducer outputs from force transducer signals. This platform simply focuses on the reliable transduction of the electronic signal and provides a convenient passage for the translation of real world signals to a computer for analysis.

Eight modules connected through backplane

The system consists of a chassis with eight slots on the backplane and includes an ultra quiet, shielded power supply. All of the module outputs are routed to rear panel connectors. If you prefer, outputs may be routed internally to the inputs of other modules. The system has a small footprint and may be stacked to provide as many channels as you need.

The **SI-BMFA** Power Frame is the foundation of the SI modular physiology suite. It incorporates a robust power supply that can accommodate up to eight physiology modules, which can be mixed or matched in any combination. Modules are quick and easy to install, thanks to an innovative and mechanically solid card rail system.

The system is flexible and configurable. A variety of modules are available for the Signal Conditioning Amplifier System, and you can mix and match the modules to suit your requirements.

Optical Transducer Amplifier—SI-BAM21-LCB (page 15)

Programmable Filter Module—SI-PF100B (page 17)

Linear Motor Control Module—SI-MOTDB (page 14)

Temperature Control Module—SI-TCM2B (page 16)

Anti-Oscillation Module—SI-AOSUB (page 17)

Constant Load Module—SI-COLUB (page 16)

Standard options available for muscle testers

When the system is ordered with **SI-MT** (Muscle Tester) system, the Signal Conditioning Amplifier System (chassis) is configured with an **SI-BAM21-LCB**. Optional modules include an **SI-TCM2B** Temperature Control Module, an **SI-MOTDB** Linear Motor Controller, an **SI-PF100B** Programmable Filter Mondule, the **SI-AOSUB** Anti-Oscillation Module and the **SI-COLUB** Constant Load Unit. The Temperature Control Module and Linear Motor Controller require two slots each on the chassis backplane.

ORDERING INFORMATION

SI-BMFA	Power Frame Enclosure
SI-MOT-MT	Linear Motor for SI-HTBM system
SI-MOTDB	Linear Motor Controller
SI-BAM21-LCB	Optical Transducer Amplifier
SI-TCM2B	2-Channel Temperature Control Module
SI-COLUB	Constant Load Module
SI-AOSUB	Anti-Oscillation Module
SI-PF100B	Programmable Filter Module

Signal Conditioning Amplifier System

Choose the amplifier modules you need to measure nearly anything!

Linear Motor Control Module

Features

- Powers the motor and provides an output indicating the actual motor position
- Connects to Analog to Digital Converter output of the computer or data acquisition system (like LabTrax-MDAC) to allow the control of the programmed waveform and timing of the motor control
- Input range of ±10 VDC
- Linear motor position is determined by a DC value applied from the Position In port
- 2-Slot control module for a linear motor

Benefits

- Over current protection that automatically shuts down when the supply voltage dips below the reference value
- External ±10 VDC position command input for control by a constant load module or data acquisition system

Applications

- Slack test
- Isotonic release
- Constant velocity release
- Stretch release
- Eccentric/concentric contractions (intact muscle)

SI-MOTDB

The SI-H Linear Motor Controller is designed for use with the SI-H line of muscle physiology research platforms. For systems that require a linear motor, this unit provides the precision control of the motor. A linear motor is required to perform mechanical muscle testing such as slack-tests, isotonic releases, constant velocity releases, stretch releases, after-loaded contractions and eccentric contractions (intact muscle). The position of the linear motor is determined by a combination of the data from the controller indicating the current position and the DC value applied to the front panel at the Position In port. The applied Position In signal can be provided by a data acquisition system (**LabTrax-MDAC** to use standard or customized protocols). The data acquisition analog output signal is set to define the waveform and timing pattern of force to be applied to the sample.

The SI-MOT motor can be used with any SI-MTM-L Muscle Tester.

SI-MOTDB SPECIFICATIONS	
POWER REQUIREMENTS	12 V DC provided by the chassis
INPUT	±10 V DC
TRAVEL	1 mm/2 VDC current
MAXIMUM TRAVEL	7 mm (±3.5 mm from center of travel)

ORDERING INFORMATION	
SI-MOT-MT	Linear Motor for SI-MTM-L system
SI-MOTDB	Linear Motor Controller

Biofluorometer

Reliable, simplified and affordable LED based fluorometer

Perfect for:
Ratiometric Calcium & ATPase

Recent advancements in optics and LED technology simplify ratiometric calcium imaging, making this equipment more affordable. A breakthrough in WPI patented technology allows the **SI-BF-100** to use wavelengths below 380 nm and produce more light in those spectra. This technology significantly cuts the cost of photometric calcium imaging without sacrificing resolution or quality.

Streamlined system to reduce errors

Up till now, calcium imaging systems have been required to compensate for errors and noise introduced by the complexity of their design. The systems require mechanical filters and use expensive xenon or mercury light sources. The beauty of the **SI-BF-100** is its simplicity. The elegance of its design reduces the noise introduced into the system and the errors inherent in traditional systems.

SI-BF-100

This single wavelength spectrophotometer can be customized for your specific application. See page 20 for details.

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Optical Force Transducer Amplifier Module

Features

- Designed for use with SI-H Muscle Tester Platforms
- Rapid auto zeroing function with fine offset adjustment
- Offset indicator LED's
- Multiple gain ranges with adjustable fine tuning for precise calibration
- 1X, 2X, 5X, 10X gains. Optional factory setting allows for 10X, 20X, 50X and 100X gains

Benefits

- Single amplifier that spans the entire SI-KG optical force transducer line
- Manual calibration to the ±10 V measurement range, for covering maximum forces ranging from 50 mN to 2N. When using the **SI-KG7A**, can calibrate as small as 5 mN.

Applications

- Muscle physiology studies, including isotonic studies

SI-BAM21-LCB

The **SI-BAM21-LCB** amplifier for SI-KG Optical Force Transducers is used in conjunction with the SI-H muscle physiology systems. The **SI-BAM21-LCB** powers the force transducer and converts the output of the transducer to an amplified analog voltage that is proportional to the force applied to the force transducer. The output signal can be multiplied by a factor of 1, 2, 5 or 10 to provide better resolution for a minimal change in applied force.

NOTE: An optional factory setting increases the multiplier by a factor of 10, allowing the signal to be multiplied by 10, 20, 50 and 100.

The **SI-BAM21-LCB** amplifier works with SI-KG optical force transducers to:

- Generate an analog output (-10 VDC to +10 VDC) that is proportional to the force applied to the tissue sample.
- Supply a DC voltage that powers the SI-KG force transducer to which it is connected.

Also available in a single stand-alone enclosure, either version provides an incredibly quiet, linear and stable transducer signal to your data recording system.

How the SI-BAM21-LCB amplifier works

In a typical setup, a muscle is held by a force transducer. The force transducer is connected to the **SI-BAM21-LCB**. As the muscle contracts or releases, the transducer converts the force into an electrical current signal which is proportional to the force applied to the transducer. The **SI-BAM21-LCB** converts the current signal into a voltage signal that can be displayed on the screen of the recording device.

Before initiating an experiment, the **SI-BAM21-LCB** must first be zeroed. This sets the baseline for measurements to follow.

The output signal is buffered and multiplied by 1, 2, 5 or 10, depending on the Gain switch setting on the front panel of the amplifier module. The ×10 setting is useful when output signals are extremely small. Finally, the force proportional signal is sent through the output amplifier circuit.

The analog output has a range of –10 V to +10 V that drives the **LABTRAX-MDAC** data acquisition system, multimeter or oscilloscope.

NOTE: When the Signal Conditioning Amplifier System is configured at the factory for an **SI-HTB** or **SI-MT** Muscle Tester system, the signal is routed internally from the **SI-BAM21-LCB** module to the **SI-AOSUB** module.

SI-BAM21-LCB SPECIFICATIONS

INPUT CONFIGURATION	Current to voltage converter
GAIN	1×, 2×, 5×, 10× Optional factory setting: 10×, 20×, 50×, 100×
INPUT OFFSET ADJUSTMENT	± 2.0 VDC
OUTPUT IMPEDANCE	470 Ω
POWER	12 VDC provided by chassis
OUTPUT RANGE	± 10 VDC

ORDERING INFORMATION

SI-BAM21-LCB	Optical Transducer Amplifier
SI-BAM21-LC	Stand alone Optical Force Transducer Amplifier

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

LABTRAX-MDAC	LabTrax 8/16 with MDAC software
2851	BNC Cable
SI-KG2	0-2 N Force Transducer
SI-KG2B	0-200 mN Force Transducer
SI-KG4	0-50 mN Force Transducer
SI-KG7a	0-5 mN Force Transducer
SI-KG7b	0-10 mN Force Transducer
SI-KGxx	contact WPI for specialty transducers with different range

See Optical Force Transducers on page 22.

SI-BAM21-LC

*The stand-alone **SI-BAM21-LC** Force Transducer Amplifier has all the capabilities of the Signal Conditioning Amplifier module (**SI-BAM21-LCB**).*

Signal Conditioning Amplifier System

Choose the amplifier modules you need to measure nearly anything!

Temperature Control Module

Features

- Uses PID control to maintain a constant temperature with ±0.1°C tolerance
- Easy to control with simple interface
- Also available as a stand-alone device
- 2-Slot control module for maintaining temperature control

Benefits

- Controls two cuvettes simultaneously
- User defined high and low alarm warnings

Applications

- Muscle physiology applications using SI-H muscle tester platforms

SI-TCM2B

The SI-H Temperature Control Unit is designed for use with the SI-H line of muscle physiology research platforms. It maintains the temperature of an SI-H cuvette up to 45°C. It is accurate to 0.1°C. The circuit is appropriate to RTD (resistive temperature device) applications. It linearly converts a temperature reading to a voltage that is displayed as a temperature on the SI-TCM2 and can be recorded. This unit is available in a stand-alone model and as a module for the Signal Conditioning Amplifier System backplane.

Call for details and pricing information.

SI-TCM2 SPECIFICATIONS	
INPUT CONFIGURATION	Current to voltage converter
POWER REQUIREMENTS	12 V DC at 2.5A 50/60 Hz wall adaptor, 2.5 mm ID/5.5 mm OD with positive center DC barrel (included–WPI #801513)
OPERATING TEMPERATURE RANGE	Room temperature
MAXIMUM TEMPERATURE	45°C
DISPLAY PRECISION	0.1°C
CONTROLLER RESOLUTION	0.1°C
CUVETTE TEMPERATURE SENSOR	1000 Ω RTD (1000 Ω at 0°C)

ORDERING INFORMATION	
SI-TCM2B	2-Channel Temperature Control Module
SI-TCM2	2-Channel Temperature Control, Stand-Alone

Constant Load Module

Features

- Offers three modes including Constant Load, External Loop and Bypass
- Can be configured using **LabTrax-MDAC** data acquisition system

Benefits

- Precise time resolution for feedback control in isotonic muscle testing

Applications

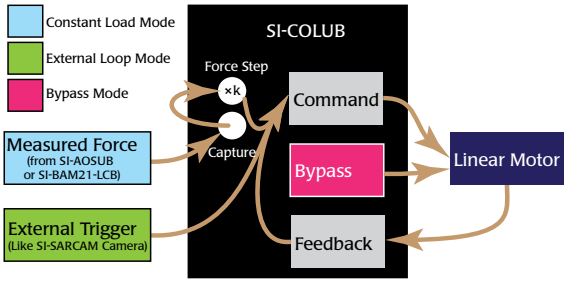
- Muscle physiology applications using SI-H muscle tester platforms

SI-COLUB

The **SI-COLUB** Constant Load Module for performing constant load experiments, has augmented flexibility. In its primary mode (Constant Load) the unit takes an external trigger command from the force transducer to perform a constant load cycle. In addition, the module allows for a different external trigger or you can completely bypass the module without having to switch cabling.

The Constant Load Module lets you maintain a constant force, muscle length or sarcomere length rather than keep the total length of the preparation constant during an isotonic test. This is accomplished using a feedback loop.

The **SI-COLUB** monitors a designated parameter to determine how much force is necessary. It also monitors a feedback signal. The motor position command signal driving the motor is constantly adjusted to drive the feedback signal to the commanded setpoint.



SI-COLUB SPECIFICATIONS	
COMMAND REQUEST	±10 V
FEEDBACK	±10 V
MOTOR OUTPUT	±10 V
POWER REQUIREMENTS	12 V DC provided by the chassis

ORDERING INFORMATION	
SI-COLUB	Constant Load Module

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Anti-Oscillation Module

Features

SI-AOSUB

- Neutralizes nearly 100% of the unavoidable transducer oscillation in optical force transducer
- High time-resolution of the corrected force signal in ms range
- Additional powerful signal smoothing with high time fidelity for all higher harmonics

Benefits

- Goes beyond traditional low-pass filtering of an oscillated signal
- No phase-shift in the force signal
- High time fidelity in following the applied step signal

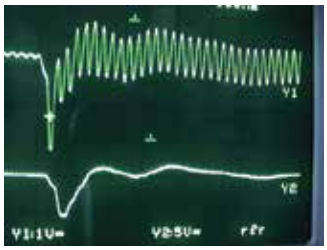
Applications

- All types of optical-based force measurements

Within a force transducer, the applied force displaces an elastic component of the transducer. This displacement is transformed into an electrical signal. If the displacement of the elastic component is small and if the displacement is linearly transformed into an electrical signal, the external force and electrical signal are linearly related to each other.

However, shortly after the force changes rapidly the electrical signal does not follow the applied force linearly, as the elastic element and the force transducer pin have a mass. So, the system acts not only as an elastic device but also as a harmonic oscillator, notably when the force changes rapidly, resulting in oscillation of the system around the new displacement level (ringing phenomenon).

To address this problem, WPI's Anti-Oscillation Unit (**SI-AOSUB)** uses a genuine electronic approach to remove the unavoidable transducer oscillation, based on electronic differentiation of the force signal and subsequent low-pass filtering of the resulting high-frequency signal.



The upper trace is a force transient obtained directly from the bridge amplifier output, and the lower trace shows the signal after it passes through the anti-oscillation module.

*To adjust the anti-oscillation filter properly, the transducer is excited at its resonance frequency using a magnetic driver or pulser (WPI #**97204**). The Pinger (WPI #**97204**) is included with the anti-oscillation module.*

SI-AOSUB SPECIFICATIONS

POWER	12 VDC provided by chassis
INPUT	± 10 VDC
PULSER OUTPUT	0 – 10 VDC adjustable 0.1 Hz – 4.0 KHz
DAMPING FREQUENCY RANGE	0.1 Hz – 2.0 KHz
OUTPUT RANGE	± 10 VDC

ORDERING INFORMATION

SI-AOSUB	Anti-Oscillation Module
97204	Pinger for Anti-Oscillation Module
2851	BNC Cable

Programmable Filter Module

Features

- Low Pass Filter
- Bessel and Butterworth filters
- Programmable cutoff frequency
- Signal may be routed through the backplane or through the front panel BNCs

Benefits

- General purpose filter module for nearly all type of noisy signal

Applications

- Muscle physiology applications using SI-H muscle tester platforms

When you use a motor, an **SI-PF100B** Programmable Filter is necessary to minimize the natural vibration. It is designed so you can eliminate the resonance frequency without affecting the signal of interest. It is a low pass filter set to pass signals of interest below the specified frequency. It can be calibrated from 5 to 1,000 Hz.

You may select either a Bessel or a Butterworth filter. Then, you must carefully select the cutoff frequency based on the typical resonance frequency of your force transducer and your own experimental setup.

When the Signal Conditioning Amplifier System electronics are configured at the factory with an **SI-PF100B** Programmable Filter, the signal is routed internally from the amplifier module (**SI-BAM21-LCB**) to the **SI-PF100B**. If you prefer, the signal may be routed from the amplifier through the ports on the front panel of the Programmable Filter using a standard BNC cable.

SI-PF100 SPECIFICATIONS

POWER	12 VDC provided by chassis
INPUT	± 10 VDC
CUTOFF FREQUENCY RANGE	5–1,000 Hz
FILTER TYPES	BESSEL, BUTTERWORTH

ORDERING INFORMATION

SI-PF100B	Programmable Filter Module
SI-PF100	Programmable Filter in Stand-Alone Enclosure

*The Programmable Filter Module as stand-alone unit (**SI-PF100**) can be used for filtering two independent input signals, with the installation of a second **SI-PF100B** module (not included).*

Optical Sarcomere Spacing System

Measure sarcomere spacing with nanometer accuracy

Features

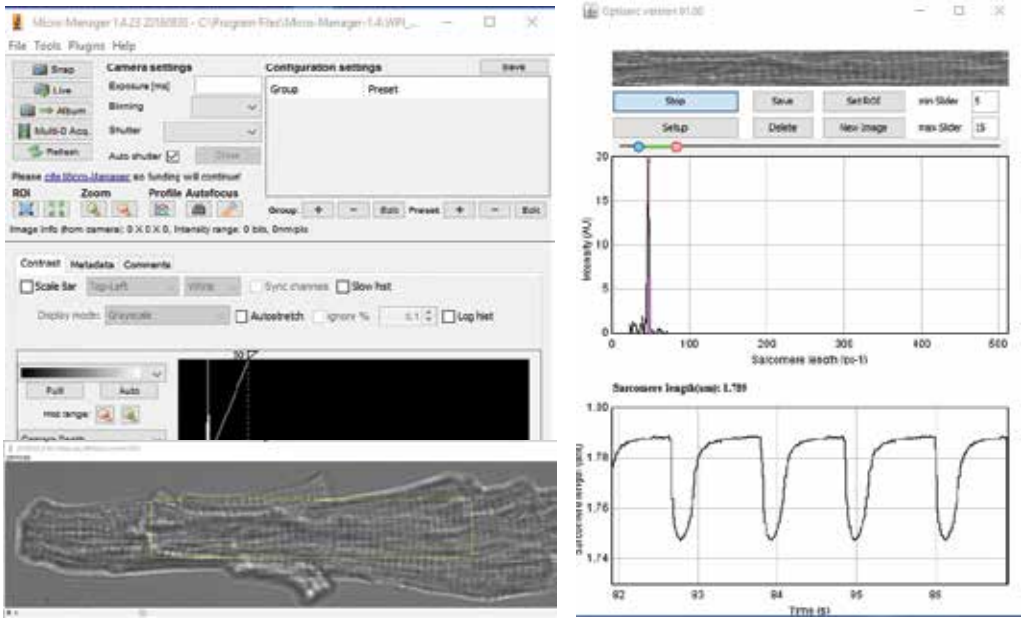
- Monitors high-speed dynamic sarcomere length changes
- Sarcomere spacing measurement with nanometer accuracy
- NIH open-source µManager* software interface between USB 3.0 camera and microscope
- Synchronous use of Sarcomere Spacing plug-in and µManager software
- User defined Region of Interest (ROI) for image capturing from whole cell down to a minimum of 6 consecutive sarcomeres
- Compatible with Windows 10

Benefits

- Camera image capturing using the standard µManager software familiar to researchers
- Use Image toolboxes for complementary image processing
- Live image processing and display of length changes in sarcomere spacing of contracting muscle cells and fibers
- Synchronous storage of live images and processed data in user-friendly MS Excel format, for further offline analysis
- User defined ROI setting allows focusing on specific cell regions and changing image capturing speed
- High-speed USB 3.0 camera fits to all standard inverted microscopes with C-Mount adapter

Applications

- Cardiac muscle physiology
- Skeletal muscle physiology
- Quality control of muscle slices in meat industry



µManager software interface and Optisarc image processing plug-in for sarcomere spacing detection run simultaneously during live image capturing of contracting cardio myocyte on selected ROI (Image with courtesy of Dr. Michael Kohlhass, Universitätsklinikum des Saarlandes, Homburg).

WPI's Optical Sarcomere Spacing System quantifies live images to detect length changes in sarcomere spacing in nanometer accuracy during twitch or tetanus contractions of muscle cells/fibers. The NIH µManager software interface and WPI's image processing plug-in for sarcomere spacing detection monitor and measure sarcomere length changes of the contracting muscle cells in real time with an optimal frame rate of 500 FPS.

The Optical Sarcomere Spacing System fits perfectly with WPI's Cell Tester system (**SI-CTS200**) to capture twitch contraction of cardio myocytes, synchronous with the force signal. Extend the quantification by adding measurements of Ca^{2+} or ATPase concentration of contracting muscle cells/fibers using the WPI's Biofluorometer (**SI-BF-100**) simultaneously.

The Optical Sarcomere Spacing System can also be extended for capturing sarcomere length changes in slow-twitch and fast-twitch skeletal muscle cells/fibers.

Sarcomere spacing detection of any muscle slice is also possible using genuine image processing methods for high reproducible measurements of selected sarcomere regions in static images.

OPTISARC CAMERA SPECIFICATIONS	
IMAGE SENSOR	1/2.5" 5 megapixel monochrome CMOS
ACTIVE PICTURE ELEMENTS	2,592 (H) x 1,944 (V).
MAXIMUM FRAME RATE	2,106 FPS @ 32 x 32.
OPTIMAL FRAME RATE	500 FPS @ 296 X 148
CONNECTION	USB 3.0 Micro-B

ORDERING INFORMATION	
SI-OSARC	USB 3.0 CMOS Camera with OptiSarc software plug-in for live image capture to detect sarcomere spacing
INV-101	Inverted Microscope with C-mount Adapter
SI-BF-100**	Biofluorometer
SI-CTS200**	Cell Tester

µManager* was developed at Vale laboratory at UCSF, funded by an NIH grant R01-EB007187 from the National Institute of Biomedical Imaging and Bioengineering (NBIB). https://micro-manager.org/ and https://imagej.nih.gov/ij/

**Arthur Edelstein, Nenad Amodaj, Karl Hoover, Ron Vale and Nico Stuurman (2010): Computer Control of Microscopes using µManager.* Current Protocols in Molecular Biology, *Chapter 14, Unit 14.20, 22 pages.*

*** For simultaneously use with SI-BF-100 and SI-CTS200, ask WPI about selecting an appropriate microscope.*

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Ca^{2+} Detection in Muscle Tissue using Fluorescence Spectroscopy

The use of fluorescent probes in cell physiology has emerged as indispensable tool in the analysis of cell functioning over recent years. The physics underlying fluorescence is illustrated by the electronic-state diagram (so-called Jablonski diagram, see Fig. 1), showing the three-stage process to create the fluorescent signal (Excitation - Excited/State Lifetime - Fluorescence Emission) in a fluorophore/indicator and simplified described below.

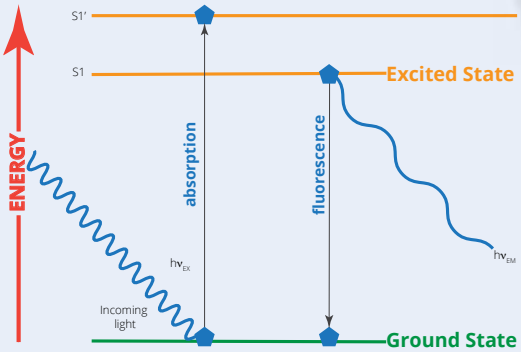


Fig. 1– Jablonski diagram illustrating the processes of fluorescence by absorption of higher photon energy by a fluorophore and subsequent emission of lower photon energy, resulting in fluorescence during the fluorescence-lifetime.

Fluorescence is obtained when an excitation photon ($h\nu_{EX}$) from an external source, such as a high-power LED, is absorbed by a fluorophore that elevates its energy (S1'). During the fluorescence-lifetime, the elevated energy (S1') decays to a lower energy state S1. Then, fluorescence results in the emission of a photon with lower energy ($h\nu_{EM}$) and at a lower wavelength. Fundamental in spectroscopy is the difference in energy or wavelength represented by ($h\nu_{EX}$-$h\nu_{EM}$), which is called the Stokes shift. The Stokes shift allows efficient discrimination of the excitation, making fluorescence a very sensitive technique and able to be detected against a low background, isolated from excitation photons.

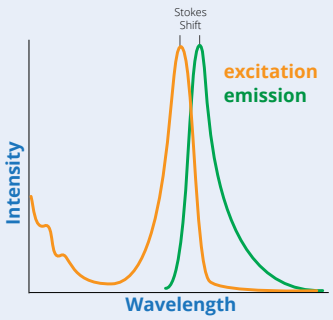


Fig. 2– Typical excitation and emission spectra, showing the lower wavelength of the excitation source and higher wavelength of the fluorescence.

Four essential elements of fluorescence signaling can be then identified to build up a detection system:

- Excitation light source adapted to the absorption bandwidth of the fluorophore (e.g. high-power LED of specific wavelength)
- A fluorophore/indicator (e.g. Fura-8 for free Ca^{2+} detection in muscle tissue)
- Emission wavelength filters to limit the bandwidth of the emission photons or overlapping bands
- A detector system that registers the fluorescence light and produces a recordable output as an electrical signal (e.g. Photomultiplier tubes).

Regardless of the application, compatibility of these four elements is essential for optimizing fluorescence detection.

Example of free Ca^{2+} detection in muscle tissue

Typically, a fluorescent dye is introduced into tissue or single cells to obtain a fluorescent response of the labeled molecule. A typical example is the detection of the transient increase in the cytoplasmic/myoplasmic free calcium concentration ($\Delta[Ca^{2+}]$) as the intermediate signaling event of the excitation-contraction coupling. The quantification of $\Delta[Ca^{2+}]$ is done using a monochromatic light to excite the dye labeled Ca^{2+} molecule in a tissue/cell sample either in a tissue bath or microscopic experimental set-up. The emitted fluorescence signal from the indicator dye can be then used to monitor the amplitude and time-course of the $\Delta[Ca^{2+}]$ detected by sensitive detectors, such as highly sensitive photomultiplier tubes (PMT module) or cameras.

The ratiometric indicator dye Fura-8 was selected for the detection of free calcium concentration ($\Delta[Ca^{2+}]$) in heart muscle tissue slices. Fura-8 was excited at 365nm and 410 nm wavelengths and the emission recorded at 535 nm wavelength in dual excitation/ single emission mode. The advantages of choosing this ratiometric measurement technique with dual excitation/single emission using Fura-8 were minimization of movement artifact, cancellation of possible effects of uneven loading, inhomogeneous distribution of fluorescence indicator in the cells or indicator bleaching in the detection of free calcium concentration ($\Delta[Ca^{2+}]$) in the muscle tissue.

This allowed quantification and comparison between:

- High spatial versus high time resolution techniques on the human left ventricular slices
- The possibility to measure free calcium concentration ($\Delta[Ca^{2+}]$) transients in a horizontal tissue bath on human left ventricular slices or murine slices.

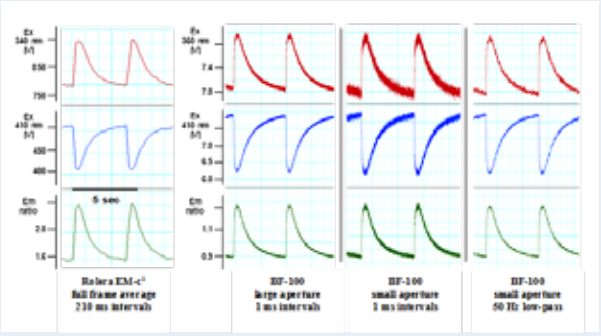


Fig. 3– Qualitative representation some results of free Ca2+ detection in human heart slices using the **SI-BF-100** *system.*

Average fluorescence intensities of Fura-8 loaded human left ventricular slices detected at 525 nm, when excited at 340 nm and 410 nm, respectively, and ratios calculated (lower trace) from the imaging data of a Rolera EM-C2 camera (left). Right, the response of the **SI-BF-100** detected at 525 nm, when excited at 365 nm and 410 nm wavelength using two aperture settings and calculated ratios (lower traces). Furthermore, fluorescent data collected with the small aperture setting and low-pass filtered at 50 Hz is shown (from: Belz et al., Proc. SPIE 9702, 2016).

References

Belz M., et. al. Fiber optic Biofluorometer for physiological research on muscle slices. Proc. SPIE 9702, Optical Fibers and Sensors for Medical Diagnostics and Treatment Applications XVI, 2016.

Spectrophotometry. Wikipedia, the free encyclopedia, 2017 (Cross-references).

Biofluorometer

Reliable, 2-channel, LED-based fluorometer

Features

- Two photomultiplier inputs
- Light excitation with high power LEDs
- Modes: single excitation & single emission, single excitation & dual emission, dual excitation & single emission
- 2 channel mode (two single excitation & single emission)
- Optical connections: Liquid Light Guides (LLGs) and SMA terminated fibers
- Sampling rates up to 1 kHz (1000 ratios/second)
- Automatic LED light drift correction for long term measurements
- Automatic room light correction
- Optional fiber optic probes for horizontal tissue bath applications
- Optional imaging probes for Langendorff systems
- Optional attachments for direct connection to fluorescence microscopes via epifluorescence port (excitation) and C-Mount (Emission) via liquid light guides

SI-BF-100

Benefits

- Versatile instrument for horizontal tissue bath, Langendorff and microscope applications
- Warmup time < 1 minute
- Low bleaching mode (5% LED On time)
- Can be combined with imaging based Sarcomere Detection System (OptiSarc)
- SMA and Liquid Light Guide connections
- Single and dual emission or excitation detection methods
- 2-channel instrument for single excitation/single emission dyes
- Customized analysis techniques in WPI's MDAC data acquisition software

Applications

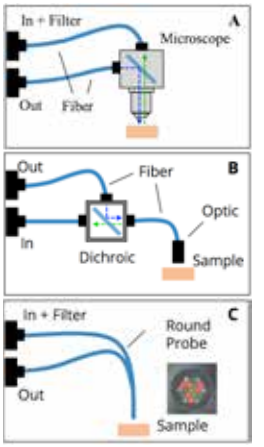
- Ratiometric calcium measurement and ATPase
- Fluorometric applications in neuroscience and cell biology
- The **SI-BF100** is an LED-based fluorometer for life science applications. It is ideally suited for ratiometric calcium detection (FURA-8) and ATPase detection (via NADH fluorescence). With up to three LED modules (wavelengths), the **SI-BF100** covers many fluorometric applications in neuroscience and cell biology.

The **SI-BF-100** enables the detection and analysis of fluorescence signals in four different modes:

- Single excitation/single emission–In this classical mode, a fluorophore is excited at one wavelength and the fluorescence signal is detected at a single higher wavelength using one photomultiplier. The concentration of the analyte is directly proportional to the intensity of the detected signal.
- Dual excitation/single emission–A fluorophore is excited at two wavelengths and the fluorescence signal is detected at one wavelength using one photomultiplier. The concentration of the analyte is proportional to the ratio of the two detected fluorescence signals. This ratiometric concept minimizes the effect of indicator dye bleaching and motion artifact in experiments. A typical example is the detection of free calcium in muscle tissue using the indicator dye Fura-8™.
- Single excitation/dual emission–A fluorophore is excited at one wavelength and the fluorescence signal is detected at two wavelength using two photomultipliers.
- Dual excitation/dual emission–Two separate fluorophores are excited at different wavelengths and the fluorescence signal of each fluorophore is detected at two separate wavelengths using two photomultipliers.

Experimental Setups

Possible experimental setups for the **SI-BF-100** include:



A: This **SI-BF-100LLG** setup depicts the attachment to a fluorescent microscope.

B: This **SI-BF-100LLG** setup shows a single fiber based detection system with a dichroic mirror and an imaging system at the distal end of a liquid light guide. Dichroic mirrors are used in A and B to separate excitation and emission light.

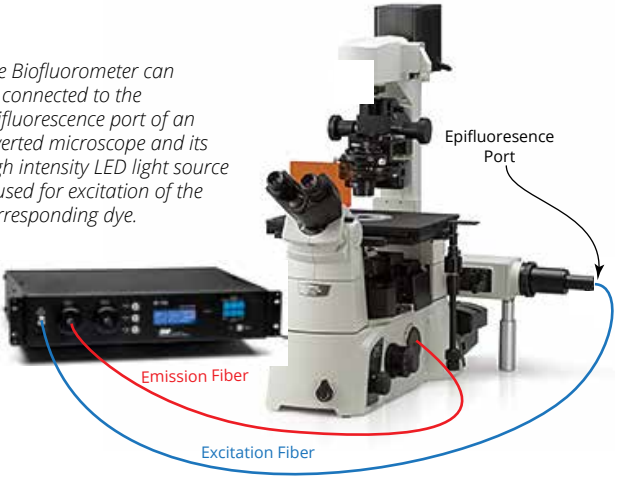
C: The **SI-BF-100SMA** setup has a round shaped fiber bundle that is used to deliver excitation light to and pick up fluorescent light from the sample (adapted from Belz et al., 2016).

Single and dual emission probes

All probes use fibers with a 300 µm core diameter. Excitation fibers have 1000 µm SMA connectors for Excitation and Double Emission Probes and 1500 µm SMA connectors for Single Emission Probes.

This SMA Single Emission Probe has a for muscle strips, where the middle fibers are used for excitation and the rectangular fiber pattern, optimized surrounding fibers are used for detection.

The Biofluorometer can be connected to the epifluorescence port of an inverted microscope and its high intensity LED light source is used for excitation of the corresponding dye.



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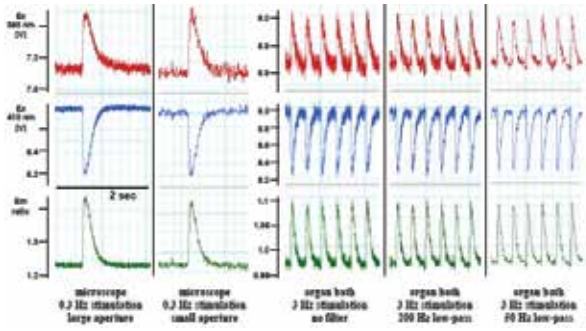
Biofluorescence of calcium use in heart muscle slices with Fura-8

Calcium sensing

A specific target molecule in muscle contraction is Ca^{2+} as key intermediate signaling event between excitation and contraction of muscle fibers, and thus essential for the analysis of the force development in muscles. On the cellular level, force production is therefore directly related to the transient increase in the myoplasmic free calcium concentration. More specifically, the assessment of both parameters simultaneously is therefore critical in the evaluation and interpretation of the force development characteristics. Fluorescence techniques used in conjunction with muscle research systems (like WPI's **SI-MT-L** or **SI-HTB2**) to record muscle force is an **innovative technique** in cardiac muscle and skeletal muscle physiology. WPI's Biofluorometer (**SI-BF-100**) was specifically developed to monitor rapid changes in Ca^{2+} transients, i.e. $\Delta[Ca^{2+}]$.



Organ bath setup: Average fluorescence intensities of Fura-8 loaded murine myocardium slices excited at 365/410 nm wavelength and detected at 525 nm. Left, using two apertures for fluorescence detection via the microscope. Right, same experimental condition using optical fiber fluorescence detection with the SI-BF-100SMA in the organ bath, sampled at 1 kHz. The organ bath data are low-pass filtered at 200 Hz or 50 Hz cut-off frequency. Adapted and reprinted with permission from Belz et al., Proc of SPIE Vol 9702, 97020Q-1 - 97020Q-11, 2016.

Advantages using Fura-8 dye:

- More sensitive to calcium than Fura-2
- Higher signal-to-noise ratio than Fura-2
- Simplified dye loading by incubation for 1 hour at room temperature
- Emission peak response is shifted to longer wavelength (peak at 525 nm)
- Red-shift dual excitation wavelength (354 nm and 415 nm)

Application in heart muscle slices

The Biofluorometer opens a wide field in functional fluorescence research, by studying the fundamental and/or applied aspects of the underlying energetics and signaling aspects of muscle contraction. This is notably useful in:

- Pre-clinical & Toxicological Studies:
  - screening of potential drugs
  - evaluating the side effects of drugs
  - evaluating models of cardiac disease
- Sports & Rehabilitation:
  - disuse vs. overuse
  - muscle damage
  - function for heart transplantation

The SI-BF-100 Organ/tissue bath setup with an SMA single emission probe for direct sensing of calcium fluorescence signal. Photo courtesy of Professor Andreas Dendorfer, Walter Brendel Zentrum, München, Germany.

System configuration

The **SI-BF-100** setup for detecting Ca^{2+} transients via Fura-8 depends on the excitation and emission wavelengths of the indicator dye Fura-8.

The**SI-BF-100** setup depends on your experimental paradigm and the sample size of interest:

- **BF-100SMA-C-Fura 8**: direct sensing of calcium via direct measurement in tissue sample
- **BF-1002XLG-C-Fura 8**: direct sensing of calcium via microscope setup in muscle cell or in small tissue sample
- **BF-100CAM-C-Fura 8**: calcium imaging via microscope setup with camera in muscle cell or in small tissue sample

BF-100SMA-C-Fura 8	***Includes***
SI-BF-100 Main Unit with SMA connection	(1) SI-BF-100SMA
HP LED 365 nm	(1) 99209-1
HP LED 420 nm	(1) 99209-4
Optical Filter 535 nm, 43 nm BP	(1) 802238
Single Emission Probe	(1) 94650

BF-100CAM-C-Fura 8	***Includes***
SI-BF-100 Main Unit with LLG connection	(1) SI-BF-100LLG
HP LED 365 nm	(1) 99209-1
HP LED 420 nm	(1) 99209-4
Optical Filter 535 nm, 43 nm BP	(1) 802238
Liquid Light Guide Ø 3mm	(3) 802407
CM-CAM-2XLG Packaging	(1) 99259

BF-1002XLG-C-Fura 8	***Includes***
SI-BF-100 Main Unit with LLG connection	(1) SI-BF-100LLG
HP LED 365 nm	(1) 99209-1
HP LED 420 nm	(1) 99209-4
Optical Filter 535 nm, 43 nm BP	(1) 802238
Liquide Light Guide Ø 3mm	(2) 802407
CM-2XLG Packaging	(1) 99261

SI-BF-100 SPECIFICATIONS

MEASUREMENT PRINCIPLE	Fiber optic fluorometer with 2 inputs and 1 output
DETECTOR INPUTS	2 PMTs
EXCITATION	High Power LED Modules: 365 nm, 420 nm, 470 nm, 530 nm (select any 3 modules, when ordering)
ANALOG OUTPUT RANGE	0–10V
OPTICAL CONNECTIONS	Choice of Liquid Light Guide (LLG) or SMA connections
POWER	12 V/2 A (includes external 100 – 240 V / 50 – 60 Hz power supply)
DIMENSIONS (h x w x d)	3.5 x 17 x 13 in. (88 x 431 x 330 mm)

ORDERING INFORMATION

SI-BF-100LLG	Biofluorometer with LLG Optical Connections
SI-BF-100SMA	Biofluorometer with SMA Fiber Optic Connections
99261	C-Mount Microscope Attachment for 2x PMTs
99259	C-Mount microscope attachment for 1x camera & 2x PMTs
	Includes 1x camera C-Mount adapter with adjustable aperture

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

SI-BF-SMA-UPGRADE	Biofluorometer Upgrade Kit for SMA optical probes
SI-BF-LLG-UPGRADE	Biofluorometer Upgrade Kit for LLG connections
802407	Liquid Light Guide (LLG), 3mm diameter, 6 ft. long
M3301	Manual Manipulator for securing the probe
M10	Magnetic Base
94650	Single Emission, Small Tissue Probe
94689	Dual Emission, Small Tissue Probe

Check our website for new LED modules, emission filters and dichroic mirrors for specific applications.

KG Optical Force Transducers

- Simple calibration
- Different models to accommodate a wide range of forces and sensitivities
- Nearly insensitive to changes in temperature/ambient light
- Extremely high level of linearity
- Virtually indestructible with normal use
- KG transducers are required for use with **SI-BAM21** amplifiers

SI-KG4

TRANSDUCER SPECIFICATIONS
UNLOADED TRANSDUCER WITHOUT TISSUE MOUNTING SUPPORT

	Force Range	Range	Noise	Compliance	Resonance Frequency
SI-KG7	0-5 mN	0-0.5 g	0.2 µN	10 nm/mN	250 Hz
SI-KG7a	0-5 mN	0-0.5 g	0.4 µN	5 nm/mN	500 Hz
SI-KG7b	0-10 mN	0-1 g	1 µN	1.5 nm/mN	550 Hz
SI-KG2	0–2 N	0-200 g	250 µN	150 nm/mN	1.3 kHz
SI-KG2B	0–0.2 N	0-20 g	80 µN		590 Hz
SI-KG4	0–50 mN	0-5 g	15 µN	0.5 nm/mN	1.2 kHz
SI-KGxx	*Contact WPI for specialty transducers with different ranges.*				

Tissue Mounting Hooks

Mounting hooks can be used in a variety of combinations, depending on the type of tissue to be examined.

Mounting hooks are sold in kits. Currently, there are 11 kit configurations, each available in four different sizes. The mounting hook size that is required depends on the force transducer used.

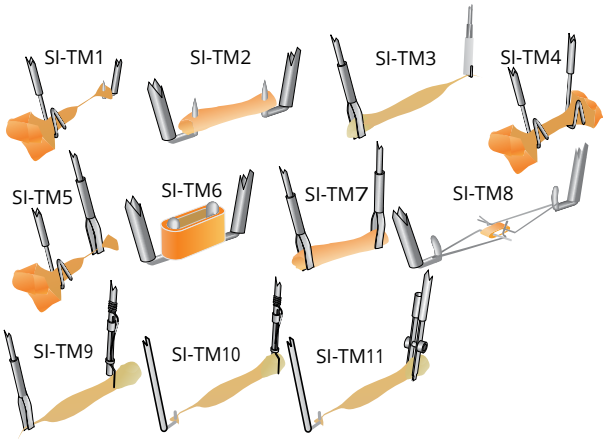
Vascular hooks are available for mounting blood vessels (rings). They are normally used with a pair of blunt hooks (**SI-TM8**).

For larger muscles, screw clamps (**SI-TM11**) and spring clips (**SI-TM9**, **SI-TM10**) are available.

The micrometer and motor receive a large (**SI-KG4** size) tissue mount. If a smaller tissue mount is used, the **97909** adapter is required. This adapter is included with every **SI-MT** or **SI-HTB** system.

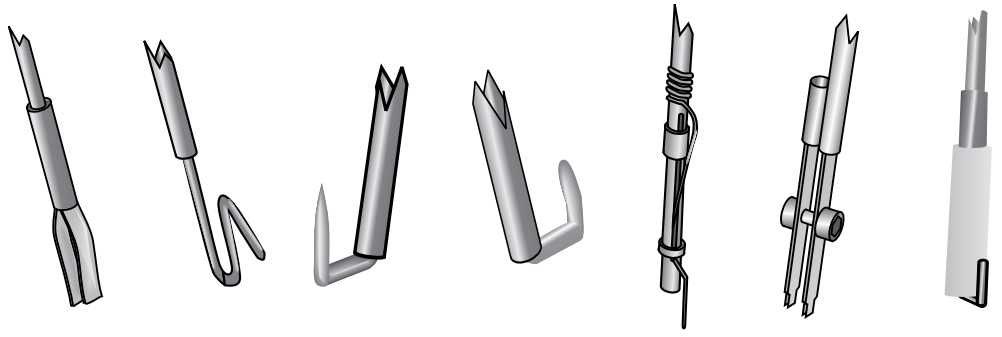
Ordering

When ordering tissue mounts, specify the tissue mount configuration and force transducer to be used.



Force Transducer mount pictured on the left; Motor/micrometer mount pictured on the right.

Tweezer **Basket** **Pointed Hook** **Blunt Hook** **Spring Clip** **Screw Clip** **Tendon Hook**



The **97909 tissue mount adapter tube (OD:0.096˝, ID:0.035˝) allows you to use **SI-KG4** size mounting hooks with **SI-KG2** size force transducers.*

ORDERING INFORMATION

	Force Transducer Mount	Micrometer/Motor Mount	Force Transducers
SI-TM1 Papillary Muscle	Basket	Pointed Hook	Available for all force transducers
SI-TM2 General Purpose	Pointed Hook	Pointed Hook	Available for all force transducers
SI-TM3 Small Skeletal Muscle	Tweezer	Tendon Hook	Available for all force transducers
SI-TM4 Trabeculae	Basket	Basket	Available for all force transducers
SI-TM5 Papillary Muscle	Basket	Tweezer	Available for all force transducers
SI-TM6 Muscle Rings	Blunt Hook	Blunt Hook	Available for all force transducers
SI-TM7 General Purpose	Tweezer	Tweezer	Available for all force transducers
SI-TM8 Muscle Rings	Blunt Hook/Vascular Hook	Blunt Hook/Vascular Hook	Available for all force transducers
SI-TM9 Strong Skeletal Muscle	Tweezer	Spring Clip	**SI-KG2, SI-KG2A, SI-KG2B** Only
SI-TM10 Strong Skeletal Muscle	Pointed Hook	Spring Clip	**SI-KG2, SI-KG2A, SI-KG2B** Only
SI-TM11 Very Strong Skeletal Muscle	Pointed Hook	Screw Clamp	**SI-KG2, SI-KG2A, SI-KG2B** Only

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4-Channel Data Acquisition System with Software

Low noise, high resolution system with 8 analog input and 3 analog output channels

Features

- Powerful low-noise (<1 mV RMS) and high-resolution (16 bits) data acquisition system for sampling up-to 8 analog input channels and 3 analog output channels simultaneously, using standard BNC connections
- MDAC software provides easy to use interface controlling, with extensible standard and customized Data Processing and Analysis Tools

Benefits

- Online Channel Math operations, general purpose Fast Fourier analysis (FFT) and digital filtering of Analog In channels
- Numerous basic signal forms can be combined to design experimental protocols, for most physiological applications
  - Factory designed standard or customized protocols
  - Semi-automated data analysis toolbox
- Protocol repeat function to avoid time consuming protocol programming of extended experiments

Applications

- Muscle physiology (Can be used with **SI-MTM** Muscle Testing Platform, **SI-CTS200** Cell Tester System, **SI-HTB2** Horizontal Tissue Bath and **SI-BF-100** Biofluorometer)
- Stand alone general data recorder for Spectroscopy, Neuroscience and Electrophysiology (Can be used with **TBR4100** Free Radical Analyzer, Extracellular Bioamplifiers like **SYS-DAM50, SYS-DAM80, SYS-900A, ISO-80**, **EVOM2™** Volt Ohm Meter, **ATC2000** Animal Temperature Controller, **BP-1** Blood Pressure Monitor or the **BAT-12** Microprobe Thermometer)
- Instrument control for software triggered devices like **A365**/**A385**/**A395** Constant Current Stimulators, **MPS-2** Perfusion System, **SYS-PV820**/**SYS-PV830** Pneumatic PicoPumps, **Duo 773** Intracellular amplifiers, and the **SYS-TBM4M** Transbridge Transducer Amplifier (e.g. for FORT force transducers)

Knowledge of the physiological characteristics of muscle tissue can be useful to quantify beneficial or adverse effects of drug supply on muscle function in pre-clinical and toxicological studies, evaluating muscle dystrophies, training effects in sports and rehabilitation (disuse vs. overuse) and advanced physiology and biomedical research.

This is usually achieved by quantifying the contractile and/or the elastic properties of muscle tissue. This needs the programming of different and specific experimental protocols (isometric, concentric and eccentric, isokinetic or isotonic), so that the physiological structure of interest can be quantified. **LabTrax-MDAC** data acquisition software was designed for use with WPI's Muscle Physiology line to test physiological characteristics of muscle tissues in various conditions, using factory designed standard or customized protocols. The semi-automated Data Analysis Toolbox of standard protocols gives quick access to user-friendly, readable and interpretable results of the experiments.

Variety of muscle physiology applications

The physiological response of muscle tissue to training, disuse, nutrition, drug supply and others factors may be studied by adding accessories to the system, like:

- Study of the muscle's force production capacities in combination with the Ca^{2+} release from the sarcoplasmic reticulum (SR) and ATPase consumption. The perfect instrument for this is WPI's Biofluorometer (**SI-BF-100**) in combination with any system of WPI's Muscle Physiology line, controlled via **LABTRAX-MDAC**.
- Study of the muscle's force production capacities from direct muscle or peripheral nerve stimulation. For this experiment, use WPI's programmable isolated current stimulators (**A365**, **A380** or **A395**), controlled via **LABTRAX-MDAC**.

LABTRAX-MDAC provides easily used continuous stimulation protocols, so that especially cardiac cells/tissue remain intact during experimental resting periods.

LABTRAX-MDAC is also well suited for other software triggered instruments or as a stand-alone general data recorder for selected WPI Instruments.

The back panel of the Lab-Trax-8/16 has four analog outputs, digital inputs or outputs, a USB port, power socket and power switch.

LAB-TRAX-8/16 SPECIFICATIONS

ANALOG INPUTS	8 BNC connections
INPUT RANGE	± 10V
SYSTEM NOISE	< 1 mV RMS
ISOLATION	1,500V
OPERATING CURRENT	800 mA maximum
ANALOG OUTPUTS	4 BNC connections
OUTPUT RANGE	± 10V
IMPLEMENTED FILTER	5th order low-pass Bessel filter with 3dB cut-off frequency
OUTPUT IMPEDANCE	100Ω
OUTPUT CURRENT	15 mA
DIGITAL I/O	16/16 TTL (BNC or DB-9 Connector)
LOGIC HIGH VOLTAGE	3.3 V minimum
LOGIC LOW VOLTAGE	1.0 V maximum
ANALOG & DIGITAL INPUTS	Operating voltage protected to ±30V
PC INTERFACE	USB 2.0
RESOLUTION	16 bits
POWER SOURCE	12V DC

ORDERING INFORMATION

LABTRAX-MDAC	Lab-Trax-8/16 with MDAC software
LAB-TRAX-4	4-Channel General Data Acquisition System
2851	BNC to BNC Cable

Micromanipulators

Micromanipulators are used when precision work is conducted under a microscope. A micropipette, electrode or probe can be mounted on a micromanipulator and move as little as a micron at a time. This tool can be used for *in vitro* fertilization, patch clamp experimentation, extracellular recording, microinjection and any application requiring fine mechanical placement (resolution).

In addition to micromanipulators, WPI offers tilt bases, piezo translators and a variety of stands.

Micromanipulators can be broken out into three broad categories

- Manual
- Manual/Motorized
- Motorized

MM3-3

SU-TRIO235

MICROMANIPULATOR COMPARISON

Micromanipulator	Manual or Motorized	Resolution	Travel	Stands	Tilt Base	Piezo Translator	Notes
SU-TRIO235	Motorized	< 100 nm	X: 25 mm Y: 25 mm Z: 25 mm Diagonal: 50 mm	Fixed platform stage with imperial/ standard holes, chamber insert and gantry supports	N/A	N/A	Carries up to a kilogram
SU-TRIO245	Motorized	< 100 nm	X: 25 mm Y: 25 mm Z: 25 mm	Fixed platform stage with imperial/ standard holes, chamber insert and gantry supports	N/A	N/A	Carries up to a kilogram
SU-QUAD	Motorized	< 100 nm	X: 25 mm Y: 25 mm Z: 25 mm Diagonal: 30 mm	Fixed platform stage with imperial/ standard holes, chamber insert and gantry supports	N/A	N/A	Quiet mode eliminates electrical noise
M3301	Manual	0.01 mm (X fine) 0.1 mm (X, Y, Z)	X (fine): 10 mm X: 37 mm Y: 20 mm Z: 25 mm	M9, M10, M10L, 501622, 501623	TBS, M-3	MPM20	
KITE	Manual	0.1 mm	X (fine): 10 mm X: 35 mm Y,Z: 20 mm	M9, M10, M10L, 501622, 501623	TBS, M-3		
M325	Manual	10 µm	X: 25 mm Y,Z: 10 mm	M9, M10, M10L, 501622, 501623	TBS, M-3		
MMJ	Manual	0.1 mm	X: 37 mm Y: 20 mm Z: 25 mm	M9, M10, M10L, 501622, 501623	TBS, M-3		Joystick control
MD4	Manual	10 µm (X fine) 100 µm (X, Y, Z)	X (fine): 10 mm X: 37 mm Y: 20 mm Z: 25 mm	M9, M10, M10L, 501622, 501623	TBS, M-3		Holds two electrodes
MM1	Manual (mini)	1.0 µm	3 mm				225 g load
MM3	Manual (mini)	1.5 µm	13 mm				340 g load
MM1-3	Manual (mini)	1.0 µm	3 mm	MB-2			225 g load
MM3-3	Manual (mini)	1.5 µm	13 mm	MB-2 with MM1A (adapter)			340 g load

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Manual Micromanipulators

Popular manual micromanipulator

M3301L

M-10 *magnetic stand sold separately.*

*Left or right-handed versions of the **M3301** are supplied with a standard 12mm clamp (**M2**) and one microelectrode holder (**M3301EH**).*

Features

- The most widely used micromanipulator
- Lightweight 550 g
- Sure, repeatable movement without drift

Benefits

- Control knobs clustered in 8 cm area in a single vertical plane for quick resolution
- Right and left hand orientation options available

Applications

- Microinjection
- Electrophysiology recording

Weighing just 550 g and employing a slim space-saving design, this well-built micromanipulator outsells all others worldwide for high precision experiments where magnification is in the range of up to 250×. Its design allows units to stand tightly grouped, since all control knobs project to the rear. And because control knobs are clustered within an 8 cm area in a single vertical plane, resolution is quick. The hand works blindly while the eye monitors the microscopic image. Vernier scales allow readings to 0.1 mm; X-axis fine control allows readings to 10 µm.

The instrument employs rack-and-pinion drive, V-shaped guide ways and cross roller bearings, so all movement is sure and repeatable, without drift, side play, backlash or sticking. Contact parts are milled of hardened steel for high performance and long life.

M3301 SPECIFICATIONS

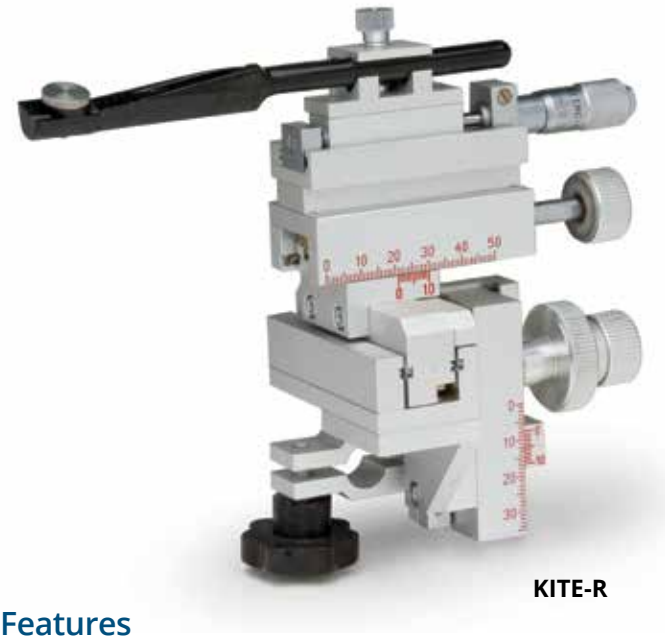
	TRAVEL RANGE	RESOLUTION
X-axis Fine	10 mm	0.01 mm
X-axis	37 mm	0.1 mm
Y-axis	20 mm	0.1 mm
Z-axis	25 mm	0.1 mm

ORDERING INFORMATION

M3301R	Manual Manipulator (right-handed)
M3301L	Manual Manipulator (left-handed)
M3301-M3-R	Manual Manipulator (right-handed) & Tilting Base*
M3301-M3-L	Manual Manipulator (left-handed) & Tilting Base*
502105	Axis Adjustment Tool

**Requires 5464 weight*

Economy manual micromanipulator



KITE-R

Features

- Vernier scales allow readings to 0.1 mm
- X-axis fine control allows readings to 10 µm
- Choice of optional **M3** Tilting base which can be mounted to a table with M6 screws
- Left or right-handed versions of the **KITE** micromanipulator are supplied with a standard 12 mm clamp and electrode holder **M3301EH**

Benefits

- Control knobs clustered in the same plane for quick resolution
- Right and left hand orientation options available

Applications

- Microinjection
- Electrophysiology recording

The **KITE** is an economical manual micromanipulator that is perfect for student use. It is available in right or left hand versions and is also sold bundled with an optional **M3** Tilting Base. Our 5 lb. weight (WPI #**5464**) is frequently sold with this unit to provide stability.

KITE SPECIFICATIONS

	TRAVEL RANGE	RESOLUTION
X-axis Fine	10 mm	0.01 mm
X-axis	35 mm	0.1 mm
Y-axis	20 mm	0.1 mm
Z-axis	20 mm	0.1 mm

ORDERING INFORMATION

KITE-R	Kite Manual Manipulator (right-handed)
KITE-L	Kite Manual Manipulator (left-handed)
KITE-M3-R	Kite (right-handed) + Tilting Base Combo*
KITE-M3-L	Kite (left-handed) + Tilting Base Combo*

**Requires 5464 weight*

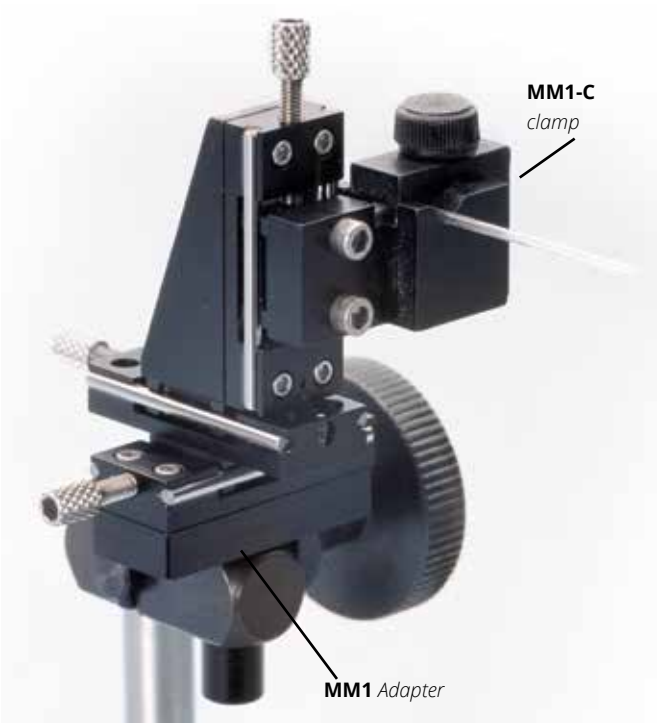
OPTIONAL ACCESSORIES

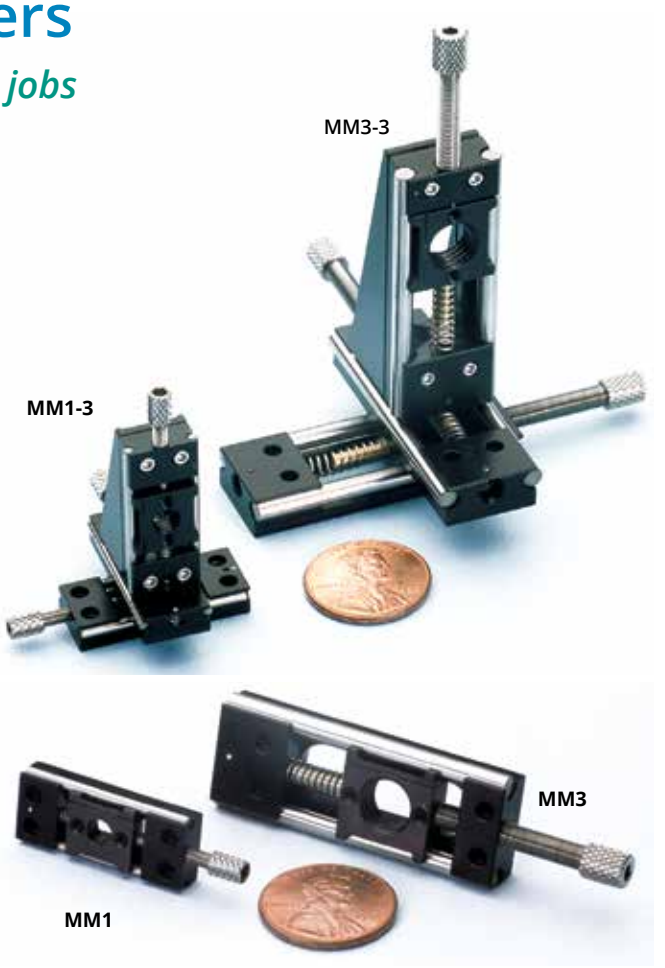
M3301EH	Replacement Electrode Holder (14 cm long)
15873	Optional Angled Electrode Holder (13 cm long)
M-3	80° Tilting Base M6 x 1 mm screw
5464	5-lb Weight for Tilting Base (Shipping weight: 7 lb (3 kg))
500475	Ball Joint, 7 cm long, for Ø 8 mm Holder
500476	Ball Joint, 4 cm long, for Ø 4 mm Holder
M4C	Microscope Stage Adapter

Also see magnetic stands (page 28)

Miniature Micropositioners

One and three axis positioners for small jobs





MM1 and MM1-3

Features

- Precise and smooth motion
- Less than 1 µm maximum wobble

Benefits

- Compact
- Provides precise and smooth motion with no backlash

Applications

- Oocyte injection with Nanoliter Injector

Single stage measures only 5 × 11 × 26 mm with 3 mm travel. Provides precise and smooth motion with no backlash, positive spring loaded carriage, straight within 1 µm and less than 1 µm maximum wobble. Features fine 80 TPI screw adjustment. 10 mm square mounting surface has a 3.9 mm tapped center hole for transmission and/or mounting. Available in single X (**MM1**) and X-Y-Z (**MM1-3**) axis configurations.

MM3 and MM3-3

Features

- Opens 0–4mm
- Precise and smooth motion
- Less than 1 µm maximum wobble

Benefits

- Compact
- Provides precise and smooth motion with no backlash

Applications

- Oocyte injection with Nanoliter Injector

Single stage measures only 7 × 17 × 44 mm with 13 mm travel. Offers precise and smooth motion with no backlash, positive spring-loaded carriage, straight within 1.5 µm, and less than 1.5 µm maximum wobble. Features fine 80 TPI screw adjustment. 13 mm square mounting surface has a 7mm tapped center hole for transmission and/or mounting. Available in single X (**MM3**) and X-Y-Z (**MM3-3**) axis configurations.

MINI-MICROPOSITIONER SPECIFICATIONS

	MM1	MM1-3	MM3	MM3-3
AXIS	X	X-Y-Z	X	X-Y-Z
STRAIGHT LINE ACCURACY	Within 1 µm over 3 mm travel	Within 1 µm over 3 mm travel	Within 1.5 µm over 13 mm travel	Within 1.5 µm over 13 mm travel
CLEAR APERTURE	3.9 mm tapped hole, 8-32 thread	3.9 mm tapped hole, 8-32 thread	7 mm tapped hole, 5/16-16 thread	7 mm tapped hole, 5/16-16 thread
LOAD CAPACITY	255 g Normal	255 g Normal	340 g Normal	340 g Normal
FINISH	Black Anodized	Black Anodized	Black Anodized	Black Anodized
WEIGHT	3 g/axis	12 g/axis	14 g/axis	48 g/axis
TYPE	Fine Screw	Fine Screw	Fine Screw	Fine Screw
TRAVEL	3 mm	3 mm	13 mm	13 mm

ORDERING INFORMATION

MM1	Mini Micropositioner, one axis, 3 mm travel
MM1-3	Mini Micropositioner, three axes, 3 mm travel
MM1-A	Mounting Adapter for MM1 and MM1-3
MM1-C	Clamp for MM1 and MM1-3
MM3	Micropositioner, one axis, 13 mm travel
MM3-3	Micropositioner, three axes, 13 mm travel
MM3-A	Mounting Adapter for MM3 and MM3-3
MM3-C	Clamp for MM3 and MM3-3
MM3-ALL	Complete 3-Axis Micropositioner & Magnetic Stand
MM1-ALL	Complete 3-Axis Mini Micropositioner & Magnetic Stand

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TRIO™ 3-Axis Manipulators

Highly stable, motorized, 3-axis manipulator with 25 mm of movement on each axis

SU-TRIO245

SU-TRIO235

Features

- Three independent axes - 25 mm orthogonal travel in X, Y and Z
- Sub-micron (less than 100 nm) resolution
- Carries up to a kilogram
- DIP switches on the Control box select direction of movement produced by turn of the Control box knob
- USB interface for computer control
- The TRIO™ comes standard with a universal mounting system suitable for the most popular headstages or pipette holders.

Benefits

- User selectable angle from 0 - 90° via Control box input
- Fast movement with a top speed of 3mm/sec (while homing)
- Mechanically robust construction for high stability
- Compact, fanless, user-friendly Control box controller preserves bench and rack space
- Push button control of multiple functions - WORK, HOME, LOCK, PULSE and RELATIVE
- Mechanical designs and software algorithms allow the motors to power down completely during recording

Applications

- Suited for *in vivo* and *in vitro* electrophysiological recording
- Applications with noise-sensitive recordings

The new **SU-TRIO245** is a highly stable 3-axis manipulator with 25 mm of travel on each axis. The TRIO's synthetic 4th axis can be set in software as any angle between 0 and 90° for diagonal movement. Based on a lead-screw design with a smaller overall size and footprint than most manipulators, the SU-TRIO245 is ideal for applications that require 2 pipettes in one setup or for setups where space is limited.

The compact design of the integrated control box requires minimal bench space. It provides quiet, fan-free operation, and is easy to use. No rack mounted controller is required. Position coordinates, in relative or absolute values, are displayed directly on the control box. The TRIO manipulators use a logarithmic acceleration algorithm that eliminates the need for speed selection. As the knobs on the control box are turned faster, acceleration ramps up. This allows for smooth and intuitive motion control of electrode position without the need to stop and change speeds or lift your hand from the knobs. A Y-axis lockout function (accessible by DIP switch) is also available, allowing X/Z-only axial movement during HOME and WORK repositioning.

An alternate configuration, the SU-TRIO235, removes the Z axis and replaces it with an adjustable diagonal axis. This configuration pairs a traditional X and Y axis with a diagonal axis that can be adjusted in angle with a set screw. The diagonal features 50 mm of travel with X and Y axes that have 25 mm of travel. On this model, we have added software to create a synthetic "Z-axis" by combining the diagonal and X axes in reverse of how we create a synthetic diagonal axis on our other manipulators. The SU-TRIO235 and SU-TRIO245 both feature the same precision bearing and lead-screw design.

TRIO SPECIFICATIONS

TRAVEL	SU-TRIO235:	25 mm on X and Y, 50 mm on diagonal
	SU-TRIO245:	25 mm on X, Y and Z axes
CONTROL BOX		5.5 x 7.5 x 4" (14 x 19 x 10.2 cm)
WEIGHT		2.2 lbs. (1.0 kg)
POWER		115/230 V, 50/60 Hz

ORDERING INFORMATION

SU-TRIO235	3-Axis Motorized Micromanipulator with X, Y, D Control
SU-TRIO245-L	3-Axis Motorized Micromanipulator with X, Y, Z Control (left-hand)
SU-TRIO245-R	3-Axis Motorized Micromanipulator with X, Y, Z Control (right-hand)
505069	Z-Axis Vertical Extension for Quad/Trio
505071	Rotating Base for MP225 Mechanical
505073	4-in. Dovetail Extension
505074	Mounting Adapter Plate
505085	Rod Holder for Motorized Manipulator

Basic systems include the manipulator, controller, rod holder, 4-inch dovetail extension, mounting adapter plate, Z-axis vertical extension, cables, and power supply

QUAD® 4-Axis Motorized Manipulator

4-axis motorized manipulator with 25 mm of movement on each axis

SU-QUAD-R

Features

- Four independent axes - 30 mm travel in diagonal for coaxial pipette movement, 25 mm travel in X, Y and Z
- Sub-micron 100 nm resolution
- Quiet mode eliminates electrical noise
- True diagonal assures coaxial movement
- USB interface for computer control

Benefits

- Compact, fanless, user-friendly control box preserves bench and rack space
- Push button control of multiple functions - WORK, HOME, LOCK, PULSE and RELATIVE
- Robotic HOME and WORK position moves for easy automated pipette exchange
- Display indicates coordinates in relative or absolute
- Five conveniently located control buttons
- When you are ready to begin collecting data, the motor drive electronics can be suppressed

Applications

- Suited for *in vivo* and *in vitro* electrophysiological recording
- Cell penetration
- Applications with noise-sensitive recordings

The **QUAD®** motorized micromanipulator is easy to use and features four independent axes. Each axis has a 25 mm range of motion, a digital display of position and a control box. The compact, intuitive controller takes up minimal bench space, is fan free and is easy to use. Three axes provide the X, Y, Z-orthogonal motion typical of most motorized micromanipulators. In the QUAD® a true fourth axis moves the electrode coaxially at exactly the desired angle of approach. The fourth axis has 30 mm of travel that significantly extends the range of travel for the system.

The QUAD® is very easy to operate. It includes a control box with digital display of position. The control box inputs for each axis allow facile manual control of electrode position. Five conveniently located buttons control all of the basic functions that you will need in normal operation. Press and hold the **WORK** button to quickly store a work position; press **WORK** again and the manipulator will return to the same location. **HOME** sends the manipulator to an initial location or any user defined position, which is useful for changing electrodes rapidly. When you are ready to begin collecting data the motor drive electronics can be suppressed by pressing **LOCK**. Display coordinates can be zeroed at any location by pressing **RELATIVE**; go back to absolute coordinates by pressing **RELATIVE** again. Finally, **PULSE** activates a pulse movement mode that produces small, rapid bursts of motion that can be advantageous for sharp electrode cell penetration.

QUAD SPECIFICATIONS	
TRAVEL	30 mm on the diagonal 4th axis 25 mm on the X, Y and Z axes
CONTROL BOX	5.5 x 7.5 x 4 in. (14 x 19 x 10.2 cm)
WEIGHT	2.2 lb. (1.0 kg)
POWER	115/230 V, 50/60 Hz

ORDERING INFORMATION	
SU-QUAD-L	4-Axis Motorized Micromanipulator (left-hand)
SU-QUAD-R	4-Axis Motorized Micromanipulator (right-hand)
505069	Z-Axis Vertical Extension for Quad/Trio
505070	Mounting Adapter Plate for Quad
505071	Rotating Base for MP225 Mechanical
505073	4-inch Dovetail Extension
505085	Rod Holder for Motorized Manipulator

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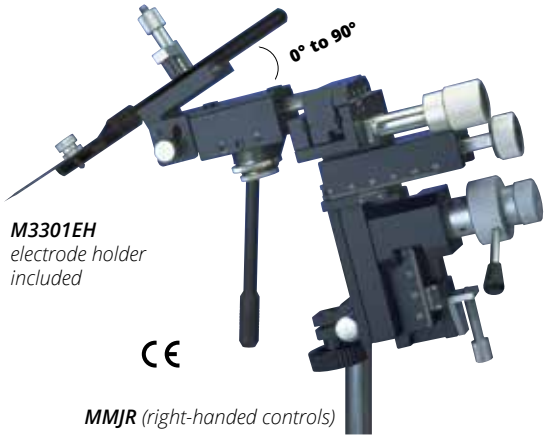
Specialty Micromanipulators

Joystick Controlled Manual Micromanipulator



M3301EH *electrode holder included*

MMJR *(right-handed controls)*

Features

- X axis can be tilted 90°
- Easy steering motion that translates normal hand movement into smooth sub-millimeter shifts

Benefits

- Fine adjustment for the X and Y axes can be controlled by the joystick
- Joystick manipulation

Applications

- Oocyte injection with Nanoliter Injector

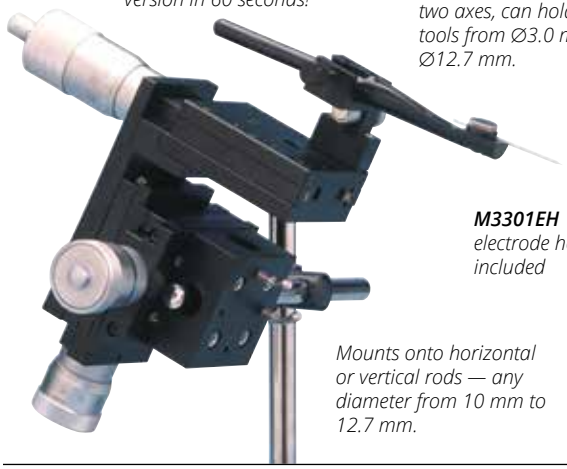
ORDERING INFORMATION	
MMJR	Joystick Micromanipulator (right-handed)
MMJL	Joystick Micromanipulator (left-handed)

Options and replacement parts listed below

Micrometer Slide Micromanipulator

*The **M325** can be configured from left- to right-handed version in 60 seconds!*

Toolholder rotates around two axes, can hold tools from Ø3.0 mm to Ø12.7 mm.



M3301EH *electrode holder included*

Mounts onto horizontal or vertical rods — any diameter from 10 mm to 12.7 mm.

Features

- Built of precision micrometer-actuated linear slides
- Can be configured for right or left hand use
- Resolution is 10 µm

Benefits

- Each slide is comprised of a large micrometer head and a spring-return linear slide
- Micrometer head is graduated in 10 µm steps which enables repeatable positioning to an accuracy of 2 µm

Applications

- Electrophysiology recording and injection

ORDERING INFORMATION	
M325	3-Axis Fine Controlled Manual Micromanipulator

Options and replacement parts listed below

Dual Tool-Holder Micromanipulator

M3301EH *electrode holders included*

MD4L *with left-hand controls*

M-3 *Tilting Base sold separately.*

Features

- Scales allow coarse adjustment readings with an accuracy of 100 µm
- X-axis fine control is achieved with a micrometer screw

Benefits

- Dual electrode holders

Applications

- Electrophysiology differential amplification

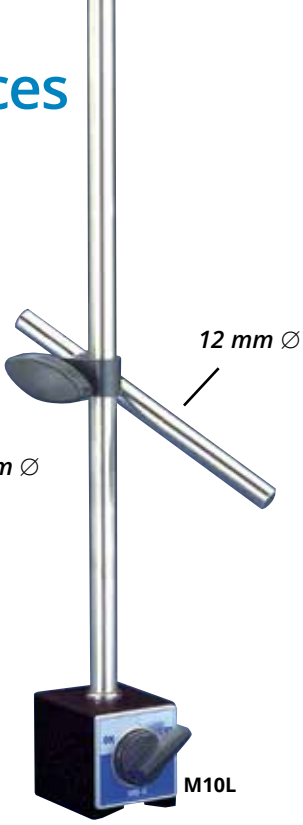
ORDERING INFORMATION	
MD4R	Double-Holder Micromanipulator (right)
MD4L	Double-Holder Micromanipulator (left)
MD4-M3-R	Double-Holder Micromanipulator (right) + Tilting Base
MD4-M3-L	Double-Holder Micromanipulator (left) + Tilting Base

OPTIONAL ACCESSORIES/REPLACEMENT PARTS	
M3301EH	Replacement Electrode Holder (14 cm 5 Ø 7.2 mm)
15873	Angled Electrode Holder (13 cm long)
M4C	Microscope Stage Adapter
500475	Ball Joint, 7 cm long, for Ø 8 mm Holder
500476	Ball Joint, 4 cm long, for Ø 4 mm Holder

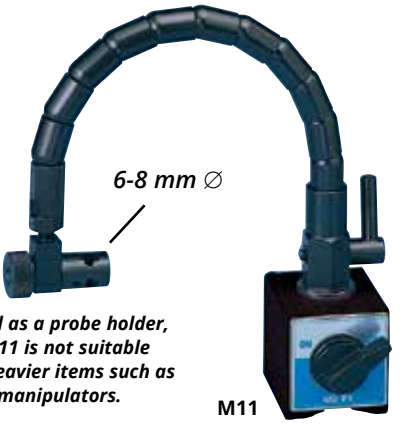
Magnetic Holding Devices

M9

M10



M10L



Useful as a probe holder, the M11 is not suitable for heavier items such as micromanipulators.

M11

M9

Mechanical clamp tightens three rotatable joints simultaneously with one locking knob. Arm adjusts without distortion. Base exerts 100kg magnetic force for great stability. Fine adjustment for precise operations included.

Magnetic Base:
50 (w) x 60 (l) x 55 (h) mm
(2.2 x 2.4 x 2.2 in.)

Vertical Holding Power:
100 kgf (220 lb force)

Arms:
L1: 119 mm (4.7 in.)
L2: 106 mm (4.2 in.)
L3: 25 mm (0.98 in.)
∅ 12 mm (0.472 in.)

Clamp Hole:
none

Weight:
1.8 kg (4 lb.)

ORDERING

M9 Magnetic Stand

M10

Similar to M1 with a 12mm diameter sub pole (fits 12mm clamp supplied with M3301, DC3001, MD4 and MMJ manipulators).

Magnetic Base:
50 (w) x 58 (l) x 55 (h) mm
(2.0 x 2.3 x 2.2 in.)

Vertical Holding Power:
80 kgf (176 lb force)

Main Pole:
diameter: 14 mm (0.55 in.)
length: 178 mm (7 in.)

Sub Pole:
diameter: 12 mm (0.47 in.)
length: 165 mm (6.5 in.)

Clamp Hole:
Adjustable from 4.5 mm to 6.5 mm

Weight:
1.8 kg (4 lb.)

ORDERING

M10 Magnetic Stand

M10L

Same as M10, but equipped with a taller (14-inch) vertical main pole.

Magnetic Base:
50 (w) x 58 (l) x 55 (h) mm
(2.0 x 2.3 x 2.2 in.)

Vertical Holding Power:
80 kgf (176 lb force)

Main Pole:
diameter: 14 mm (0.55 in.)
length: 356 mm (14 in.)

Sub Pole:
diameter: 12 mm (0.47 in.)
length: 165 mm (6.5 in.)

Clamp Hole:
Adjustable from 4.5 mm to 6.5 mm

Weight:
1.8 kg (4 lb.)

ORDERING

M10L Magnetic Stand

M11

Bends freely for maximum flexibility. The connecting arm twists and bends like a snake. Lock the arm in position with a flick of the controlling lever.

Magnetic Base:
50 (w) x 58 (l) x 55 (h) mm
(2.0 x 2.3 x 2.2 in.)

Vertical Holding Power:
80 kgf (176 lb force)

Main Pole:
diameter: 16 mm (0.63 in.)
length: 315 mm (12.4 in.)

Sub Pole:
none

Clamp Hole:
Adjustable from 6 mm to 8 mm

Weight:
1.4 kg (3 lb.)

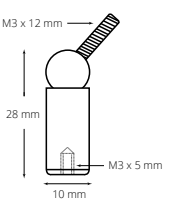
ORDERING

M11 Magnetic Stand

Powerful Ball Joint Rare Earth Magnet

Construct holding devices for small parts/equipment

- Small but very powerful. Holds 2 kilograms (~5 pounds)!
- Steel ball rotates freely 360° on a 180° axis
- M3 mounting screw on ball for attachment to equipment
- Magnet base threaded (M3) for mounting onto a base or equipment



This novel magnetic ball joint has phenomenal holding power for up to 2kg of attached weight while permitting the ball a full 360° rotation on a 180° axis. You can freely orient your equipment to an infinite number of positions within this rotation. This is made possible by the combination of a steel ball (10 mm diameter) and a powerful rare earth magnet contained in the magnet cylinder (∅10 x 20 mm). Convenient M3 attachment sites are provided on both the ball (male) and the magnet base (female). For use with micromanipulators for the positioning and holding of optical instruments including various lighting sources and lasers, pipettes and any small parts that would benefit from the flexibility offered by this new magnetic ball joint.


500871

ORDERING INFORMATION

500871 Magnetic Ball Joint

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The base of each stand exerts a powerful magnetic force that holds it solidly on ferrous metal surfaces — even vertically or upside down

MB2

Mechanical clamping type tightens three joints simultaneously. Arm is freely adjustable without distortion. Equipped with fine adjuster and medium size magnet for stabilizing the base. Suitable for performing precision operation. Fits clamp for **MM1-ALL** and **MM3-ALL**.

Magnetic Base:
30 (w) x 35 (l) x 35 (h) mm
(1.2 x 1.4 x 1.4 in.)

Vertical Holding Power:
17 kgf (37 lb. force)

Arm:
L1: 46 mm (1.8 in.)
L2: 46 mm (1.8 in.)
L3: 39 mm (1.5 in.)

Clamp Hole:
Adjustable from 5 to 6.5 mm

Weight:
0.38 kg (0.83 lb)

ORDERING	
MB2	Compact Magnetic Stand

M8

A ball joint at the base of the main post allows 360° rotation, offering considerable versatility. The second arm adopts angles up to 75°.

Magnetic Base:
50 (w) x 58 (l) x 55 (h) mm
(2.0 x 2.3 x 2.2 in.)

Vertical Holding Power:
80 kgf (176 lb. force)

Main Pole:
diameter: 12 mm (0.47 in.)
length: 194 mm (7.6 in.)

Sub Pole:
diameter: 10 mm (0.39 in.)
length: 165 mm (6.5 in.)

Clamp Hole:
Adjustable from 4.5 mm to 6.5 mm

Weight:
1.8 kg (4 lb.)

ORDERING	
M8	Magnetic Stand

M1

A precision base providing stable support for such devices as electrodes and manipulators. Adjustable second arm adopts a variety of angles.

Base:
50 (w) x 58 (l) x 55 (h) mm
(2.0 x 2.3 x 2.2 in.)

Vertical Holding Power:
80 kgf (176 lb. force)

Main Pole:
diameter: 12 mm (0.47 in.)
length: 176 mm (6.9 in.)

Sub Pole:
diameter: 10 mm (0.39 in.)
length: 165 mm (6.5 in.)

Clamp Hole:
diameter: 4.5 mm and 6.5 mm

Weight:
1.8 kg (4 lb.)

ORDERING	
M1	Magnetic Stand

M1L

Same base and support arm as M1, but equipped with a longer (14-inch) vertical post.

Base:
50 (w) x 58 (l) x 55 (h) mm
(2.0 x 2.3 x 2.2 in.)

Vertical Holding Power:
80 kgf (176 lb. force)

Main Pole:
diameter: 12 mm (0.47 in.)
length: 356 mm (14 in.)

Sub Pole:
diameter: 10 mm (0.39 in.)
length: 165 mm (6.5 in.)

Clamp Hole:
diameter: 4.5 mm and 6.5 mm

Weight:
1.8 kg (4 lb.)

ORDERING	
M1L	Magnetic Stand

Versatile Manipulator Mounting Clamp

Mount your Micromanipulator

***M5** — ∅10 mm clamp*

Three of the stands above — **M1**, **M1L** and **M8** — have 10 mm diameter mounting rods. The standard mount on several WPI manipulators (**DC3001**, **KITE**, **M3301**, **MMJ**, and **MD4**) accommodates a 12 mm rod. In order to use one of these three stands, you will need to replace the manipulator's standard 12mm mounting clamp with the optional M5 clamp.

ORDERING INFORMATION	
M5	∅10 mm Clamp

Magnetic Holding Devices

A solid platform for mounting your manipulators

501651

Round Base

An ideal accessory for optical tables and vibration-free platform. Reduces experimental set-up time by allowing free positioning and instant clamp down of optical components. Switchable ON/OFF magnetic circuit permits fine adjustment and precise positioning.

- Easy ON/OFF operation using lever
- Thin and powerful magnetic force
- Generous array of tap holes

Holding Power:
20 kgf (44 lb. force)

Dimension:
75 (OD) x 20 (h) mm
2.9 (OD) x 0.8 (h) in.

Mounting Hole:
4-M4 x 0.7, depth 6 mm*
M8 x 1, depth 6 mm
Span 35 mm

Weight:
0.7 kg (1.5 lb.)

ORDERING	
501651	Magnetic Base, 75 mm diameter
503568	Magnetic Base, 50 mm diameter

∗ Posts with M4-threads not available from WPI.

503570

Square Base

An ideal accessory for optical tables and vibration-free platform. Reduces experimental set-up time by allowing free positioning and instant clamp down of optical components. Switchable ON/OFF magnetic circuit permits fine adjustment and precise positioning.

- Easy ON/OFF operation using lever
- Thin and powerful magnetic force
- Generous array of tap holes

Holding Power:
20 kgf (44 lb. force)

Dimension:
65 (w) x 65 (l) x 20 (h) mm
2.6 (w) x 2.6 (l) x 0.8 (h) in.

Mounting Hole:
8-M4 x 0.7, depth 6 mm*
M8 x 1, depth 6 mm
Span 25 mm

Weight:
0.6 kg (1.3 lb.)

ORDERING	
501653	Magnetic Base, 65x65 mm
503569	Magnetic Base, 45x45 mm
503570	Magnetic Base, 90x90 mm
503571	Magnetic Base, 120x120 mm

∗ Posts with M4-threads not available from WPI.

501652

MOBITY

MOBITY™ is a new magnetic clamping system. With its ease of use, only one hand is needed to operate the attractive power. The MOBITY™ has a strong 88lbf pull, yet weighs only 1.5 lbs. MOBITY™ meets various applications with 4 tapped holes on the top surface. Requires (1) 9V alkaline battery (included).

Holding Power:
40 kgf (88 lb. force)

Dimension:
55 (w) x 73 (l) x 50 (h) mm
2.2 (w) x 2.9 (l) x 2.0 (h) in.

Mounting Hole:
3-M4, depth 20 mm*
M8, depth 15 mm

Weight:
0.7 kg (1.5 lb.)

ORDERING	
501652	MOBITY Magnetic Clamping System

∗ Posts with M4-threads not available from WPI. .

M7

M7

A small holder ideal for use where space is limited. Main post unscrews from base which may then be used alone as a switchable magnetic holder.

Magnetic Base:
30 (w) x 35 (l) x 35 (h) mm
1.2 (w) x 1.4 (l) x 1.4 (h) in.

Vertical Holding Power:
20 kgf (44 lb. force)

Main Pole:
Diameter: 7 mm (0.28 in.)
Length: 52 mm (2 in.)

Clamp Hole:
Diameter: 6 mm

Weight:
0.36 kg (0.8 lb.)

ORDERING	
M7	Compact Magnetic Stand

Base Plates

A magnetic stand requires a steel mounting surface. WPI's steel base plates have plenty of mass to give stability to your experimental setup. Beveled edges make them easy to handle. Rubber feet hold them off the benchtop, making them easier to grasp when moving. The special black coating provides a durable, protective, non-reflective finish.

5479
30.5×61×1 cm (12×24×3⁄8-in.)

5052
21.6×30.5×1.3 cm (8½×12×½ in.)

ORDERING INFORMATION	
5052	Steel Base Plate, 4.5 kg (10 lb)
5479	Steel Base Plate, 14.5 kg (32 lb)

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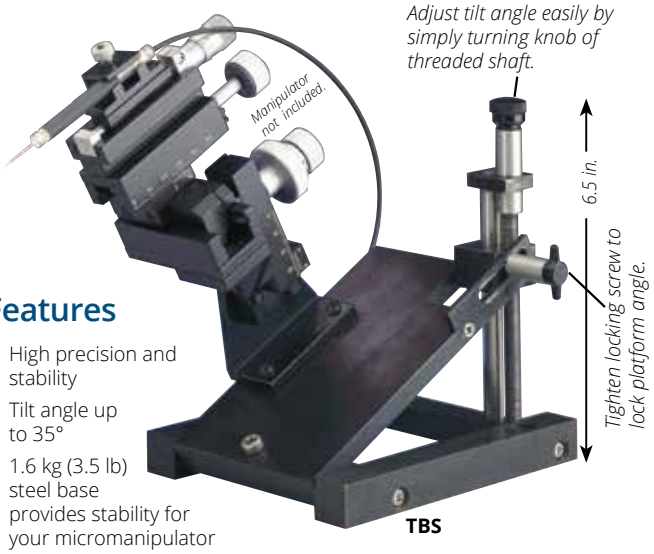
Mounting a Manipulator

Tilting Base with Screw Adjustment

At last! A tilt base you can operate with one hand!



Features

- High precision and stability
- Tilt angle up to 35°
- 1.6 kg (3.5 lb) steel base provides stability for your micromanipulator
- Holes also allow permanent mounting to your bench top
- Adjust tilt angle by turning knob
- Manipulator mounting bracket included

Benefits

- 13x15 cm (5x6 in.) footprint saves space in your work area
- Two sets of mounting holes are pre-drilled for WPI manipulators (**M3301R** shown) but steel platform may be drilled for mounting other devices

Applications

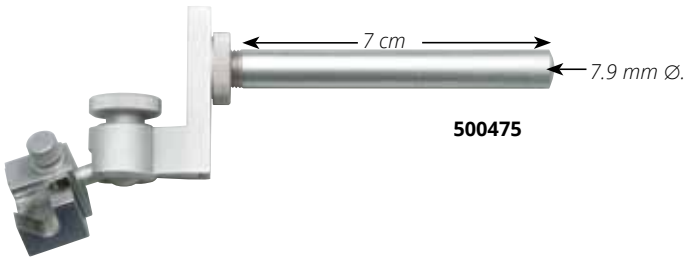
- Microinjection
- Electrophysiology amplification
- Stimulation

ORDERING INFORMATION	
TBS	Tilt Base with Screw Adjustment

Shipping Weight 7 lb.

Ball-joint holder attachment

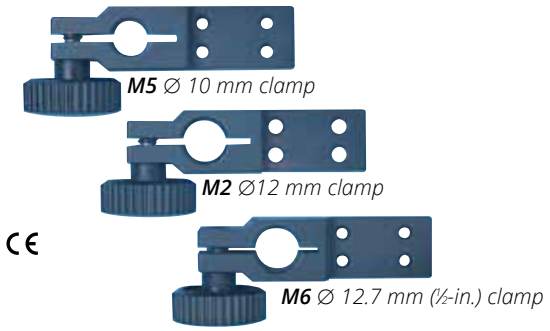
Here's a new angle for mounting



ORDERING INFORMATION	
500475	Ball Joint, 7 cm long, for O.D. 5-9 mm Electrode Holder (shown)
500476	Ball Joint, 4 cm long, for O.D. 2.8-4.5 mm Electrode Holder

Manipulator Clamps

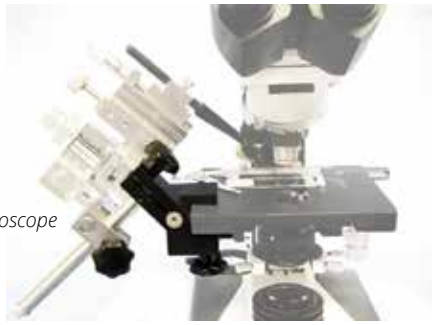
Interchangeable clamps allow manipulators to be mounted on a variety of supports.



ORDERING INFORMATION	
M2	Ø 12 mm Clamp
M5	Ø 10 mm Clamp
M6	Ø 12.7 mm (½-in.) Clamp

Mount a manipulator on your microscope stage

M4C Microscope Stage Adapter *— clamps onto microscope stage to provide a stable support for any manipulator with a Ø12 mm clamp.*



The M4C is shown mounted on a microscope stage.

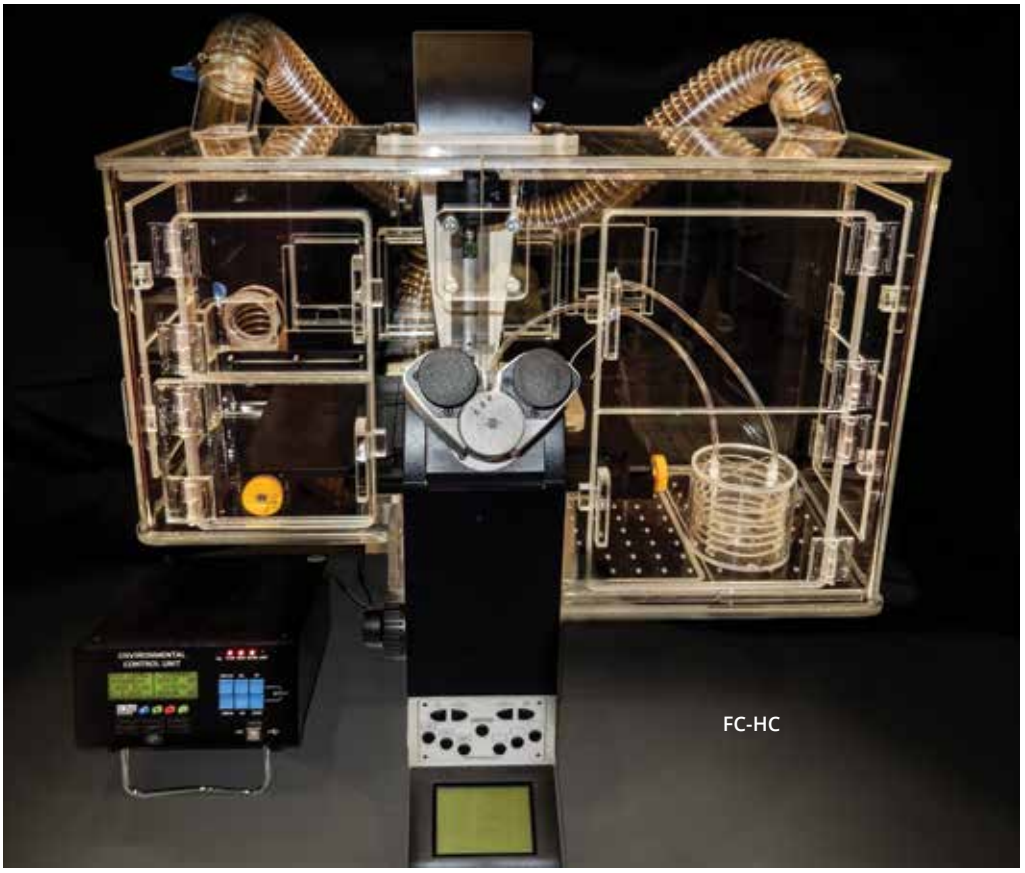
ORDERING INFORMATION	
M4C	Microscope Stage Adapter

Environmental Control for Live Cell Microscopy

Incubation and environmental control for long term imaging of cellular growth

Features

- Unique diffusion grid, combined with air input and return vents, provide an air flow pattern for consistent, even heating, with no hot or cold spots in the chamber
- External heater that can be placed far enough from the system to eliminate electrical and vibrational interference from the heater
- High degree of temperature precision and stability
- Minimal focal drift after equilibrium is achieved—accuracy ±0.1°C at the sample itself, and 0.2°C across the microscope stage (allowing for uniform heating of multiwell dishes)
- Airflow pattern and temperature uniformity eliminate dramatic changes in environmental temperature when the incubator door opens
- Ergonomic design for ease of use—The focus and x/y stage controls are outside of the incubator itself. Large doors allow easy access to the specimen and small ones for cords, tubing, *etc.*
- Precision, shielded temperature probe
- Simple, one person setup of the system



Incubator on a Nikon Eclipse TE-2000 Microscope. Incubators for Zeiss and Olympus microscopes are also available, as well as versions that accommodate confocal modules. All incubators are compatible with all commercially available cameras, light sources, filter wheels, motorized stages and motorized nose pieces.

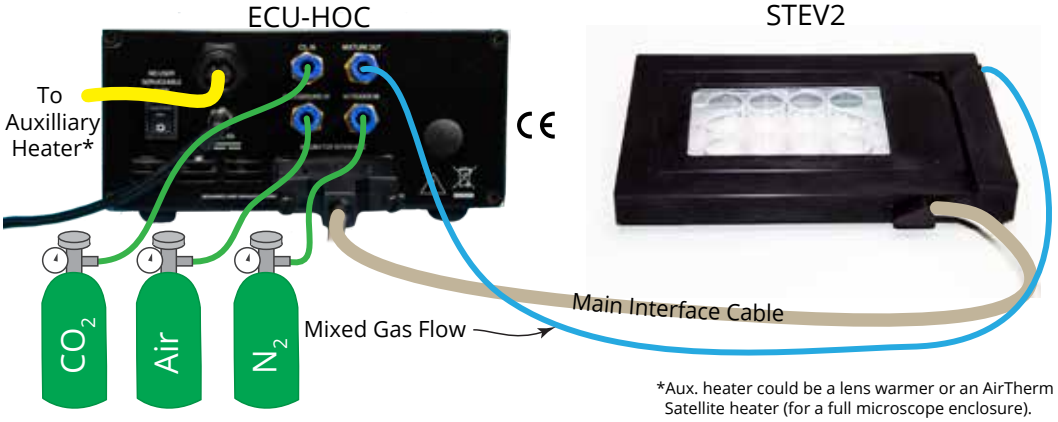
Benefits

- Choice of controller to manage air flow, heat, carbon dioxide and oxygen
- Control and monitor an external heater or lens warmer with **ECU or control and monitor temperature and monitor humidity with ECU-HOC**
- Diffuser grid and proper air venting insures consistent air flow inside the acrylic microscope chamber

Applications

- Live cell imaging under a microscope
- Time lapse video research

This Live Cell Microscope Incubator was extensively tested in laboratories. When compared with other systems, it offers dramatic advantages. For example, other incubators for live cell microscopy rely on passive, random diffusion of heated air from a single source to maintain the desired temperature setpoint. With no hot air return vent, the heated air escapes from the system through cracks at the microscope/incubator junction in an uncontrolled, random fashion. These systems offer no temperature uniformity, suffer from focus drift and often experience electrical and vibrational interference from the heater. You will also notice dramatic temperature drifts when the imaging environment is disturbed.



This diagram shows how the Stagetop environment connects with the ECU-HOC to control heat, air flow, carbon dioxide and oxygen.

*Aux. heater could be a lens warmer or an AirTherm Satellite heater (for a full microscope enclosure).

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Choice of controller to manage heat, CO_2 and O_2

This unique, acrylic Live Cell Imaging chamber, combined with an Environmental Control Unit (**ECU**) and an **AirTherm** controller, ensure precision control of your incubator environment.

The ECU comes in different varieties so you have all the control you require.

- With the **ECU-H5**, you can control air flow and heating.
- In addition to air flow and temperature control, the **ECU-HC** lets you control the carbon dioxide level. It has an internal sensor.
- The **ECU-HOC** adds control of the oxygen level, which is accomplished by displacing the oxygen with nitrogen.

Control external heater and monitor humidity

The first four **ECU** units are capable of controlling a simple, external heater, like the AirTherm Satelite (**AirTherm-SAT**) or a microscope lens warmer. The **AirTherm-SMT** can monitor and control temperature and monitor humidity level inside the microscope chamber.

Diffuser grid and venting for consistent air flow

Air flow affects the temperature uniformity of incubators. The red arrows on Fig. 1 and Fig. 3 indicate air flow. The Live Cell Microscope Incubator uses a diffuser grid and proper venting to insure consistent air flow. Traditional incubators with poor air flow suffer with hot and cold spots in the incubator, as seen in thermal images (Fig. 2 and Fig. 4). Warmer temperatures are indicated by red and cooler temperatures by blue.

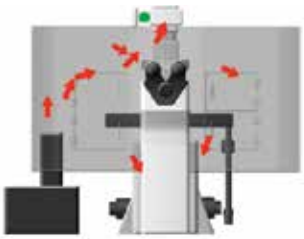

Fig. 1—Single air input and no venting causes random air flow in a traditional incubator.

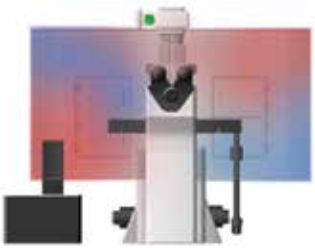

Fig. 2—Hot and cold spots result from inconsistent flow.

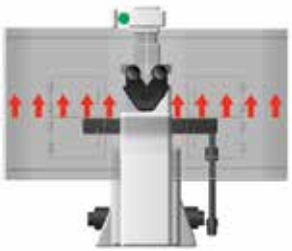

Fig. 3—A diffusion grid with air input and exhaust vents yields consistent air flow.

Fig. 4—Consistent air flow means uniform heating.

AIR-THERM-SMT

CE

AIRTHERM-SAT CE

This humidifier may be used inside a microscope chamber for controlling the humidity inside the stagetop environment chamber.

ORDERING AN ENVIRONMENTAL CHAMBER

Acrylic enclosures are essentially custom-built. When ordering a system, you will need to provide the following information:

Microscope	Stage	Stage-Up
Perfect Focus	Camera	Left Port
Right Port	Analyzer	Fluor Attachment
Tirf	White Light Tirf	Binocular D Head
Tilting Head	Filter Wheels	Excitation
Emission	Dual Lamphouse	Transmitted Light Shutter
Cells	35 mm/60 mm Coverslips	Wells

ORDERING INFORMATION

FULL CHAMBER SYSTEM WITH ECU CONTROLLER & NEW AIRTHERM-SAT/SMT

All Systems Include: Proprietary Humidification Module, Stage Adapter, Stage Dish with Optical Grade Glass

FC-HC	Microscope Environmental Chamber, Heat & CO_2 Controller *Requires 100% CO_2 & ambient air supplies.*
FC-HOC	Microscope Environmental Chamber, Heat Controller, CO_2 and O_2 Controller
FC-H5	Microscope Environmental Chamber, Heat Controller, Digital Control for Bottle Gas
FC-SMT	Microscope Environmental Chamber, Heat Controller (AIRTHERM-SMT instead of ECU) *Requires pre-mixed 5% CO_2 gas supply*
300626	Optional Humidifier for AirTherm-SMT

Stagetop Environmental Control

Control temperature and CO_2 in a microscope stagetop environment

Features

- Four programmable digital control loops:
  - Independent incubator base temperature PID control with ±0.1°C precision
  - Independent incubator lid temperature PID control with ±0.1°C precision
  - CO_2 digital PID control with ±0.1% precision
  - Airflow digital PID control from 0–900 SCCM
- USB-based remote control and data logging
- Electronic flow meter
- Programmable alarm for out of tolerance condition on all four channels
- Compact and lightweight

Benefits

- Compact housing that fits most inverted microscope stages and holds standard culture well plates
- Control temperature and CO_2, O_2 using the Environmental Control Unit (ECU)
- Control and monitor system parameters using the ECU

Applications

- For short term or long term studies of living cell cultures under a microscope (Live Cell Imaging)
- Time lapse video research

Time lapse video research requires a microscope stagetop incubator.

Compact housing fits most inverted microscope stages

Perfect for live cell imaging, **STEV2** (the stagetop environmental control platform) is a compact environmental case that houses your culture wells and fits on a microscope stage inside the live cell microscope incubator.

Control temperature and CO_2 and O_2

This system offers precision control of both temperature and carbon dioxide, as well as remote control and data logging via a USB connection. The system is flexible and easy to configure for a variety of experimental conditions.

Control and monitor system parameters

The system includes the Environmental Control Unit electronics which use four programmable loops to control the temperatures of the case and the lid, CO_2 within the environmental case and airflow within the incubator.

The Environmental Control Unit home screen shows the real time readings for the parameters you want to see.

ECU SPECIFICATIONS

Operating Temperature (ambient)	10 – 50°C (50 – 122°F)
Operating Humidity (ambient)	15 – 70% RH, non-condensing
Warm up Time	20 minutes
Computer Interface	USB via external USB/RS232 converter
Sensor	Non-dispersive infrared (NDIR), dual beam, 20s response time
Power	110/240V, 50/60Hz
CO_2 Sensor (ST-HC only)	
Sensor Range	0 – 20% CO_2
Control Range	0 – 20%
Control Precision	0.1% CO_2
Control Accuracy	0.1 – 3% of reading
Drift	<2.5% reading/year
O_2 Sensor (ST-HOC only)	
Sensor Type	Zirconium Dioxide, diffusion, 4 sec response time
Sensor Range	0–25%
Control Range	0–25%*
Control Precision	0.1% O_2
Control Accuracy	±0.5% (2% of the full scale)

ORDERING INFORMATION

STAGETOP ENVIRONMENTAL CONTROL SYSTEMS

ST-H5	Chamber, Controller, Heat, Digital Flow Control for Bottle Gas
ST-HC	Chamber, Controller with CO_2 & Heat (using CO_2 internal sensor)
ST-HOC	Chamber, Controller with CO_2, O_2 & Heat (using CO_2 internal sensor)

ACCESSORIES

AIRTHERM-SAT-1W	AirTherm Satellite Heater (110V)
AIRTHERM-SAT-2W	AirTherm Satellite Heater (230V)

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Heat Controller/Humidity Monitor

Smart, electrically quiet air heater for live cell imaging & custom incubators

Features

- Precision heat controller for use in live cell imaging and custom incubators
- Control heat and monitor humidity (optional) with a single controller
- Electrically and acoustically quiet
- Quick, precise response to thermal change

Benefits

- PID control algorithms allow for tight control of temperature in the environmental chamber
- System includes hoses and probes so that it is ready to connect with your microscope chamber, incubator or controlled environment

Applications

- Live cell imaging systems fitted with full microscope environmental chamber enclosures
- Control environment in custom incubators

AIR-THERM-SMT

The **AirTherm™ SMT** is a new generation of heat control system from WPI designed to be used in Live Cell Imaging applications with microscopes fitted with a full microscope environmental chamber enclosure. The standard **AirTherm™ SMT** controls temperature and, as an option, monitors humidity.

PID algorithm for maintaining tight control

The **AirTherm™ SMT** uses a PID control algorithm to tightly control the temperature and monitor humidity of the controlled environment

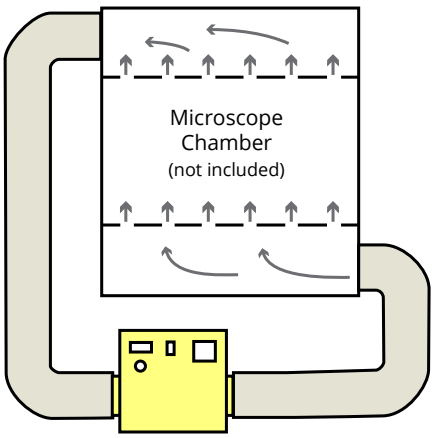
With **AirTherm™ SMT**, the temperature of the sample and microscope optics can be controlled to within 0.2°C. During operation, air is drawn out of the chamber through a flexible hose, heated by the **AirTherm™ SMT** heater and re-circulated to the chamber by the return hose.

Ready to connect to your microscope chamber

The system is typically used in a closed loop configuration.

The **AirTherm™ SMT** system includes:

- Two coil-reinforced heater hose pieces and hose clamps.
- Temperature sensor for remote placement in environmental chamber
- Humidity probe for monitoring chamber humidity available as an option.



Air-Therm SMT

A typical AirTherm™ SMT installation places the heated air inflow at the bottom and the cold air return at the top of the microscope chamber.

References

X. Yin, D.A. Knecht, M.A. Lynes "Meallothionein mediates leukocyte chemotaxis" *BMC Immunology* 6. 2005: 6--21

AIRTHERM SPECIFICATIONS

AIR FLOW RATE	20–50 CFM (0.55–1.4 m^3/minute)
CONTROL TEMPERATURE RANGE	Ambient to 45°C
TEMPERATURE RESOLUTION	0.1°C
TEMPERATURE ACCURACY	0.2°C
ANALOG OUTPUT FOR CHART RE-CORDER	0.5°C resolution; 0–10 V represents 0–100°C
HEATING VOLUME	Less than 50 CF (1400 L), re-circulating
TEMPERATURE SENSOR TYPE	Platinum RTD 1000 Ω
HUMIDIFIER TYPE	Ultrasonic
HUMIDIFIER TANK CAPACITY	0.5 gallons
HUMIDIFIER DAILY OUTPUT	2 gallons
FUSE	For 120 VAC, 8A 250 V 5x20 mm metric For 230 VAC, 4A 250 V 5x20 mm metric
POWER	450 W, 95–135 V or 220–240 V, 50/60 Hz
DIMENSIONS	6½ x 8 x 7½ in. (15.5 x 21 x 19 cm)

ORDERING INFORMATION

AIRTHERM-SMT-2W	AirTherm™ SMT Heater, 230V
AIRTHERM-SAT-2W	AirTherm Satellite Heater, 230V

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

15590	Replacement Hoses, 2.5" diam., 4.5 ft
98727	Replacement Temperature Probe
98728	Humidity Probe
300626	AirTherm SMT Humidifier Kit with Sensor & Hose (110 V)
300411	Replacement Humidifier for AirTherm SMT (110 V)
5389	Inlet and Outlet Hoses
96824	3-Way Hose Assembly (3 hoses and T-connector)

Bench Top Vibration Isolation Platforms

Simple setup and adjustment

***MK-BM-8100**, 50-105 lb. payload weight range (23-48 kg)*

Features

- Only 4.6" thin
- Portable
- Available in a variety of payload ranges

Benefits

- Better performance than an air table
- Simple setup and adjustment
- Requires no air or electricity

Applications

- Microscopy and other research applications that require the isolation of the preparation from vibrations of any kind

These bench top platforms offers 10-100 times better performance than a full size air table in a package only 4.6 inches tall, and without air or electricity! These vibration isolation platforms are extremely easy to use and offer extreme performance — 1.5 Hz horizontal natural frequency and 0.5 Hz vertical natural frequency. There are only two adjustments. This is the thinnest, most portable and most user-friendly isolator ever offered that is capable of delivering this level of performance.

Weight: Approximately 40 lb. (16 kg)
Dimensions**:** 18" W x 20" D x 4.6" H (457 x 508 x 117 mm)

Performance

- Horizontal frequencies are weight dependent
- Horizontal frequency of 1.5 Hz is achieved at or near the upper limits of the payload range
- At the lower limits of the payload range the horizontal frequency is approximately 2.5 Hz
- Vertical frequency is tunable to 0.5 Hz throughout the payload range

ORDERING INFORMATION

MODEL	PAYLOAD RANGE
MK-BM-825	Vibration Platform, 10 - 30 lb. (4.5 - 14 kg)
MK-BM-850	Vibration Platform, 25 - 55 lb. (11 - 25 kg)
MK-BM-8100	Vibration Platform, 50 - 105 lb. (23 - 48 kg)
MK-BM-8125	Vibration Platform, 90 - 130 lb. (40 - 59 kg)
MK-BM-8150	Vibration Platform, 125 - 155 lb. (57 - 70 kg)
MK-BM-8175*	Vibration Platform, 150 - 180 lb. (68 - 81.5 kg)
MK-BM-8200*	Vibration Platform, 175 - 205 lb. (79.5 - 93 kg)
MK-BM-8225*	Vibration Platform, 200 - 230 lb. (90.5 - 104 kg)
MK-BM-8250*	Vibration Platform, 225 - 255 lb. (102 - 115.5 kg)

** Weight: Approximately 47 lb. (21 kg)/(same dimensions)*

Vibration-Free Tables

Vibration-Free Workstation

Features

- Vertical and horizontal vibration isolation
- High performance active-air suspension
- Automatic leveling
- VibraDamped steel
- Class 100 clean room compatible
- Leveling feet

Custom order.
Call for pricing and part numbers.

Benefits

- Eliminate inconsistent and unreliable performance
- Reduce excessive wear, maintenance and fatigue failures
- Protect sensitive instruments and equipment from faulty operation or failure using Vibration-Free Platforms and Workstations

Applications

- Patch clamping, cell injection, analytical balances and optical microscopes

All buildings vibrate. Activities of people, machinery, heating and ventilation systems, and nearby truck or rail traffic cause all types of vibrations. These vibrations, though acceptable to occupants, cannot be tolerated by equipment used in patch clamping, cell injection, analytical balances and optical microscopes. *Additional tabletop sizes and finishes are available, as well as optional accessories such as side rails and casters. See WPI website for available configurations.*

Universal Manipulator Stand

Mount manipulators at angles and heights with infinite flexibility

501622

Vibration-free Platform (VFP) not included

UMS SPECIFICATIONS

DIMENSIONS
Base Plate 10.0 x 12.5 x 1.5 cm (LxWxH)
Stand 4.0 x 4.0 x 30 cm (LxWxH) (501622)
4.0 x 4.0 x 45 cm (LxWxH) (501623)
Mounting Holes
English: 1/4 20 x 1" (2 bolts supplied)
Metric: M6 x 25 mm grid (2 bolts supplied)
SHIPPING WEIGHT
501622 9 lb. (4 kg)
501623 11 lb. (5 kg)

ORDERING INFORMATION

501622	Universal Micromanipulator Stand 30 cm (includes one clamp)
501623	Universal Micromanipulator Stand 45 cm (includes one clamp)
501624	Additional Rotation Clamp

The **M3301**, **KITE, DC3001** and **SM325** *(but not **M325**)* can be used with these mounts.

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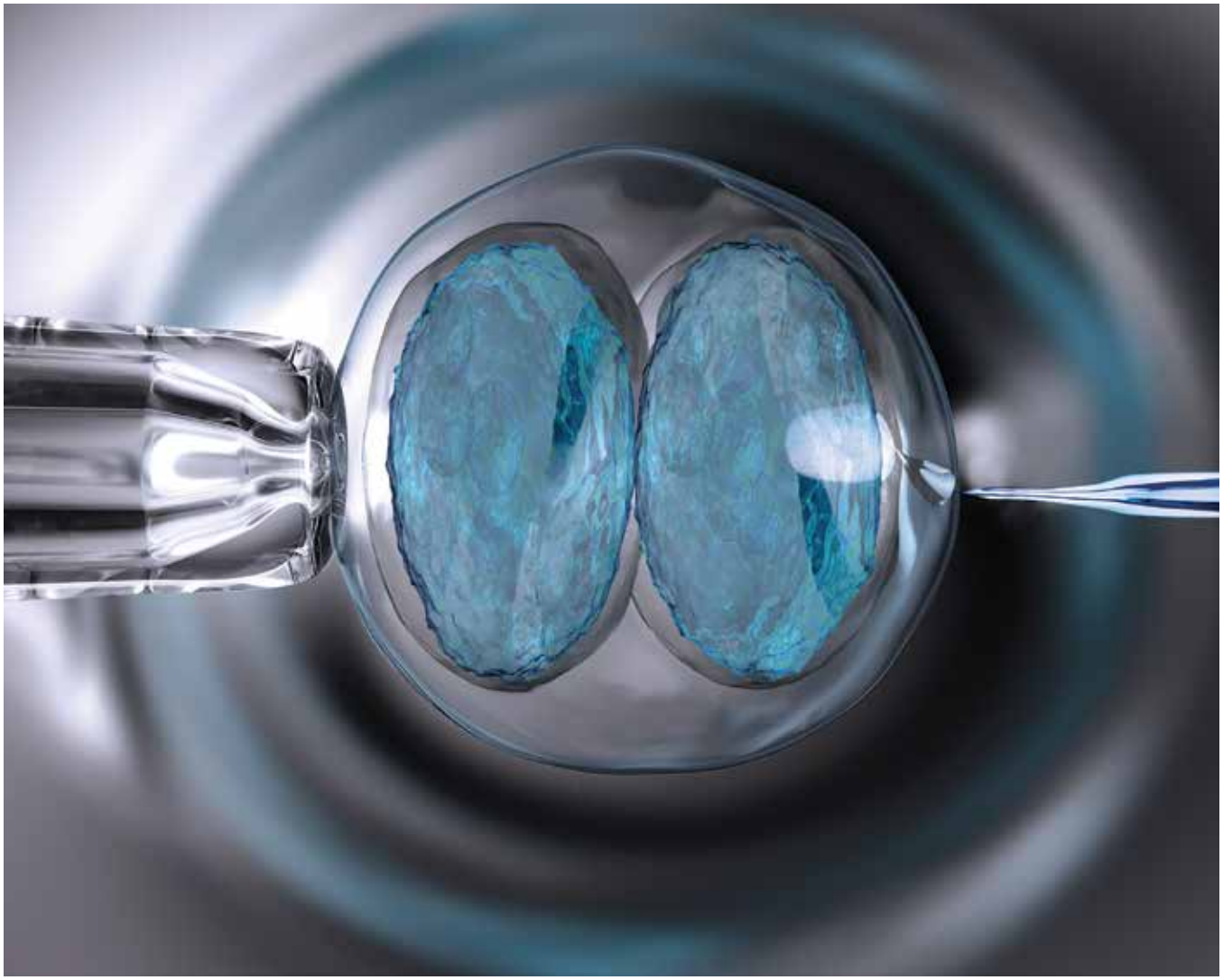
Microinjection



We offer a complete microinjection system

WPI has been in the microinjection business since the very beginning. We were first on the market with pressure injection equipment, and we have been engineering and delivering innovative instruments ever since.

For essential fluidic control in neurophysiology, we offer solutions across pumping platforms including syringe, peristaltic, microfluidic and injection pumps. For picoliter to microliter ranges, our tools are designed for applications like patch clamp, oocyte work, infusion, perfusion, cellular injection, continuous flow and non-pulsatile flow.

With zebrafish (Danio Rerio) rapidly gaining in popularity as bio-medical research subjects, WPI meets the need for lab budgets with efficient, cost-effective stations for microinjection and transfection.

WPI Microinjection System

The system depicted at left includes components often favored by researchers, indicated with ✱ in the list below: ***PV820*** *Pneumatic PicoPump,* ***PUL-1000*** *Micropipette Puller,* ***M4C*** *stand,* ***M3301R*** *micromanipulator,* ***5430-XX*** *PicoNozzle Kit with a* ***µTip****,* ***PZMTIII*** *microscope, lighted base, articulating mirror and optional* ***PRO-300 HDS*** *camera and view screen,* ***E2XX*** *micropipette storage jar,* ***Z-MOLDS*** *Microinjection and Transplantation Molds,* ***14003-G*** *Vannas spring scissors, glass capillaries,* ***77020*** *glass tweezers and Fluorodish optical grade glass bottom culture dishes. Whatever your needs, WPI offers a range of equipment to fill your requirements.*

Options for Customizing Your System

INJECTORS FOR GLASS PIPETTES

- ✱ **PV820** Pneumatic PicoPump with Hold Pressure
- **PV830** Pneumatic PicoPump with Hold Pressure and Vacuum
- **NL2010MC2T** Nanoliter Injector with SMARTouch Controller

Designed to simplify intracellular injection and a variety of other microinjection tasks, WPI's ***PicoPumps*** *use accurate timing and carefully regulated air pressures for securing cells and injecting. Injected volumes range from picoliters to nanoliters.*

Microprocessor-controlled Nanoliter Injector ***NL2010MC2T*** *with SMARTouch controller uses positive displacement injection, eliminating the need for pipette calibration. System uses glass micropipettes.*

PINPOINT INJECTOR

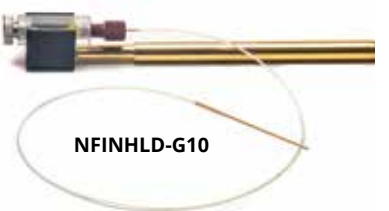
✱ **MICRO-ePORE™** Cell Penetrator

A simple and versatile pinpoint controlled electroporation system for clean efficient injection of CRISPER reagents into 2-stage embryos. The cell membrane is easily penetrated, without cell disruption or tear drop formation. The technique has been used in animal embryos, including, mice, rats and bovine, as well as injecting morpholino oligomers into Zebrafish tails.

INJECTORS FOR GLASS PIPETTES OR METAL NEEDLES

The versatile UltraMicroPump ***UMP3*** injector is a Syringe-based micropump using metal needles as small as 36 gauge and microsyringes to deliver picoliter volumes.

A glass pipette injection kit is also available



NFINHLD-G10

Use with the NANOFIL syringe and 1mm OD glass for your microinjection application."

UMP3-1

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MICROSCOPES

- **PZMTIII** Precision Stereo Zoom Trinocular Microscope
- **PZMIII** Precision Stereo Zoom Binocular Microscope
- **PZMIII-MI** Binocular Microscope Head with LED illuminated base (articulating mirror)

NOTE:#Base can be used with other manufacturer's microscope optics

***PZMTIII-MI** Trinocular Microscope Head with LED illuminated base (articulating mirror) and variable light intensity. Dual reflection lens/ mirror system provides transmitted brightfield/ pseudo-darkfield illumintation.*

*The Trinocular Microscope may be used with the **PRO-300 HDS**.*

Photo Courtesy of Benjamin Dubansky, PhD. University of North Texas

PULLERS

- **PUL-1000** Microprocessor-Controlled 4-Step Micropipette Puller
- **SU-P97** Flaming/Brown Pipette Puller
- **SU-P1000** Next Generation Pipette Puller

WPI is an authorized distributor for Sutter Instruments

PUL-1000 *is a microprocessor controlled horizontal puller for making glass micropipettes or microelectrodes used in intracellular recording, microperfusion or microinjection. It offers programmable sequences of up to four steps with heating, force, movement and cooling time. Perfect for long taper pipettes.*

MANIPULATORS

- **M3301** Manual Micromanipulator
- **KITE** Manual Micromanipulator
- **M4C** Microscope Stage Adapter
- **SU-TRIO** 3-Axis Micromanipulator
- **SU-QUAD** 4-Axis Micromaniulator

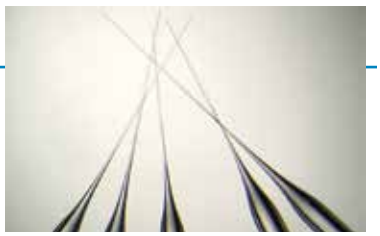
*Weighing just 550 grams, the **M3301** is a well-built micromanipulator that outsells all others world-wide for high precision experiments where magnification is in the range of up to 250×.*

M4C *Microscope Stage Adapter*

GLASS MICROPIPETTES

- Pre-Pulled Long Taper Glass Pipettes (**TIP15FLT**, **TIP12FLT**)
- Glass Capillaries
- **µTip** Pre-Pulled Pipettes with Calibrated Tip ID

Calibrated Tip ID. Get pre-pulled, pipettes with or without a filament. Available in a variety of sizes. Luer connect option is available.



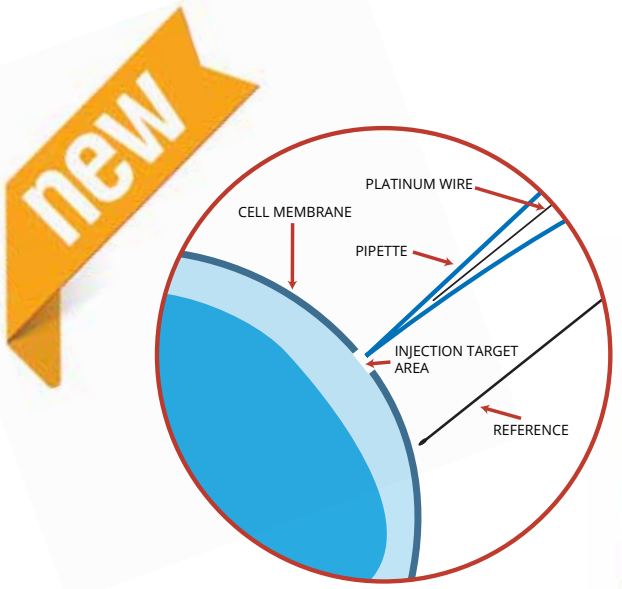
Eliminate the cost and trouble of pulling your own pipettes. Get new low cost, long taper pipettes with or without a filament. Taper length: 12-14 mm.

ACCESSORIES

- **PRO-300 HDS** Camera and Monitoring Screen
- **5430-XX** PicoNozzle Kit
- **NanoFil** Microliter Syringes - 10 or 100 µL
- **NFINHLD-G10** 1.0 mm Glass Pipette Holder for NanoFil Syringe
- **MicroFil** for backfilling glass needles
- Pipetters
- **E2XX** Micropipette Storage Jar
- **801566/801963** Vacuum Pump for use with the **PV830**
- **FluoroDish** Optical Glass Bottom Dishes
- **M10** or **M-3** Manipulator Base
- **Z-MOLDS** Microinjection and Transplantation Molds
- Many Surgical Instruments

Pinpoint Injector

The next generation injection method for increased knock-in efficiency



Applications

- Microinjection into oocytes and pre-implantation stage mammalian embryos, including microinjection of CRISPR-Cas9 reagents into the cytoplasm of two-cell stage embryos
- Pronuclear rodent zygote microinjection
- Gene silencing in zebrafish

MICRO-ePORE

Preliminary Design

98991 - *Auxiliary Knob Controller sold separately*

Features

- Touch-screen display—resistive touch panel for use with gloves
- Injection control with foot switch or manually with touch screen
- Intuitive user interface
- User adjustable frequency and voltage with touch screen or knobs
- Small footprint
- Four user-programmable protocols
- Adjustable audio continuity tone indicates active probe
- Injection counter indicates total number of injections
- Electrodes include reference electrode option
- Electrode holder compatible with most common manipulators

Benefits

- High yield (80-85%) of viable, 2-cell stage mouse embryos after injection
- Integrates with WPI's PV820/PV830 or the Eppendorf Femtojet®
  (Femtojet® 4i is a registered Trademark of Eppendorf AG)
- Hands-free operation with foot switch control
- Works with most inverted microscopes

References

Gu, B., Posfai, E., & Rossant, J. (2018). Efficient generation of targeted large insertions by microinjection into two-cell-stage mouse embryos. *Nature Biotechnology*, 36(7), 632–637. http://doi.org/10.1038/nbt.4166

MICRO-ePore successes in university labs

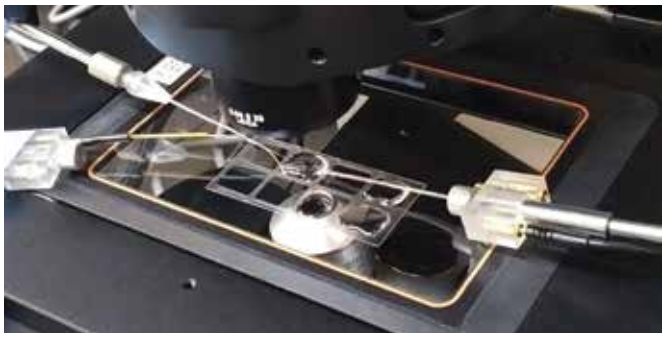


Photo courtesy of Dr Janet Rossant, The Hospital for Sick Children in Toronto, Canada. An example of the MICRO-ePORE™ electrode setup on an inverted microscope. MICRO-ePORE™ electrode design ensures compatibility with the leading microscope manufacturers.

MICRO-ePORE SPECIFICATIONS

VOLTAGE PARAMETERS	0–3.0 V, at 1 mV increments
FREQUENCY PARAMETERS	50–3000 Hz, at 1 Hz increments
PIPETTE RESISTANCE MAXIMUM	40 MΩ
DIMENSIONS	19.7 × 12.7 × 7.6 cm (7.75 × 5 × 3 in.)
WEIGHT	0.9 kg (2 lb)
CERTIFICATIONS	CE, RoHS

ORDERING INFORMATION

MICRO-ePORE MICRO-ePore System™

Includes Electrode Holder • Microinjection Headstage, including adapter for Femtojet™ • Holding Pipette • Platinum Reference Electrode • Vacuum Tubing Set • Foot Switch (Auxiliary Knob Controller sold separately)

98991	Auxiliary Knob Controller
SYS-PV820	Pneumatic PicoPump Microinjector
SYS-PV830	Pneumatic PicoPump Microinjector with Vacuum Pressure
1B100-3*	Single-Barrel Standard Borosilicate Glass Tubing, 3 in. (76mm) long, 1.0 mm OD, 0.58 mm ID, package of 500
TIP1TW1*	Pre-Pulled Glass Pipettes, 1 µm tip ID, 1.0 mm glass OD, Thin wall, fire polished

***Many varieties and choices are available for glass capillaries and pre-pulled µTip micropipettes.*

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Reliable Pneumatic PicoPump

Pneumatic microinjector with vacuum pressure

PV830

Microinjection of sub-nanoliter volumes through a very small opening in a glass micropipette is often accomplished best with a controlled burst of gas pressure. Designed to simplify intracellular injection and a variety of other microinjection tasks, WPI's PicoPumps use precisely regulated pressures for securing cells and injecting them with fluid. Injected volumes range from picoliters to nanoliters.

The **PV830** model provides separate regulation and pressure gages for the eject and hold pressures. In addition to the features of the **PV820**, the **PV830** model also includes a vacuum pressure regulator and vacuum gauge.

See page 44 for more information.

Microelectrode Puller

A compact, versatile and reliable workhorse

PUL-1000

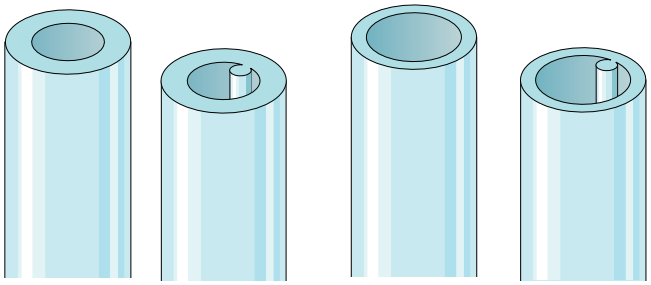
PUL-1000 is a microprocessor controlled horizontal puller for making glass micropipettes or microelectrodes used in intracellular recording, patch clamp studies, microperfusion or microinjection. The puller was designed with tight mechanical specifications and precision electronics for complete control of the pulling process and accurate reproducibility. It offers programmable sequences of up to four steps with heating, force, movement and cooling time. This allows graduated cycles for applications like patch clamp recording.

This puller is a reasonably priced, compact, versatile and reliable workhorse. The microprocessor, combined with the LCD display, makes the **PUL-1000** easy to use.

See page 108 for more information.

Glass Capillaries

Quality glass, superior prices for microinjection/microelectrodes



Standard, no Filament *Standard Filament* *Thin Wall, no Filament* *Thin Wall Filament*

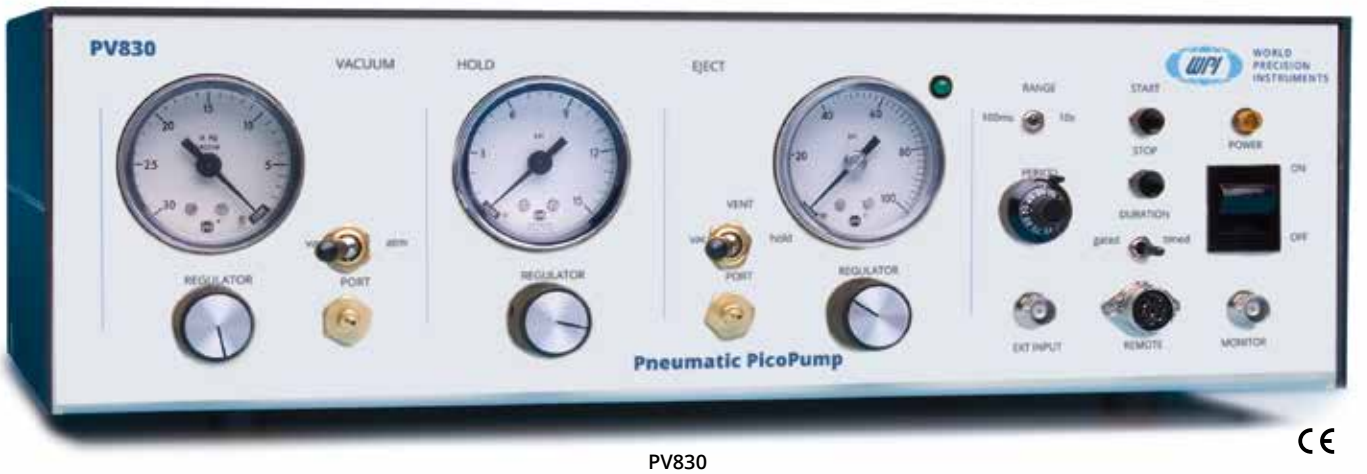
Our quality borosilicate glass capillaries are available with a large variety of options, including fire polished, filaments, thin wall, specialty glass and multi-barrel.

Borosilicate glass capillaries: Close dimensional tolerances assure micro-electrode uniformity and reproducibility. Capillaries are available in 1, 2, 3, 5 and 7-barrel configurations, complete range of single barrel thin-wall sizes and a variety of special configurations. Capillaries with filaments contain a solid filament fused to the inner wall, which speeds filling of electrodes. Capillaries with or without inner filaments are available for making microelectrodes in a wide range of diameters.

For details, see page 47.

Reliable Pneumatic PicoPump

Pneumatic microinjector with vacuum pressure



PV830

Features

- Inject into a single cell with picoliter volumes
- Regulated hold, ejection and vacuum pressure
- Carefully regulated air pressures for securing cells and injecting them with fluid
- Optional independent vacuum regulation
- Pressure Input: 0-120 psi
- Pressure Output: 0.3-90 psi
- Choice of two models

Benefits

- Hold pressure prevents backfilling of the pipette by capillary action
- PV830 includes vacuum pressure for filling pipettes from the tip or securing floating cells during injection

Applications

- Intracellular injection in the picoliter to nanoliter range

Although syringe and piston techniques are popular for microinjection in the nanoliter range, microinjection of sub-nanoliter volumes through a very small opening in a glass micropipette is often better accomplished with a controlled burst of gas pressure. Designed to simplify intracellular injection and a variety of other microinjection tasks, WPI's PicoPumps use precisely regulated 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. In the time between injections, a secondary default "hold" pressure is applied to the pipette to prevent fluid uptake through capillary action or diffusion. The pressure pulses are typically controlled by a precision timer. Timing, ejection pressure, holding pressure and suction are adjusted independently by control knobs and monitored with indicator gauges on the front panel. Injection pressure is controlled by a 20-turn regulator on the front panel. The built-in timing function controls the amount of time that the injection pressure is applied with millisecond resolution. Time intervals can range from 10 s down to 10 ms or less. The pressure burst can also be controlled manually or triggered by an external source.

The **PV830** model provides separate regulation and pressure gauges for the eject and hold pressures. In addition to the features of the **PV820**, the **PV830** model also includes a vacuum pressure regulator and vacuum gauge.

Hold Pressure Prevents Backfilling

Like the **PV830**, the **PV820** was designed to simplify intracellular injection. The hold pressure prevents backfilling of the pipette by capillary action. Simple to use. Reliable every time. Each PicoPump is supplied with a **5430-ALL** kit that includes two PicoNozzles and tubing to connect the holders to the pressure and vacuum ports.

*PicoNozzle Kit **5430-ALL** (included) allows micropipettes to be securely mounted in micro-positioners for stable axial air delivery. (Handle diameter 7 mm × 100 mm long.)*

*The optional **5430-XX** PicoNozzle Kit has a Luer-fitted pipette holder for quick and easy changes. Choose your kit based on the pipette OD (XX indicates OD: 1.0, 1.2, 1.5 or 2.0 mm). The red handle fits easily into most manipulators. This kit contains:*

(1) MPH6S microelectrode holder

(1) Handle for the MPH6S (4" hollow tube with male Luer fitting at both ends—diameter 6.25 mm × 100 mm long)

(1) 5' tubing (0.060" ID, 0.120" OD, male locking Luer fitting on one end and a female locking Luer fitting at the other end, rated for 200 PSI and 86 durometer shore A)

Vacuum Pressure for Additional Applications

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. Vacuum can be applied through the ejection port, but vacuum in the **PV820** must be externally regulated (see Mini Vacuum Pump, page 71). To fill pipettes from the tip or through a secondary port to secure a floating cell during microinjection, vacuum may be switched from regulated vacuum to atmosphere by using the switch on the front panel.

References

Di Cara F, Sheshachalam A, Braverman NE, Rachubinski RA, Simmonds AJ (2017). Peroxisome-Mediated Metabolism Is Required for Immune Response to Microbial Infection. *Immunity*. 2017 Jul 18;47(1):93-106.e7. https://www.ncbi.nlm.nih.gov/pubmed/28723556

Carrington, B., Varshney, G. K., Burgess, S. M., & Sood, R. (2015). CRISPR-STAT: an easy and reliable PCR-based method to evaluate target-specific sgRNA activity. *Nucleic Acids Research*, 43(22), e157. http://doi.org/10.1093/nar/gkv802

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Pneumatic picoliter injector

*WPI's **PV820** Pneumatic PicoPump has been providing scientists with precision and repeatable microinjection in volumes ranging from picoliters to nanoliters for decades. The trusted Pneumatic PicoPump is the preferred Zebrafish microinjection pump. The **PV820** offers the same functionality as the **PV830**, minus the independent vacuum regulator.*

PV820

CE

PICOPUMP SPECIFICATIONS

	PV820	PV830
PRESSURE		
PRESSURE INPUT	0 to 120 psi	0 to 120 psi
PRESSURE OUTPUT	0.3 to 90 psi *	0.3 to 90 psi
PRESSURE BURST TIMER (10-turn dial)	10 ms to 10 s in Timed Mode	10 ms to 10 s in Timed Mode
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 (¼ in. OD Tubing)	Quick Connect (¼ in. OD Tubing)
OUTPUT CONNECTOR	Barbed (1/16-in. ID Tubing)	Barbed (1/16-in. ID Tubing)
VACUUM		
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 (¼ in. OD Tubing)	Quick Connect (¼ 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-in. OD, 1000 psi), one ½-inch female NPT adapter	
OUTPUT KIT	Two PicoNozzle Kits	
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)

**Both Hold and Eject Pressure*

Ramezani, T., Laux, D. W., Bravo, I. R., Tada, M., & Feng, Y. (2015). Live Imaging of Innate Immune and Preneoplastic Cell Interactions Using an Inducible Gal4/UAS Expression System in Larval Zebrafish Skin. *Journal of Visualized Experiments*, (96), e52107–e52107. http://doi.org/10.3791/52107

Chokshi, P. (2015). Analysis of scn5Laa and scn5Lab Gene Function in Danio rerio (Zebrafish) Heart Development through TALENs/CRISPR-CAS9-mediated Gene Knockout. Retrieved March 14, 2016, from http://thescholarship.ecu.edu/bitstream/handle/10342/4923/Chokshi_ecu_0600O_11444.pdf?sequence=1

Ewart, M.-A., Kennedy, S., MacMillan, D., Raja, A. L., Watt, I. M., & Currie, S. (2014). Altered vascular smooth muscle function in the ApoE knockout mouse during the progression of atherosclerosis.

http://doi.org/10.1016/j.atherosclerosis.2014.02.014

Henson, H. E., Parupalli, C., Ju, B., & Taylor, M. R. (2014). Functional and genetic analysis of choroid plexus development in zebrafish. Frontiers in *Neuroscience*, 8, 364. http://doi.org/10.3389/fnins.2014.00364

Huang, L., Xiao, A., Wecker, A., McBride, D. A., Choi, S. Y., Zhou, W., & Lipschutz, J. H. (2014). A Possible Zebrafish Model of Polycystic Kidney Disease: Knockdown of wnt5a Causes Cysts in Zebrafish Kidneys. *Journal of Visualized Experiments*, (94), e52156–e52156. http://doi.org/10.3791/52156

Konantz, J., & Antos, C. L. (2014). Reverse Genetic Morpholino Approach Using Cardiac Ventricular Injection to Transfect Multiple Difficult-to-target Tissues in the Zebrafish Larva. *Journal of Visualized Experiments*, (88), e51595–e51595. http://doi.org/10.3791/51595

ORDERING INFORMATION

SYS-PV820	PicoPump w/ hold pressure
SYS-PV830	PicoPump w/ hold pressure and vacuum

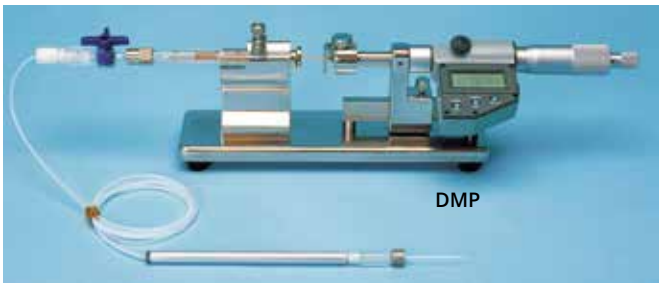
Specify line voltage All PicoPumps require external vacuum source.

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

3260	Foot Switch
2932	Rack Mount Kit, 3.5-in. high (PV820)
2933	Rack Mount Kit, 5,25-in. high (PV830)
5430-10	PicoNozzle Kit (MPH6S for 1.0 mm pipette & 5' tubing)
5430-12	PicoNozzle Kit (MPH6S for 1.2 mm pipette & 5' tubing)
5430-15	PicoNozzle Kit (MPH6S for 1.5 mm pipette & 5' tubing)
5430-20	PicoNozzle Kit (MPH6S for 2.0 mm pipette & 5' tubing)
5430-ALL	PicoNozzle Kit (for 1.0, 1.2, 1.5 and 1.65 mm pipettes & 5-ft. tubing)
75122-110	Gaskets for PicoNozzle , 1.0 mm, green, package of 10
75122-210	Gaskets for PicoNozzle — 1.2 mm, black, package of 10
75122-310	Gaskets for PicoNozzle — 1.5 mm, blue, package of 10
75122-410	Gaskets for PicoNozzle — 1.65 mm, red, package of 10
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

Manual Microsyringe Pumps

Precise manual injection of fluid using glass pipettes



Features

- Accepts syringe sizes: 10 µL–1 mL gas tight Luer tip
- Micrometer head has resolution of 10 µm per division
- Solid, stainless steel frame

Benefits

- Choice of models, with or without digital display
- Cost-effective solution

Applications

- Use for perfusion or withdrawal of liquids

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 nL to the microliter range, depending on the syringe used.

With or without digital display

DMP comes with a digital micrometer that will allow the reading of piston advancement easily with a 0.001 mm resolution. MMP has the traditional mechanical micrometer head with a resolution of 10 µm per division and advances 500 µm per revolution.

Constructed of stainless steel

The entire frame body of the injector is constructed of stainless steel for excellent stability and durability. The piston of the micrometer can be adjusted to the syringe's plunger position. Small diameter PTFE tubing is used for 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 µL gas tight syringe. Other syringe sizes may be purchased separately.

DMP & MMP SPECIFICATIONS

TRAVEL DISTANCE	25 mm
ADVANCES RESOLUTION	0.001 mm for DMP and 0.01 mm for MMP
SYRINGE SIZE	10 µL 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

ORDERING INFORMATION

MMP	Manual Microsyringe Pump
DMP	Manual Microsyringe Pump with Digital Display

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

MMP-KIT Injection Assembly Parts Kit
Not including valve—see **14057-10**, page 220)

Microinjection and Transplantation Molds

A simpler method for handling zebrafish embryos

Features

- For high throughput microinjection research
- Make impressions in agarose gel to facilitate embryo alignment
- Four molds per kit
- Reusable

Benefits

- Organizes and immobilizes embryos for microinjection

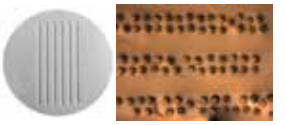
Applications

- Zebrafish research

Mold your agarose, pipette in your embryos, and watch them auto aligning in the grooves. **Z-MOLDS** Microinjection and Transplantation Molds (4 per kit) are designed for zebrafish research.

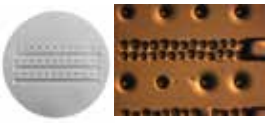
Proteomics & Large Screening–*Inject many embryos, up to 1000. The grooves made by the mold in the agarose gel enable the embryos to self align.*

Xenograft and Larval Injection–*The sloped ridges make perfect angles in the agarose gel, which then makes it easier to do microinjections in the larvae.*



Transplantation–*Increase the speed of doing microinjections. Simply turn the petri dish as you are injecting.*

Standard Microinjection–*Use for blastomere transplantation.*



ORDERING INFORMATION

Z-MOLDS	Microinjection & Transplantation Molds

References

Kitambi SS, Toledo EM, Usoskin D, Wee S, Harisankar A, Svensson R, Sigmundsson, K, Kalderén C, Niklasson M, Kundu S, Aranda S, Westermark B, Uhrbom L, Andäng M, Damberg P, Nelander S, Arenas E, Artursson P, Walfridsson J, Forsberg Nilsson K, Hammarström LG, Ernfors P. Vulnerability of glioblastoma cells to catastrophic vacuolization and death induced by a small molecule. *Cell*. 2014 Apr 10;157(2):313-28.

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Glass Capillaries

Quality glass, superior prices for microinjection/microelectrodes

Features

- Quality borosilicate glass capillaries
- Large variety available, including fire polished, filaments, thin wall, specialty glass and multi-barrel

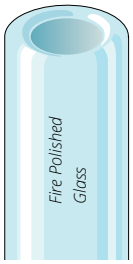
Benefits

- Superior pricing
- Most glass orders ship within 48 hours

Applications

- Microinjection
- Electrophysiology
- Patch clamp
- Fluid Handling

FIre Polishing



Fire-polished glass capillaries are easier to insert into microelectrode holders without damaging the gasket. More importantly, fire-polished glass won't scratch the chloridized wire used in a recording electrode. Fire-polishing does not affect the glass's mechanical or electrical properties.

Making Uniform, Reproducible Microelectrodes

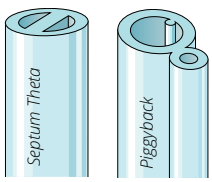
Borosilicate glass capillaries: Close dimensional tolerances assure microelectrode uniformity and reproducibility. Capillaries are available in 1, 2, 3, 5 and 7-barrel configurations, complete range of single barrel thin-wall sizes and a variety of special configurations. Capillaries with filaments contain a solid filament fused to the inner wall, which speeds filling of electrodes. Capillaries with or without inner filaments are available for making microelectrodes in a wide range of diameters.

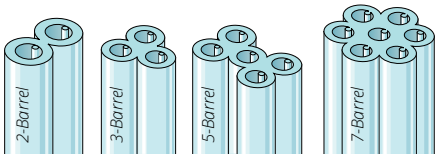
Filament Glass Capillaries

Single barrel standard wall thickness capillaries are offered either with or without inner filaments for quick filling in a variety of lengths and diameters.

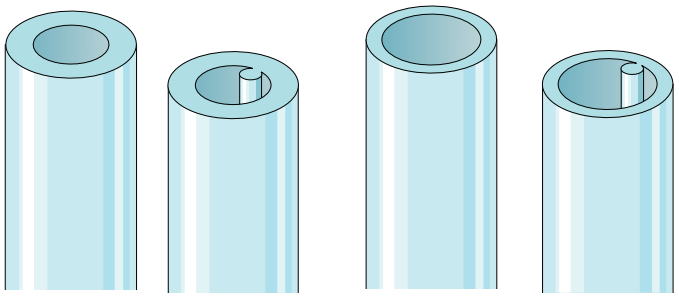
Thin Wall Glass Capillaries

Thin wall single barrel capillaries are offered both with or without inner filaments.





Specialty glass is also available. See page 217.



Standard, no Filament | *Standard Filament* | *Thin Wall, no Filament* | *Thin Wall Filament*

ORDERING INFORMATION

	Length	OD(mm)	ID(mm)	Filament	Fire-Polished	Quantity	Item
Single Barrel Standard Borosilicate Glass	3 in. (76 mm)	1.0	0.58	✔		500	**1B100F-3**
	3 in. (76 mm)	1.0	0.58			500	**1B100-3**
	3 in. (76 mm)	1.2	0.68	✔		350	**1B120F-3**
	3 in. (76 mm)	1.2	0.68			350	**1B120-3**
	3 in. (76 mm)	1.5	0.84	✔		225	**1B150F-3**
	3 in. (76 mm)	1.5	0.84		✔	300	**1B150-3**
	4 in. (100 mm)	1.0	0.58	✔	✔	500	**1B100F-4**
	4 in. (100 mm)	1.0	0.58		✔	500	**1B100-4**
	4 in. (100 mm)	1.2	0.68	✔	✔	400	**1B120F-4**
	4 in. (100 mm)	1.2	0.68			350	**1B120-4**
	4 in. (100 mm)	1.5	0.84	✔	✔	300	**1B150F-4**
	4 in. (100 mm)	1.5	0.84		✔	300	**1B150-4**
	4 in. (100 mm)	2.0	1.12	✔		125	**1B200F-4**
	4 in. (100 mm)	2.0	1.12		✔	200	**1B200-4**
	6 in. (152 mm)	1.0	0.58	✔		500	**1B100F-6**
	6 in. (152 mm)	1.0	0.58			500	**1B100-6**
	6 in. (152 mm)	1.2	0.68	✔		350	**1B120F-6**
	6 in. (152 mm)	1.2	0.68			350	**1B120-6**
	6 in. (152 mm)	1.5	0.84	✔		225	**1B150F-6**
	6 in. (152 mm)	1.5	0.84			225	**1B150-6**
	6 in. (152 mm)	2.0	1.12	✔		125	**1B200F-6**
	6 in. (152 mm)	2.0	1.12			125	**1B200-6**
Thin-Wall Single-Barrel Standard	3 in. (76 mm)	1.0	0.75	✔		500	**TW100F-3**
	3 in. (76 mm)	1.0	0.75			500	**TW100-3**
	3 in. (76 mm)	1.2	0.90	✔	✔	400	**TW120F-3**
	3 in. (76 mm)	1.2	0.90			350	**TW120-3**
	3 in. (76 mm)	1.5	1.12	✔		225	**TW150F-3**
	3 in. (76 mm)	1.5	1.12		✔	300	**TW150-3**
	4 in. (100 mm)	1.0	0.75	✔		500	**TW100F-4**
	4 in. (100 mm)	1.0	0.75		✔	500	**TW100-4**
	4 in. (100 mm)	1.2	0.90	✔		350	**TW120F-4**
	4 in. (100 mm)	1.2	0.90			350	**TW120-4**
	4 in. (100 mm)	1.5	1.12	✔		225	**TW150F-4**
	4 in. (100 mm)	1.5	1.12		✔	300	**TW150-4**
	6 in. (152 mm)	1.0	0.75	✔		500	**TW100F-6**
	6 in. (152 mm)	1.0	0.75		✔	500	**TW100-6**
	6 in. (152 mm)	1.2	0.90	✔	✔	400	**TW120F-6**
	6 in. (152 mm)	1.2	0.90			350	**TW120-6**
	6 in. (152 mm)	1.5	1.12	✔		225	**TW150F-6**
	6 in. (152 mm)	1.5	1.12		✔	300	**TW150-6**

Single barrel glass is Kimble N51A. All thin wall glass is Schott Duran 8330.

Microelectrode Puller

Cost-effective and compact micropipette puller

Features

- Microprocessor controlled
- Program sequences up to four steps
- Store up to 95 programs in memory for easy recall
- Multiple factory programs installed

Benefits

- Tempered glass cover to reduce the effects of humidity on puller reproducibility
- Switchable power supply ensures that line voltage fluctuations don't affect reproducibility

Applications

- Pull your own microelectrodes and micropipettes

PUL-1000

CE

PUL-1000 is a microprocessor controlled horizontal puller for making glass micropipettes or microelectrodes used in microperfusion or microinjection. The puller was designed with tight mechanical specifications and precision electronics for complete control of the pulling process and accurate reproducibility. It offers programmable sequences of up to four steps with heat, pulling force, pull length and cooling time.

This puller is a reasonably priced, compact, versatile and a reliable workhorse. The microprocessor, combined with the LCD display, makes the **PUL-1000** easy to use.

Tempered Glass Cover

The cover of the pulling chamber is made with tempered glass to minimize the temperature effect on the reproducibility of pulled pipettes.

Switchable Power Supply

PUL-1000 has a high quality switching power supply for use anywhere in the world without worry about the line voltage differences. Pulling reproducibility is unaffected by line voltage fluctuation. Heating voltage can be controlled to within 0.1% accuracy even when line voltage fluctuates from 90 to 240 VAC

References

Plautz, C. Z., Williams, H. C., & Grainger, R. M. (2016). Functional Cloning Using a Xenopus Oocyte Expression System. *Journal of Visualized Experiments* (107), e53518–e53518. http://doi.org/10.3791/53518

Komarova, Y., Peloquin, J., & Borisy, G. (2011). Components of a microinjection system. *Cold Spring Harbor Protocols,* 2011(8), 935–9. http://doi.org/10.1101/pdb.ip27

PUL-1000 SPECIFICATIONS

HEATER ELEMENT	Platinum/Iridium
PULLING FORCE	Solenoid, adjustable
TAPER LENGTH	1–10 mm
CAPILLARY OD RANGE	1.0–2.0 mm
MAXIMUM CAPILLARY LENGTH	170 mm
MINIMUM CAPILLARY LENGTH	55 mm
MEMORY SETS	95
AUTO SHUT-OFF TIME	90 s
POWER	90–240VAC, 50/60 Hz
DIMENSIONS	34 x 24 x 12 cm
SHIPPING WEIGHT	16 lb

ORDERING INFORMATION

PUL-1000 Micopipette Puller
System includes PUL-1000 Puller; TW100-4 Thin Wall Glass Capillaries (package of 500); MF34G-5 package of MicroFil

13834	Filament, Platinum/Iridium, 2.5mm wide, 2.5mm Square Box
504951	Filament, Platinum/Iridium, 4.5mm wide, Trough

Also see these other pullers available from WPI

SU-P1000
See page 110.

SU-P97
See page 111.

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Fluid Handling

A large variety of pumps, from picoliter to microliter

We offer a large variety of pumps for everything from microfluidics to general fluid handling applications. Our peristaltic pumps are easy to setup and clean, offer continuous flow with virtually “infinite” volume (depending only on the capacity of your source), require no contact with metal or the pump and are good for large volume pumping. Our syringe pumps provide accurate volume control and are an excellent choice for lower volume applications. Our pneumatic PicoPumps are designed for delivery of very small volumes.

Which Pump is Right for Me?

PUMPS & FLUID HANDLING COMPARISON CHART

	Fluid Range	Channels	Special features	Page
PERISTALTIC PUMPS				
MiniStar™	0.006- 37 mL/min	1	Compact design, remote control	53
Peripro-2HS	0.8 - 300 mL/min	2	Calibrated output, replaceable tubing cartridges	52
Peripro-4HS	0.8 - 300 mL/min	4	Calibrated output, replaceable tubing cartridges	52
Peripro-4LS	0.01-80 mL/min	4	Calibrated output, replaceable tubing cartridges	52
Peripro-8LS	0.01-80 mL/min	8	Calibrated output, replaceable tubing cartridges	52
SINGLE-CHANNEL AND WHOLE-CELL SOLUTION EXCHANGE				
MPS2	Up to 250 µL/min.	8	Programmable control; low dead volume	51
LABORATORY SYRINGE PUMPS				
AL-1000	0.73 µL/hr to 1699 mL/hr	1	Push/pull	65
AL-2000	0.73 µL/hr to 1699 mL/hr	2	Push/pull (2 networked pumps)	65
AL-1000 HP	1.459 µL/hr - 6120 mL/hr	1	Infuse/withdraw, High Pressure	65
AL-4000	1.459 µL/hr to 6120 µL/hr	2	Infuse/withdraw	65
AL-6000	0.73 µL/hr to 1699 mL/hr	6	Infuse/withdraw	65
AL-8000	0.454 µL/hr to 163 mL/hr	8	Infuse/withdraw	65
SPLG100	1.26 pL/min to 88.32 mL/min	1	Infuse only	72
SPLG101	1.26 pL/min to 25.99 mL/min	2	Infuse only	72
SPLG110	1.26 pL/min to 88.28 mL/min	1	Infuse/withdraw	73
SPLG200	0.5 pL/min to 220.97 mL/min	2	Infuse only	74
SPLG210	0.5 pL/min to 220.97 mL/min	2	Infuse/withdraw	73
SPLG212	0.5 pL/min to 220.97 mL/min	2	Infuse/withdraw programmable	73
SPLG270	0.5 pL/min to 220.97 mL/min	2+2	Push-pull	73
SPLG272	0.5 pL/min to 220.97 mL/min	2+2	Push-pull programmable	73
Available online: wpiinc.com **SP100i**	0.0001-519 mL/hr	1	Basic single channel	-
SP101i	0.001 µL/hr – 35 mL/min	2	Micro dialysis application	-
SP120p	0.1 µL/hr – 127 mL/hr	1+1	Push pull, single cycle	-
SP200i	0.001 µL/hr - 145 mL/min	2	RS232 TTL/foot switch	-
SP210c	0.001 µL/hr - 86 mL/min	2+2	RS232 push pull, continuous	-
SP210iw	0.001 µL/hr - 145 mL/min	2	RS232 infuse/withdraw	-
SP220i	0.001 µL/hr - 21 mL/min	10	RS232 infuse only	-
SP230iw	0.001 µL/hr - 21 mL/min	10	RS232 infuse/withdraw	-
SP250i	0.001 µL/hr - 21 mL/min	4	RS232 infuse only	-
SP260p	0.001 µL/hr - 86 mL/min	2+2	RS232 push pull, single cycle	-
MICRO SYRINGE PUMP / STEREOTAXIC INJECTION				
UMP3T-1	0.03 nL/min - 10 µL/sec	1	Ultra micro infuse/withdraw RS232	56
MMP	Manual 100 µL-1 mL syringe	1	Manual	64
DMP	Manual 100 µL-1 mL syringe	1	Digital readout micrometer	64
MICROINJECTION				
PV820	Injected volumes from pL to nL	1	Injection pressure and holding pressure	63
PV830	Injected volumes from pL to nL	1	Injection pressure and holding pressure and vacuum	62
NANOLITER2010	Bolus, 2.3-69 mL/Injection	1	Oocyte injector, infuse only	61
Microinjection Systems (Zebrafish, C. Elegans, Drosophila, Xenopus oocytes)				
MICROFLUIDICS				
ExiGo	50 nL/min - 10 mL/min	1	Infuse only, feedback via integrated flow sensor, includes iPad mini which can control up to four pumps	77
Mirus	100nL/min – 10 mL/min ±1%	8	Microchip perfusion. Infuse only, reversible flow, ~600 µL dead volume, PC control	78
Kima	15 – 35 mL/hr ±4%	1	Microchip perfusion. Infuse only, recirculating pump controlled by iPod Touch, wi-fi communication, <300 µL dead volume	77
Unigo	1 µL/min–1 mL/min; unidirectional (push)	1	A precision, microfluidic, single-channel, pressure pump. Can expand up to 4 channels.	78
SUPPLIES & TOOLS				
Pipetters — standard and autoclavable				81
Miniature Vacuum Pump				82

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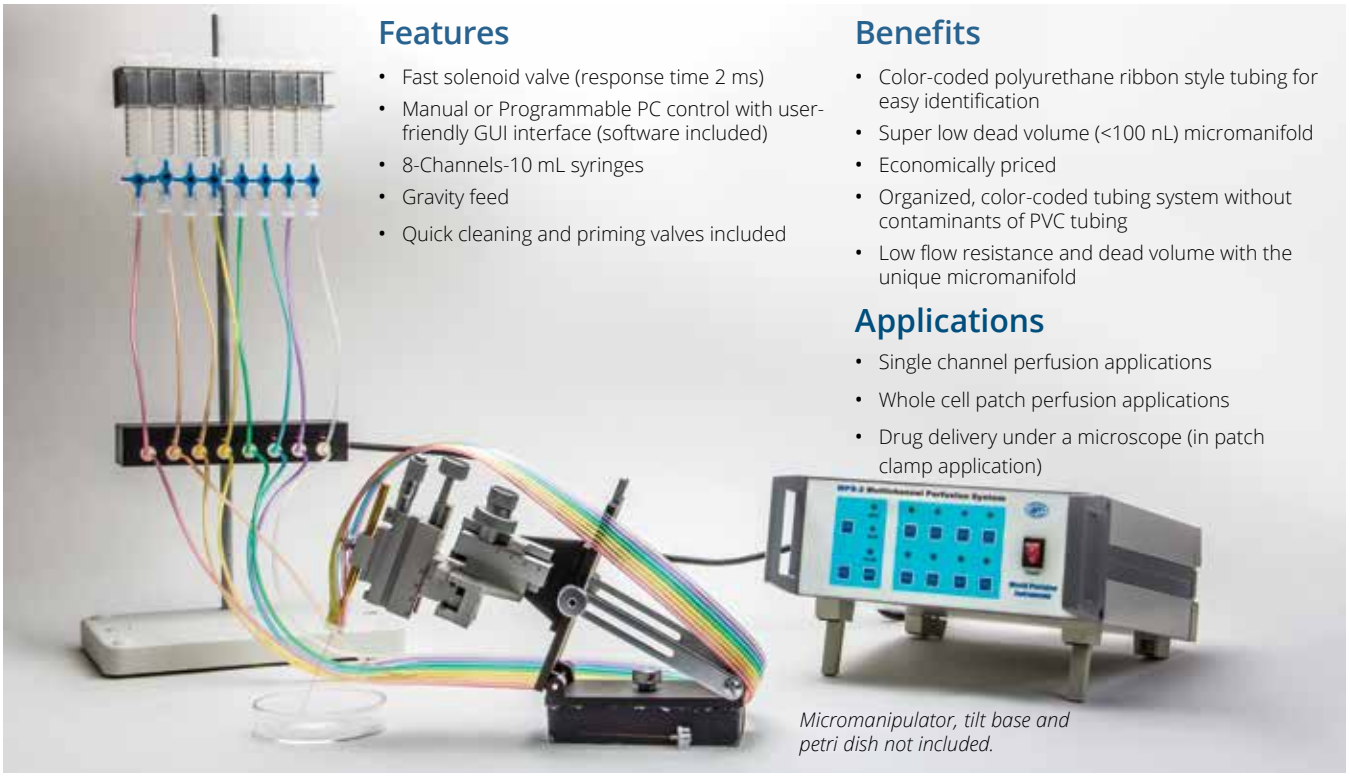
Multichannel Perfusion System

For single ion channel and whole-cell solution exchange



Micromanipulator, tilt base and petri dish not included.

Features

- Fast solenoid valve (response time 2 ms)
- Manual or Programmable PC control with user-friendly GUI interface (software included)
- 8-Channels-10 mL syringes
- Gravity feed
- Quick cleaning and priming valves included

Benefits

- Color-coded polyurethane ribbon style tubing for easy identification
- Super low dead volume (<100 nL) micromanifold
- Economically priced
- Organized, color-coded tubing system without contaminants of PVC tubing
- Low flow resistance and dead volume with the unique micromanifold

Applications

- Single channel perfusion applications
- Whole cell patch perfusion applications
- Drug delivery under a microscope (in patch clamp application)

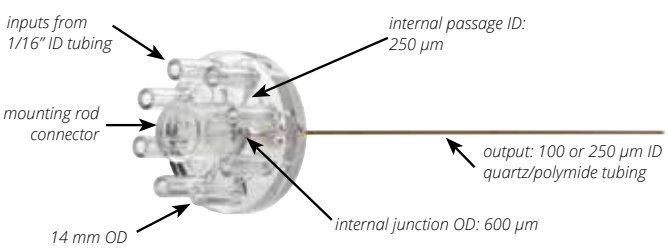
MPS-2 is a programmable 8-channel perfusion system designed for single channel and whole-cell patch preparations. Offering the best combination of performance and value, the **MPS-2** incorporates the same high quality solenoid valves found on similar but much more expensive systems. Unlike other perfusion systems on the market, which often compromise performance to fit every possible application, the **MPS-2** is the only perfusion system designed and optimized specifically for single-channel and whole-cell patch perfusion applications.

Options for Manual and Automatic Control

The system can be controlled manually via membrane switches on the front panel or through a PC. Two different manual control modes are offered. One controls each channel independently and the other mode allows you to assign a master channel that will keep the system flow when all other channels are switched off. User-friendly graphic timing software is included, and the programmed perfusion sequence can be started by computer, a patch clamp amplifier or other external trigger, or manually.

Organized, Color-coded, Ribbon Tubing

The perfusion fluid flows through specially designed color-coded polyurethane ribbon style tubing. The color-coding allows you to easily trace each channel for diagnostic checks or set up, and the ribbon style of tubing keeps the system neat and organized. Unlike PVC based tubing, polyurethane tubing contains no plasticizer, which can cause contamination. The tubing ribbon is designed as an economical disposable item, which is often critical when cleanliness is needed.



Micromanifold closeup: Fluid-filled passages are shown in magenta.

Low Flow Resistance and Dead Volume

The most unique feature of the **MPS-2** is its perfusion micromanifold. Using the latest microfluidic techniques, the injection molded micromanifold provides the least flow resistance and dead volume of any product on the market. The flow channel inner diameter is approximately 1.0 mm, except for the last 5 mm before the junction point. This design allows a fast flow rate without using a pressured system. Small channels and a unique design at the merging point further reduce the chance of cross contamination. Dead volume is less than 100 nL at junction.

MPS-2 SPECIFICATIONS

CHANNELS	8
VALVE RESPONSE TIME	2 ms
VALVE CONTROL	USB, TTL, external start via software
SYRINGE RESERVOIR VOLUME	10 mL
MANIFOLD	8 to 1
OUTPUT TUBING ID	250 µm and 100 µm.
MAXIMUM FLOW RATES *(with 50 mm output tubing, gravity fed)*	100 µm ID tip, 8 µL/min. Tubing cap: 7.85 nL/mm 250 µm ID tip, 250-500 µL/min. Tubing cap: 49.1 nL/mm
DEAD VOLUME	< 100 nL excluding the single outlet tubing

ORDERING INFORMATION

MPS-2	Multichannel Perfusion System & Control Software

System includes: stand, PS-2 controller, valve console, syringe holder, power cord, USB cable, DB9-to-BNC 8-cable assembly, (2) 1A fuses, (10) 10 mL syringes, (10) 3-way stopcocks, (10) Luer fitting with barb for 1/16-in. ID tubing, color coded polyurethane tubing ribbon (5 ft), tubing for making micromanifold cleaning adaptor (3 in.), micromanifold holding rod, (2) micromanifolds with 100 µm id tip, (2) micromanifolds with 250 µm id tip and installation software

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

502109-15	Color-coded PU Tubing, 1/16" ID x 8 Channels, 15 ft
502110	Micromanifold, 100 µm ID tip, 2 pcs/pk
502125	Micromanifold, 250 µm ID tip, 2 pcs/pk

Specify line voltage and Micromanifold tip OD when ordering.

Affordable High Performance Peristaltic Pump

Digital Peri-Star™ Pro peristaltic pump is affordably priced!

Features

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

Benefits

- Backlit display with water resistant cover
- Easy setup and calibration with simple instructions on screen
- Both high and low flow pumps employ planetary gears for minimal pulsations and greater accuracy

Applications

- Chemical transfer
- Pharmaceutical processing

CE

PERIPRO-4LS

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. You 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.

Backlit display with water resistant cover

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.

Easy set up and calibrate the pump

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

Unique planetary gears for accuracy

Peri-Star Pro is available in two versions: a 4-roller version for high flow and an 8-roller version for lower volumes which provides 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, enables high flow accuracy and prolongs tubing life. Snap-on cartridges allow tubing to be changed quickly without cross contamination of solutions.

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)

ORDERING INFORMATION

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/REPLACEMENT PARTS

503049	Replacement Tubing Cartridge, Large
503050	Replacement Tubing Cartridge, Small
503022	Replacement Silicone Tubing, 1 m, 1.6 mm I.D., #14, with stops
503023	Replacement Silicone Tubing, 1 m, 6.4 mm I.D., #17
503120	TTL Control Module

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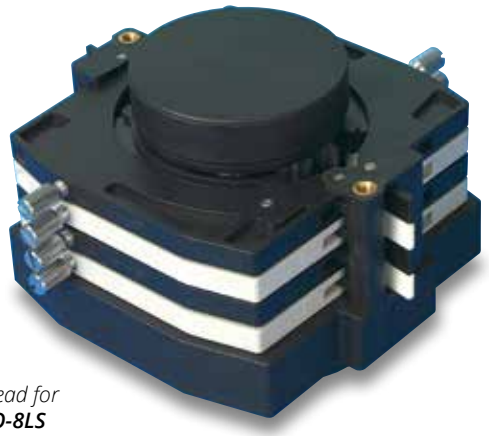
Mini Peristaltic Pump

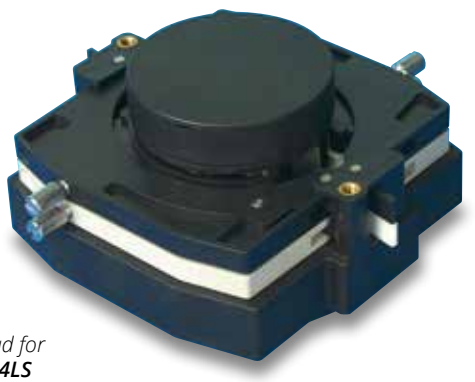
Lightweight, portable Mini★Star™

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



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

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



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

Features

- Flow Range: 0.06-14.0 mL/min
- Speed: 1-50.0 rpm, forward/reverse
- Stand and clamp shown in the image are included
- Includes tubing

Benefits

- Remote control (wired)
- Small footprint
- Quiet operation
- Compact and easily transported

MINISTAR

Applications

- Small volume chemical transfer
- Pharmaceutical processing
- Sample perfusion

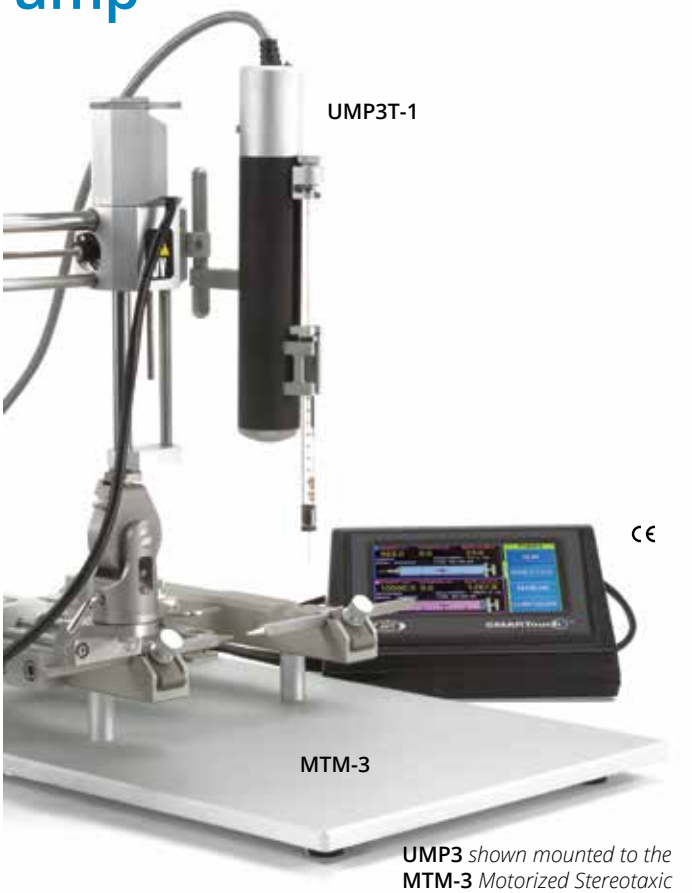
This compact, lightweight peristaltic pump fits just about anywhere. It can be mounted directly on the bench, in a regular rack or to a post. The speed can be adjusted from 1 to 50 rpm. With recommended silicone tubing, the volume can be set from 0.06 to 14.0 mL/min. The **MiniStar™** also features a hand held remote control that allows you 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	≤ 4.8 mm
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

ORDERING INFORMATION	
MINISTAR	Miniature Peristaltic Pump, 1-channel
504011	MiniStar™ and Stand (as pictured above)
503120	TTL Control Module
503121	Silicone Tubing with stops, 2.4mm ID x 0.8mm wall x 1 m (5-pk)
503122	Silicone Tubing with stops, 1 mm ID x 1 mm wall x 1 m (5-pk)

Microinjection Syringe Pump

Delivering picoliter volumes precisely



UMP3 *shown mounted to the* **MTM-3** *Motorized Stereotaxic Frame (not included).*

Features

- Graphic display with SMARTouch touch screen controller for "intelligent", easy to use interface controlling up to four syringe pumps
- Splash proof touch screen
- User configurable mounting bar
- Dual mode motor drive
- Compatible with all UMP, UMP2 and UMP3 pumps
- Optional foot switch available
- 5-Digit display

Benefits

- Accepts a wide variety of microinjection syringes
- Manual or automated injections
- Quiet operation for electrophysiology recordings
- Mounts directly on micromanipulator or stereotaxic frame
- Nominal injections down to 1.0 nL
- Rapid setup with intuitive touchscreen controller

Applications

- Microinjection
- Neuroscience
- Microfluidics
- Micro delivery of biochemical agents or dyes

The UltraMicroPump 3 (**UMP3**) is a versatile pump which uses micro syringes to deliver picoliter to milliliter volumes. The pump is optimum for applications that require injections of precise and small amounts of liquid. With its touchscreen controller, UMP3 can displace as little as 0.53 µL/step (using 10 µL syringe with 60 mm scale length).

The new SMARTouch™ controller for the UltraMicroPump features Patent Pending technology which includes:

- Total system calibration – Calibrate the syringe and the controller together as a system. This feature eliminates the variability of the syringes and delivers the calibrated volume.
- Smart smoothness – The controller can be set to automatically adjust microstepping according to the injection rate to deliver the smoothest flow.
- User defined travel limits – Set the limits for a specific syringe in the software. This prevents the pump from over-driving the plunger into the syringe, potentially causing syringe breakage.

The **MICRO2T** SMARTouch™ controller is feature rich. All operations are controlled through interactive touch screen. It has a graphical indication of the flow and the volume remaining in the syringe. It offers automatic end stop detection that is dependent on the syringe volume. You can control two pumps independently from one controller with its dual display. It also has automatic pump detection and a Pause/Resume feature that allows dosing during infusion/withdrawal The volume accumulated is displayed on screen, as well as the percentage of volume left in the syringe. The SMARTouch controller is fully compatible with all earlier versions of the UltraMicroPump.

Low Fluid Dead Volume

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.

Flexibility in Mounting

For positioning, the UMP3 may be attached to any of several WPI micro-positioners such as the **M3301** (manual), **SU-QUAD** or **SU-TRIO** (motorized) or any manual stereotaxic manipulator.

Rapid Setup with Intuitive Touchscreen Controller

An Integral component in the UMP3 system is the SmarTouch touchscreen controller, which provides an "intelligent" and easy-to-use interface to up to four (or two) syringe pumps. Operating parameters are set with the touchscreen panel. You can save your parameters for instant recall. An optional foot switch offers "hands free" start/stop operation.

Computer Control—A USB port on the rear of the controller can be used to connect it to a computer for scripted protocols.

NOTE: UMP3 accepts glass syringes with barrel diameters from 5.5 to 9 mm.

References

Augestad, I. L., Nyman, A. K. G., Costa, A. I., Barnett, S. C., Sandvig, A., Håberg, A. K., & Sandvig, I. (2017). Effects of Neural Stem Cell and Olfactory Ensheathing Cell Co-transplants on Tissue Remodelling After Transient Focal Cerebral Ischemia in the Adult Rat. *Neurochemical Research*, 1–11. http://doi.org/10.1007/s11064-016-2098-3

Eleftheriadou, I., Dieringer, M., & Poh, X. (2017). Selective transduction of astrocytic and neuronal CNS subpopulations by lentiviral vectors pseudotyped with Chikungunya virus envelope. *Biomaterials*. Retrieved from http://www.sciencedirect.com/science/article/pii/S0142961217300376

Job, M. O., & Kuhar, M. J. (2017). Cart Peptide in the Nucleus Accumbens Regulates Psychostimulants: Correlations Between Psychostimulant and Cart Peptide Effects. *Neuroscience*. http://doi.org/10.1016/j.neuroscience.2017.02.012

Mosberger, A. C., et al.. (2017). Axotomized Corticospinal Neurons Increase Supra-Lesional Innervation and Remain Crucial for Skilled Reaching after Bilateral Pyramidotomy. *Cerebral Cortex* (New York, 1991). http://doi.org/10.1093/cercor/bhw405

The SMARTouch™ controller can control up to two UMP3 pumps.

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UMP3 *shown mounted on a standard micromanipulator (not included) and using the new SMARTouch controller.*

ULTRAMICROPUMP SPECIFICATIONS

(based on 10 µL syringe)

NORMAL MODE

TRAVEL	62 mm
MINIMUM DISPENSING VOLUME	0.58 nL / step (10 µL syringe)
LINEAR MOTION PER STEP	3.175 µm/half step
WEIGHT	325 g (11.5 oz)
MOUNTING ROD DIAMETERS	7.9 mm (0.31 in.)
MAINS POWER SUPPLY	90-264VAC @ 47-63Hz
DIMENSIONS	Ø 32 mm x 190 mm (Ø 1.3 in. x 7.5 in.)
MAXIMUM SYRINGE SIZE	1 mL

MICROSTEPPING MODE

Precision is increased eight-fold

ORDERING INFORMATION

UMP3T-1	UltraMicroPump III (one) and **Micro2T** Controller
UMP3T-2	UltraMicroPump III (two) and **Micro2T** Controller
UMP3-3	UltraMicroPump III (three) and **Micro4** Controller
UMP3-4	UltraMicroPump III (four) and **Micro4** Controller
UMP3	UltraMicroPump III (without controller)
MICRO2T	SMARTouch Controller, Two-Channel

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

13142	Foot Switch for MICRO2T*
502201	V-clamp for Stereotaxic Frame
503301	Extension Cable, miniDIN (male-female) 10 ft
503207	Small Base Stand and Clamps

13142 *is the foot pedal for use with the MICRO2T ONLY. It is not compatible with the old MICRO4 controller, which uses the* **15867** *foot pedal. The two foot pedals are not cross-compatible.*

Microvolume Syringes

ORDERING INFORMATION

Syringes with Luer Fitting (no needle)

Order No.	Volume	Description	O.D.	SCALE LENGTH	UMP3	UMP2
ILS005LT	5 µL	ILS 5 µL Gas-tight Luer tip	6.5 mm	54.1 mm	Y	Y
ILS010LT	10 µL	ILS 10 µL Gas-tight Luer tip	6.5 mm	54.1 mm	Y	Y
ILS025LT	25 µL	ILS 25 µL Gas-tight Luer tip	8.0 mm	60 mm	Y	Y
SGE050TLL	50 µL	SGE 50 µL Gas-tight Teflon Luer Lock	8.0 mm	60 mm	Y	Y
SGE100TLL	100 µL	SGE 100 µL Gas-tight Teflon Luer Lock	8.0 mm	60 mm	Y	Y
SGE250TLL	250 µL	SGE 250 µL Gas-tight Teflon Luer Lock	8.0 mm	60 mm	Y	N

Syringes with Replaceable Beveled Needles

Order No.	Volume	Description	O.D.	SCALE LENGTH	UMP3	UMP2
SGE0005RN*	0.5 µL	SGE 0.5 µL 23 ga (0.63 mm), 70 mm long needle	8.0 mm	54.1 mm	Y	Y
SGE001RN*	1.0 µL	SGE 1.0 µL 26 ga (0.47 mm), 70 mm long needle	8.0 mm	54.1 mm	Y	Y
SGE005RN	5 µL	SGE 5 µL 23 ga (0.63 mm), 70 mm long needle	8.0 mm	54.1 mm	Y	Y
SGE010RNS	10 µL	SGE 10 µL 26 ga (0.47 mm), 50 mm long needle	8.0 mm	54.1 mm	Y	Y
SGE025RN	25 µL	SGE 25 µL 25 ga (0.50 mm), 50 mm long needle	8.0 mm	60 mm	Y	Y
SGE050RN	50 µL	SGE 50 µL 25 ga (0.50 mm), 50 mm long needle	8.0 mm	60 mm	Y	Y
SGE100RN	100 µL	SGE 100 µL 25 ga (0.50 mm), 50 mm long needle	8.0 mm	60 mm	Y	Y

** The capacity of this syringe is so small that the entire sample is contained within the needle. The plunger extends to the tip of the needle, displacing the full sample during injection — which gives the syringe zero dead volume.*
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

Sub-Microliter Injection System

Includes the smallest dead volume injection when the 10 µL syringe is used with WPI needles 34-36g

ferrule: Ø 8 mm

Features

- The smallest dead volume injection syringe
- Various needle sizes available from 26 ga. and 33-36 ga.
- Blunt or sharp needles
- Compatible with WPI's UMP3 microinjection system

Benefits

- Low dead volume (0.5 µL or less)
- Switching the syringe tip during an experiment is easy
- Variety of tips.

Applications

- Animal research
- Capillary electrophoresis
- Versatile research applications — RPE and IO Kits

NanoFil™ is a specially designed 10 µL 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.

Low Dead Volume

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).

Easily Switch Syringe Tip

When the inner tip diameter of a conventional syringe is reduced to less than 100 µm, it is very difficult to front fill 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 µL syringe, a solid ring or bushing is permanently bonded to the tubing. Replacing the tip in the middle of the experiment is not practical. With 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.

Holds Metal Tips and Quartz Tubing

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 electrophysiology recording. The silicone gasket makes it possible to hold not only metal needles but also **Silflex** 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 barrel inner diameter (ID) of 460 µm. Flexible quartz capillaries used in Gas Chromotography (GC) and Capillary Electrophoresis (CE) can also be easily coupled to the syringe.

Variety of Tips

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

Selecting the correct tip for your application

The replaceable needles used with 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 can affect the resolution and accuracy of a microinjection in the low nanoliter range is diffusion from the needle opening. When the tip ID is equal to or larger than 100 µm, the error caused by tip diffusion can be 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, making accurate injection of a nanoliter possible.

All of WPI's beveled needles have a unique 25° tri-surface bevel that is optimized for microinjection. A 10 degree single-surface beveled tip penetrates better than one with a 25° angle, however the distance between the upper opening to the tip (the dimension "F" in the table on page 59) is longer. As a result, it requires deeper penetration of the tip. This can be an issue for microinjection into very small areas where the dimensions of the anatomy can't accomodate the required depth of insertion.. WPI's unique 25° beveled tip reduces the required insertion depth by incorporating two extra beveled surfaces. The edge 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 sharp point. It penetrates more easily and is more durable. Our tests show that our 33 gauge, 25 degree beveled tip penetrates easier and lasts longer than other manufacturers' 33 gauge, 10 degree single beveled tips. With a 35 gauge tri-surface beveled tip, the resistance to the penetration becomes even less. Each of our needles 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 (dimension F on the drawing) is 348 µm for the 33 gauge tip. The distance for our 35 gauge tip is only 230 µm. 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

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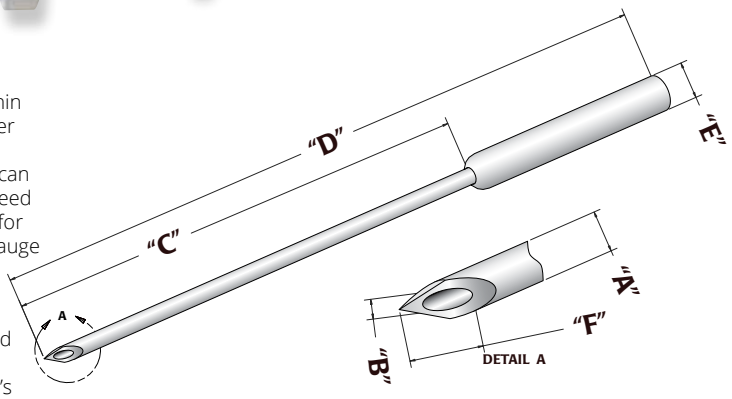
glass barrel: ø 7 mm

NANOFIL

produce, there are some limitations to consider before using it. Its thin diameter makes it necessary to limit its length to 2.5 to 3 mm in order to maintain a usable strength. Since the tip ID is in the 25 to 50 µm range, it is very easily clogged. Therefore, only well filtered solutions can be used. Depending on the viscosity of the sample, you 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.

Flexible Quartz Tubing

The flexible quartz tubing tip is made of 160 µm 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 µL of dead volume in its Luer hub, the dead volume of this tip is less than 0.589 µL. It is useful for loading electrodes with solutions that have a limited volume or are too expensive to waste.



SPECIFICATIONS

Tip Order Number	Gauge	Tip O.D. "A"	Tip I.D. "B *nominal*	Tip Length "C"	Total Length "D"	Shank O.D. "E"	Bevel Length "F"	Total Dead Volume	Tip Material
NF33BV-2	33	210 µm	115 µm	10 mm	40 mm	460 µm	≈348 µm	0.416 µL	Stainless Steel
NF34BV-2	34	185 µm	85 µm	5 mm	35 mm	460 µm	≈290 µm	0.199 µL	Stainless Steel
NF35BV-2	35	135 µm	55 µm	5 mm	35 mm	460 µm	≈204 µm	0.435 µL	Stainless Steel
NF36BV-2	36	120 µm	35 µm	3 mm	33 mm	460 µm	≈156 µm	0.340 µL	Stainless Steel
NFQ34-5	34	160 µm	100 µm	55 mm	75 mm	460 µm	n/a	0.589 µL	Quartz
NF33BL-2	33	210 µm	115 µm	10 mm	34 mm	460 µm	≈0	0.416 µL	Stainless Steel
NF34BL-2	34	185 µm	85 µm	5 mm	29 mm	460 µm	≈0	0.199 µL	Stainless Steel
NF35BL-2	35	135 µm	55 µm	5 mm	29 mm	460 µm	≈0	0.435 µL	Stainless Steel
NF36BL-2	36	120 µm	35 µm	3 mm	27 mm	460 µm	≈0	0.340 µL	Stainless Steel
Silflex			100 µm		35 cm			2.749 µL	
NF26BV-2	26	460 µm	110 µm	3 mm	40 mm	460 µm		0.380 µL	

References

Arriaga, G., Macopson, J. J., & Jarvis, E. D. (2015). Transsynaptic Tracing from Peripheral Targets with Pseudorabies Virus Followed by Cholera Toxin and Biotinylated Dextran Amines Double Labeling. *Journal of Visualized Experiments*, (103), e50672–e50672. http://doi.org/10.3791/50672

Delotterie, D. F., Mathis, C., Cassel, J.-C., Rosenbrock, H., Dorner-Ciossek, C., & Marti, A. (2015). Touchscreen tasks in mice to demonstrate differences between hippocampal and striatal functions. *Neurobiology of Learning and Memory*, 120, 16–27. http://doi.org/10.1016/j.nlm.2015.02.007

Han, Z., Banworth, M. J., Makkia, R., Conley, S. M., Al-Ubaidi, M. R., Cooper, M. J., & Naash, M. I. (2015). Genomic DNA nanoparticles rescue rhodopsin-associated retinitis pigmentosa phenotype. FASEB Journal : *Official Publication of the Federation of American Societies for Experimental Biology*, 29(6), 2535–44. http://doi.org/10.1096/fj.15-270363

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. This method is limited by the accuracy of plunger movement that is achievable with a human hand.

Installed on WPI's UMP3 microsyringe pump: This will allow the user to achieve nanoliter resolution and reproducibility. For neural system injection, mount the UMP3 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 syringe is mounted on the UMP3 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 foot switch 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.

ORDERING INFORMATION

NANOFIL	NanoFil™ Syringe, 10 microliter *Includes two 28-gauge MicroFil needles MF28G; one 1cc plastic syringe; and one 26-gauge beveled needle NF26BV.*
NANOFIL-100	NanoFil™ Syringe, 100 microliter *26-gauge beveled needle NF26BV included.*

REPLACEMENT NEEDLE

NF26BV-2	26G Beveled Needle, 460 µm nominal diam. (package of 2)

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)
NF33-36BL	Assortment of 4 blunt NanoFil™ Needles
NF33-36BV	Assortment of 4 beveled NanoFil™ Needles

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

NFINHLD	NanoFil™ Injection Holder
SILFLEX-2	SilFlex 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. of 5)

NanoFil™ Application Kits

Designed for eye research

Features

- Includes SilFlex tubing, gasket, holder and tip assortment
- NanoFil™ syringe sold separately
- Less than 3 µL dead volume
- Achieve accurate, repetitive, oil-free injections

Benefits

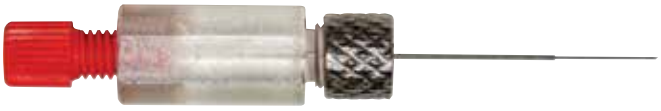
- No oil back filling necessary
- Comes with four needle sizes included in the kit

Applications

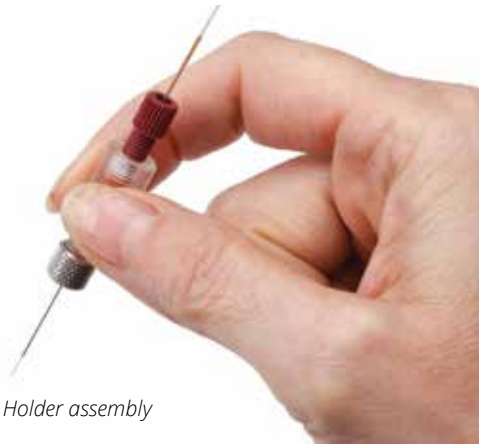
- Intraocular injection
- Retinal pigment epithelium injection
- Mouse brain injection

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 are used exclusively with a **NanoFil™** syringe and **UMP3** to achieve accurate and repeatable oil free injections down to submicroliter ranges. Each kit includes two pieces of Silflex tubing, a holder assembly, spare gaskets, and an assortment of four needles — 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 needles so that first time users can find the best size for their application.

The Silflex tubing is a very important component of the kit. This 35 cm long, flexible tubing has a precise outer diameter for airtight fitting with the syringe. It also has a small inner diameter to minimize dead volume. The SilFlex is coupled to the injection tip with a seal system 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 materials for easy cleaning after viral injection.



RPE-KIT



RPE-KIT *Holder assembly*

ORDERING INFORMATION	
RPE-KIT	Retinal Pigment Epithelium (RPE) Injection Kit *SilFlex tubing, gasket, holder, and blunt tip mix*
IO-KIT	Intraocular (IO) Injection Kit *SilFlex tubing, holder, gasket, 4 beveled tips (33g, 34g, 35 g, 36g)*
503207	Stand & Clamps
NFINHLD	NanoFil Injection Holder
NFINHLD-G10	1.0 mm Glass Pipette Holder for NanoFil Syringe

References

Park, S. W., Kim, J. H., Park, W. J., & Kim, J. H. (2015). Limbal Approach-Subretinal Injection of Viral Vectors for Gene Therapy in Mice Retinal Pigment Epithelium. *Journal of Visualized Experiments*, (102), e53030–e53030. http://doi.org/10.3791/53030

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Nanoliter Injector

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

Features

- Microprocessor-controlled injector
- Direct piston displacement in capillary glass
- Filling and injection speeds: 23nL/sec and 46 nL/sec
- Optional standard or **Micro2T** controller
- Optional foot switch

Benefits

- No syringes required
- Graphical representation of volume status
- Automatically calculated injections based on syringe volume and scale length
- Intuitive touchscreen interface

Applications

- Oocyte injection

WPI's microprocessor-controlled **Nanoliter 2010** uses direct piston displacement. By either pushing the injection button on the control box or pressing on the optional foot switch, a discrete volume will be injected. Choice of capillary filling and injection speeds are 23nL/sec or 46nL/sec (emptying speed is 92nL/sec). Maximum fluid ejection is 5 µL. Each unit comes with sufficient glass to pull at least 300 micropipettes (see **PUL-1000**, page 48). Glass is 1.14mm O.D. (nominal) and 0.5 mm I.D.

By setting the DIP switch, the injection volume can be changed from 2.3 to 69.0nL in 16 steps. Up to 100 injections may be performed from a single filling of the micropipette. Since the volume of a normal Xenopus oocyte is about 500nL, 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 (300), replacement "O" rings, Allen wrench, MicroFil **MF34G** backfilling needle and two sample **µTip™** pre-pulled micropipettes.

New SMARTouch controller

Already own a unit with the standard controller (shown below) or a **Micro4** digital controller? Now you can upgrade to touchscreen control with the new **SMARTouch**.

References

Chouchane, M., et. al. (2017). Lineage Reprogramming of Astroglial Cells from Different Origins into Distinct Neuronal Subtypes. *Stem Cell Reports*, 9(1), 162–176. http://doi.org/10.1016/j.stemcr.2017.05.009

Moreno-Juan, V., et. al. (2017). Prenatal thalamic waves regulate cortical area size prior to sensory processing. *Nature Communications*, 8, 14172. http://doi.org/10.1038/ncomms14172

Tappert, L., et. al. (2017). Sublethal doses of imidacloprid disrupt sexual communication and host finding in a parasitoid wasp. Scientific Reports, 7(1), 42756. http://doi.org/10.1038/srep42756

Lynagh, T., et. al. (2017). Unique Contributions of an Arginine Side Chain to Ligand Recognition in a Glutamate-gated Chloride Channel. *The Journal of Biological Chemistry*, 292(9), 3940–3946. http://doi.org/10.1074/jbc.M116.772939

Li, S., et. al. (2017). Small RNA-Seq analysis reveals microRNA-regulation of the Imd pathway during Escherichia coli infection in Drosophila. *Developmental & Comparative Immunology*, 70, 80–87. http://doi.org/10.1016/j.dci.2017.01.008

The standard configuration of the Nanoliter 2010 includes the small controller which is simple to setup and operate.

NANOLITER2010

NL2010MC2T

Micromanipulator sold separately.

NANOLITER 2010 SPECIFICATIONS

REMOTE CONTROL	Yes
GLASS OD	1.14 mm
GLASS ID	0.5 mm
STEP	12.7 µm/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
SINGLE STEP VOLUME RANGE	2.3 - 69.0 nL
SMALLEST VOLUME	2.3 nL
LARGEST SINGLE STEP VOLUME	69 nL
TO CHANGE VOLUME	Set switch
INJECTIONS PER FILLING, MAX.	100 injections
SHIPPING WEIGHT	3 lb. (1.1 kg)

ORDERING INFORMATION

NANOLITER2010 Nanoliter 2010 and Standard Controller
System includes Nanoliter 2010 injector, small controller, 1 vial 3.5 in. capillaries (300), replacement "O" rings, Allen wrench, MicroFil™ MF34G backfilling needle and two sample µTip™ pre-pulled micropipettes.

NL2010MC2T Nanoliter Injector & SMARTouch® Controller
(small controller not included)
System includes Nanoliter 2010 injector, MICRO2T controller, 1 vial 3.5 in. capillaries (300), replacement "O" rings, Allen wrench, MicroFil™ MF34G backfilling needle and two sample µTip™ pre-pulled micropipettes.

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

13142	Foot Switch for Nanoliter 2010
504127	Replacement Nanoliter 2010 Injector Head
504949	Replacement 3.5-in. Glass Capillaries, 1.14 mm OD (300)
504950	Replacement 7-in. Glass Capillaries , 1.14 mm OD (300)
TIP10XV119	Micropipettes (10) Prepulled 10 µm
40239	Adapter for SMARTouch
300521	Replacement O-rings (five)
500778	Replacement Nanoliter Injector Mounting Adapter
300033	Adapter for Micro4

Touchscreen Programmable Pump Series

Legato syringe pumps for reliable delivery with the ease of a touch screen

Features

- High resolution color touch screen
- Real time clock
- Touch pad "lock" feature
- Full metal chassis
- Built in syringe table with up to 75 lb. linear force
- Built in RS-485 interface to link multiple pumps
- USB port & RS232 Interface, TTL interface
- Continuous mode of operation
- Protection with a spill dam
- Analog control option
- CE, UL, CSA, CB Scheme, EU RoHS compliance

Benefits

- Automatic dispensing of small volumes
- Very precise flow rate control
- Hands free operation with foot pedal
- Better flow performance with accuracy ±0.35%

Applications

- Drug administration
- Chemical applications with slow incorporation of fixed volumes of fluids

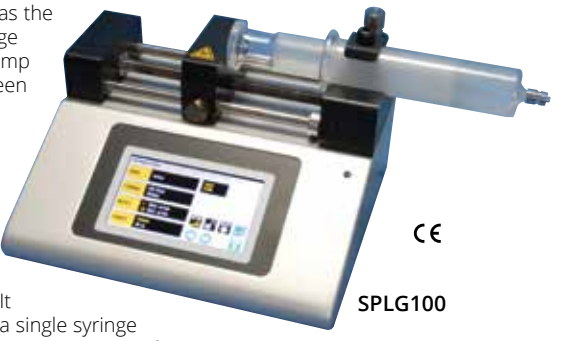
The large touch screen color display lets you see all of the pump's operating parameters to ensure proper operation during the experiments. Syringe size and flow rate are easily displayed, as well as the volume delivered and elapsed time. Set up is easy using the icon-driven software. An LED on the front panel makes it easy to see if the pump is running. Advanced micro stepping techniques are employed to further reduce the step angle to eliminate flow pulsation. Accuracy is ±0.5%. A wide dynamic flow range from picoliters per minute to millimeters per minute can be programmed into the pump. These versatile pumps can be connected through an RS485 interface. Add the new Adagio software to maximize the use of the pump's functions and features. Adagio allows you to configure the pump through the software, as well as operate one or multiple pumps. LabVIEW drivers are available on the National Instruments website.

SPLG100 SERIES FLOW RATES

Syringe	Diameter	Minimum	Maximum
0.5 µL	0.103 mm	1.260 pL/min	1.325 µL/min
1 µL	0.146 mm	2.520 pL/min	2.651 µL/min
2 µL	0.206 mm	5.100 pL/min	5.299 µL/min
5 µL	0.343 mm	14.100 pL/min	14.690 µL/min
10 µL	0.485 mm	28.260 pL/min	29.380 µL/min
25 µL	0.729 mm	63.900 pL/min	66.370 µL/min
50 µL	1.03 mm	127.600 pL/min	132.500 µL/min
100 µL	1.457 mm	255.20 pL/min	265.100 µL/min
250 µL	2.304 mm	638.300 nL/ min	662.900 µL/min
500 µL	3.256 mm	1.275 nL/min	1.324 mL/min
1000 µL	4.608 mm	2.553 nL/min	2.652 mL/min
1 mL	4.699 mm	2.655 nL/min	2.757 mL/min
3 mL	8.585 mm	8.863 nL/min	9.204 mL/min
5 mL	11.989 mm	17.290 nL/min	17.950 mL/min
10 mL	14.427 mm	25.030 nL/min	25.990 mL/min
20 mL	19.05 mm	43.640 nL/min	45.320 mL/min
30 mL	21.59 mm	56.050 nL/min	58.210 mL/min
60 mL	26.594 mm	85.050 nL/ min	88.320 mL/min

SPLG100 Infuse-Only Syringe Pump

The **SPLG100** was the first single-syringe infusion-only pump with a touchscreen interface. The **SPLG100** has a wide flow rate range from 1.26 pL/min to 88.32 mL/min, depending on syringe size. It accommodates a single syringe from 0.5 µL to 60 mL. Any type of syringe, including glass, plastic or stainless steel are held securely in place.



CE

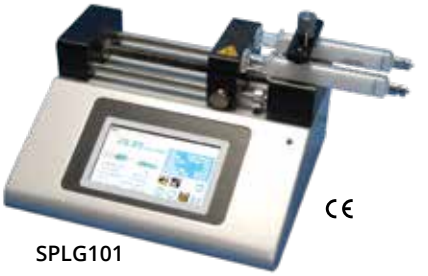
SPLG100

SPLG100 SPECIFICATIONS

SYRINGE SIZE	0.5 µL to 60 mL
POWER	100-240 VAC: 50/60 Hz, 50W. 0.5 A fuse
MOTOR DRIVE CONTROL	Microprocessor with 1/16 microstepping
LINEAR FORCE (MAXIMUM)	13.6 kg (30 lb.) @ 100% force selection
NUMBER OF MICROSTEPS PER REVOLUTION OF LEAD SCREW	15,360
STEP RATE (MIN.)	27.5 sec/µstep
STEP RATE (MAX.)	26 µsec/µstep
DRIVE MOTOR	0.9 degree Stepper Motor
PUSHER TRAVEL RATE (MIN.)	0.15 µm/min
PUSHER TRAVEL RATE (MAX.)	159 mm/min
FLOW RATE (MIN.)	1.26 pL/ min (0.5 µL syringe)
FLOW RATE (MAX.)	88.32 mL/min (60 mL syringe)
DIMENSIONS	22.6 x 19.05 x 15 cm (9 x 7.5 x 5 in)
WEIGHT	2.66 kg (5.9 lb.)
CONNECTORS	RS485 - IEEE-1394 6 pos, USB Type B

SPLG101 Dual Infuse-Only Syringe Pump

The **SPLG101** is ideal for applications where dual syringes are required with small volumes up to 10 mL. It accommodates two syringes from 0.5 µL to 10 mL. The **SPLG101** has a wide flow rate range from 1.26pL/min to 25.99 mL/min, depending on syringe size.



CE

SPLG101

SPLG101 SPECIFICATIONS

SYRINGE SIZE	0.5 µL to 10 mL
POWER	100-240 VAC: 50/60 Hz, 50W. 0.5 A fuse
MOTOR DRIVE CONTROL	Microprocessor with 1/16 microstepping
LINEAR FORCE (MAX.)	13.6 kg (30 lbs.) @ 100% force selection
NUMBER OF MICROSTEPS PER REVOLUTION OF LEAD SCREW	15,360
STEP RATE (MIN.)	27.5 sec/µstep
STEP RATE (MAX.)	26 µsec/µstep
DRIVE MOTOR	0.9 degree Stepper Motor
PUSHER TRAVEL RATE (MIN.)	0.15 µm/min
PUSHER TRAVEL RATE (MAX.)	159 mm/min
FLOW RATE (MIN.)	1.26 pL/ min (0.5 µL syringe)
FLOW RATE (MAX.)	25.99 mL/min (10 mL syringe)
DIMENSIONS	22.6 x 19.05 x 15 cm (9 x 7.5 x 5 in)
WEIGHT	2.66 kg (5.9 lbs.)
CONNECTORS	RS-232 - 9 Pin D-Sub connector, RS485 - IEEE-1394 6 pos, USB - Type B

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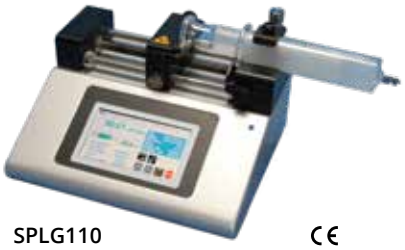
SPLG110 Infuse/Withdraw Syringe Pump



SPLG110 CE

The **SPLG110** offers infuse/withdraw flow control and programmability for up to two multi-step programs of 50 steps each. The **SPLG110** has a wide flow rate range from 1.26pL/min to 88.28mL/min, depending on syringe size. The **SPLG110** accommodates a single syringe from 0.5 µL to 60 mL. Any type of syringe can be used in the unit including glass, plastic or stainless steel. The pump is ideal for more complex multi-step dosing and has multi-mode operation including infusion only, withdrawal only, infusion and withdrawal and withdrawal/infusion modes.

SPLG110 SPECIFICATIONS

SYRINGE SIZE	0.5 µL to 60 mL
POWER	100-240 VAC: 50/60 Hz, 50W. 0.5 A fuse
MOTOR DRIVE CONTROL	Microprocessor with 1/16 microstepping
LINEAR FORCE (MAX.)	13.6 kg (30 lb.) @ 100% Force Selection
NUMBER OF MICROSTEPS PER REVOLUTION OF LEAD SCREW	15,360
STEP RATE (MIN.)	27.5 sec/µstep
STEP RATE (MAX.)	26 µsec/µstep
DRIVE MOTOR	0.9 degree Stepper Motor
PUSHER TRAVEL RATE (MIN.)	0.15 µm/min
PUSHER TRAVEL RATE (MAX.)	159 mm/min
FLOW RATE (MIN.)	1.26 pL/ min (0.5 µl syringe)
FLOW RATE (MAX.)	88.28 mL/min (60 ml syringe)
DIMENSIONS	22.6 x 19.05 x 15 cm (9 x 7.5 x 5 in)
WEIGHT	2.66 kg (5.9 lb.)
CONNECTORS	RS-232 - 9 Pin D-Sub connector, RS485 - IEEE-1394 6 pos, USB - Type B

SPLG210 Infuse/Withdraw Syringe Pump

SPLG210 CE

The **SPLG210** Infuse/Withdraw syringe pump is easy to use with the high resolution touch screen. The basic model works with one syringe or two (from 0.5 µL to 140 mL) and can be reconfigured in the field to be used with multiple syringes. A protective cover over the display prevents leakage into the display. To optimize your bench space, the **SPLG210** can be placed on its side to reduce the footprint to only 3.5 x 9.75 in. The display also rotates with the change to allow you to operate the pump vertically. The programmable model offers maximum flexibility for configuring and running different programs. Up to 40 programs of 20 steps each can be configured and stored for quick recall with the touch of a button.

SPLG210 SPECIFICATIONS

SYRINGE SIZE	0.5 µL to 140 mL
POWER	100-240 VAC: 50/60 Hz, 50W. 0.5 A fuse
MOTOR DRIVE CONTROL	Microprocessor with 1/16 microstepping
LINEAR FORCE (MAX.)	34 kg (75 lb.) @ 100% force selection
NUMBER OF MICROSTEPS PER REVOLUTION OF LEAD SCREW	6400
STEP RATE (MIN.)	27.5 sec/µstep
STEP RATE (MAX.)	26 µsec/µstep
DRIVE MOTOR	1.8 degree stepper motor
PUSHER TRAVEL RATE (MIN.)	0.36 µm/min
PUSHER TRAVEL RATE (MAX.	190.80 mm/min
FLOW RATE (MIN.)	5 pL/min (0.5 µL syringe)
FLOW RATE (MAX.)	215.803 mL/min (140 mL syringe)
DIMENSIONS	8.89 x 25.4 x 27.94 cm (3.5 x 10 x 11 in))
WEIGHT	4.9 kg (10.75 lb.)
CONNECTORS	RS-232 - 9 Pin D-Sub connector, RS-485 - IEEE-1394 6 pos, USB - Type B, I/O & TTL - 15 Pin D-Sub connector

SPLG270 Push/Pull Continuous

SPLG270 CE

The **SPLG270** is a Push-Pull syringe pump. It accommodates two syringes from 0.5 µL to 140 mL for infusion and two syringes for withdrawal. This model supports infusion and withdrawal simultaneously at user-defined flow rates and with selectable target volumes to control the total volume pumped. It also supports infuse only, withdraw only, infuse/withdraw, withdraw/infuse and continuous mode. The touch screen interface lets you quickly create configurations and recall them for easy use. The 4.3" TFT color display with touch pad interface presents all the pump operating parameters on one easy-to-view run screen. Protective cover over the display prevents leakage into the display.

SPLG270 SPECIFICATIONS

SYRINGE SIZE	0.5 µL to 140 mL
POWER	100-240 VAC: 50/60 Hz, 50W. 0.5 A fuse
MOTOR DRIVE CONTROL	Microprocessor with 1/16 microstepping
LINEAR FORCE (MAX.	34 kg (75 lb.) @ 100% force selection
NUMBER OF MICROSTEPS PER REVOLUTION OF LEAD SCREW	6400
STEP RATE (MIN.)	27.5 sec/µstep
STEP RATE (MAX.)	26 µsec/µstep
DRIVE MOTOR	1.8º Stepper Motor
PUSHER TRAVEL RATE (MIN.)	0.36 µm/min
PUSHER TRAVEL RATE (MAX.)	190.80 mm/min
FLOW RATE (MIN.)	5 pL/min (0.5 µL syringe)
FLOW RATE (MAX.)	215.803 mL/min (140 mL syringe)
DIMENSIONS	8.89 x 25.4 x 27.94 cm (3.5 x 10 x 11 in)
WEIGHT	4.9 kg (10.75 lb.)
CONNECTORS	RS-232 - 9 Pin D-Sub connector, RS-485 - IEEE-1394 6 pos, USB - Type B, I/O & TTL - 15 Pin D-Sub connector

Adagio Software

● Low cost, simple installation ● Flow evolution graph ● Import and export programs ● Quick and easy manual pump control ● Monitor one or more pumps ● Program data logging

The manual pump control tool allows easy direct control of the pump. Pump commands can be entered directly into the log. Multiple programs can be opened at the same time. The program's progression is tracked, and can be stored in a file for later access.

Intuitive Run Screen — *Combining multiple parameters simultaneously with internationally recognizable icons allow the Legato™ Series to provide a new level of intuitive syringe pump operation.*

ORDERING INFORMATION

SPLG100	Legato 100 Syringe Pump, Infuse-Only
SPLG101	Legato 101 Syringe Pump, Dual Infuse-Only
SPLG110	Legato 110 Syringe Pump, Infuse/Withdraw
SPLG200	SPL Syringe Pump, Infuse Only
SPLG210	SPL Syringe Pump, Infuse/Withdraw
SPLG212	SPL Syringe Pump, Infuse/Withdraw Programmable
SPLG270	SPL Syringe Pump, Push-Pull
SPLG272	SPL Syringe Pump, Push-Pull Programmable
504576	Small Syringe Multi Rack (for six 30-60 mL syringes or ten 0.5 µL-20 mL syringes)
504577	Large Syringe Multi Rack (for up to four 60-140 mL plastic syringes)
504578	Software Adagio/USB Key

Touchscreen Programmable Pump Series

Legato syringe pumps for reliable delivery with the ease of a touch screen

Features

- High resolution color touch screen
- Real time clock
- Touch pad "lock" feature
- Full metal chassis
- Built in syringe table with up to 75 lb. linear force
- Built in RS-485 interface to link multiple pumps
- USB port & RS232 Interface, TTL interface
- Continuous mode of operation
- Protection with a spill dam
- Analog control option
- CE, UL, CSA, CB Scheme, EU RoHS compliance

Benefits

- Automatic dispensing of small volumes
- Very precise flow rate control
- Hands free operation with foot pedal
- Better flow performance with accuracy ±0.35%

Applications

- Drug administration
- Chemical applications with slow incorporation of fixed volumes of fluids

When mounted vertically, the display screen of the SPLG series pumps automatically reorients for ease of use.

SPLG200

CE

SPLG200 Infuse-Only Syringe Pump

The **SPLG200** Infuse only syringe pump is easy to use with the high resolution touch screen. The basic model works with one syringe or two (from 0.5 µL to 140 mL) and can be reconfigured in the field to be used with multiple syringes. To optimize your bench space, the **SPLG200** can be placed on its side to reduce the footprint to only 3.5 x 9.75 inches. The display automatically reorients itself with the change to allow the user to operate the pump vertically. The pump features user definable flow rates with selectable target volumes and time values to control the infusion rate and the total volume. Up to 40 programs of 20 steps each can be configured and stored in the unit for quick recall with the touch of a button.

SPLG200 SERIES FLOW RATES

Syringe	Diameter	Minimum	Maximum
0.5 µL	0.103 mm	3.12 pL/min	1.589 µL/min
1 µL	0.146 mm	6.18 pL/min	3.180 µL/min
2 µL	0.206 mm	12.301 pL/min	6.358 µL/min
5 µL	0.343 mm	33.96 pL/min	17.630 µL/min
10 µL	0.485 mm	67.72 pL/min	35.249 µL/min
25 µL	0.729 mm	153.42 pL/min	79.640 µL/min
50 µL	1.03 mm	306.24 pL/min	158.984 µL/min
100 µL	1.457 mm	612.72 pL/min	318.126 µL/min
250 µL	2.304 mm	1.533 nL/ min	795.51 µL/min
500 µL	3.256 mm	3.06 nL/min	1.588 mL/min
1000 µL	4.608 mm	6.129 nL/min	3.181 mL/min
1 mL	4.699 mm	6.373 nL/min	3.308 mL/min
3 mL	8.585 mm	21.272 nL/min	11.044 mL/min
5 mL	11.989 mm	41.485 nL/min	21.539 mL/min
10 mL	14.427 mm	60.073 nL/min	31.19 mL/min
20 mL	19.05 mm	104.74 nL/min	54.383 mL/min
30 mL	21.59 mm	134.533 nL/min	69.852 mL/min
50 mL	26.594 mm	204.122 nL/ min	105.985 mL/min
100 mL	35.7 mm	367.839 nL/min	190.992 mL/min
140 mL	38.4 mm	415.623 nL/min	215.803 mL/min

SPLG200 SPECIFICTIONS

SYRINGE SIZE	0.5 µL to 140 mL
POWER	100-240 VAC: 50/60 Hz, 50W. 0.5 A fuse
MOTOR DRIVE CONTROL	Microprocessor with 1/16 microstepping
LINEAR FORCE (MAX.)	34 kg (75 lbs.) @ 100% force selection
NUMBER OF MICROSTEPS PER REVOLUTION OF LEAD SCREW	6400
STEP RATE (MIN.)	27.5 sec/µstep
STEP RATE (MAX.)	26 µsec/µstep
DRIVE MOTOR	1.8° stepper motor
PUSHER TRAVEL RATE (MIN.)	0.36 µm/min
PUSHER TRAVEL RATE (MAX.)	190.80 mm/min
FLOW RATE (MIN.)	5 pL/min (0.5 µL syringe)
FLOW RATE (MAX.)	215.803 mL/min (140 mL syringe)
DIMENSIONS	8.89 x 25.4 x 27.94 cm (3.5 x 10 x 11 in.)
WEIGHT	4.9 kg (10.75 lb.)
CONNECTORS	RS-232 - 9 Pin D-Sub connector, S485 - IEEE-1394 6 pos, USB - Type B, I/O & TTL - 15 Pin D-Sub connector

ORDERING INFORMATION

SPLG200	SPL Syringe Pump, Infuse Only
504576	Small Syringe Multi Rack (for six 30-60 mL syringes or ten 0.5 µL-20 mL syringes)
504577	Large Syringe Multi Rack (for up to four 60-140 mL plastic syringes)
504578	Software Adagio/USB Key

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Affordable Syringe Pumps

Syringe pumps for high metering precision at low, pulse-free rates

Features

- Sturdy and reliable
- Extremely simple to set up and use
- Surprisingly affordable.

Benefits

- Automatic dispensing of small volumes
- Very precise flow rate control
- Hands-free operation with foot pedal
- Better flow performance with accuracy ±0.35%

Applications

- Drug administration
- Chemical applications with slow incorporation of fixed volumes of fluids

On the SP series syringe pumps, the 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 and 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.

SP210c Continuous Cycle Syringe Pump

The **SP210c** holds 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 continuous dispensing.

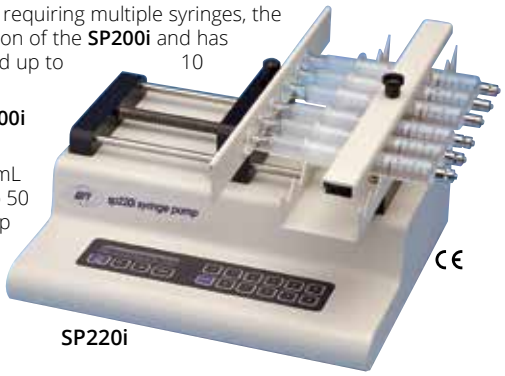
SP210 c

- Holds four syringes, 10 mL to 60 mL each

SP220i Multi-Syringe Infusion Pump

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

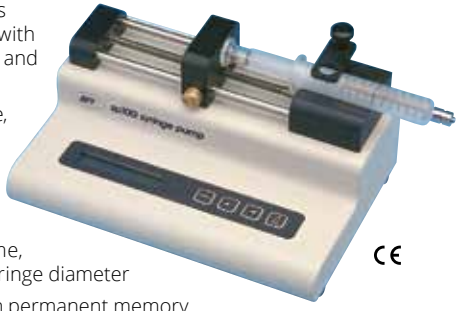
- All features of **SP200i**
- Accommodates 10 syringes up to 10 mL or 6 syringes up to 50 mL or 4 syringes up to 140 mL.



SP220i

SP100i Single-Syringe Infusion Pump

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



SP100i

- Holds any size syringe, 10 µL to 50 mL
- Automatic volume control and shutoff
- Simple menu-driven setup: dispense volume, dispense flow rate, syringe diameter
- Last settings stored in permanent memory
- Continuous dispense volume display

SP120p Two-Syringe Push-Pull Pump

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.

- All the features of **SP100i**
- Holds two syringes, from 10 µL to 10 mL.

SP120p

ORDERING INFORMATION

SP100i	Syringe Pump, Infusion (Single) 95-135V
SP100iZ	Syringe Pump, Infusion (Single) 220-240V
SP101i	Syringe Pump, Microdialysis (Double, Slow Speed) 95-135V
SP101iZ	Syringe Pump, Microdialysis (Double, Slow Speed) 220-240V
SP120p	Syringe Pump, Infusion-Withdrawal (Double) 95-135V
SP120pZ	Syringe Pump, Infusion-Withdrawal (Double) 220-240V
SP200i	Syringe Pump, Infusion (Double) 95-135V
SP200iZ	Syringe Pump, Infusion (Double) 220-240V
SP210c	Syringe Pump, Infusion-Withdrawal (Continuous) 95-135V
SP210cZ	Syringe Pump, Infusion-Withdrawal (Continuous) 220-240V
SP210iw	Syringe Pump, Infusion & Withdrawal (Double) 95-135V
SP210iwZ	Syringe Pump, Infusion & Withdrawal (Double) 220-240V
SP220i	Syringe Pump, Infusion (Multiple) 95-135V
SP220iZ	Syringe Pump, Infusion (Multiple) 220-240V
SP230iw	Syringe Pump, Infusion & Withdrawal (Multiple) 95-135V
SP230iwZ	Syringe Pump, Infusion & Withdrawal (Multiple) 220-240V
SP250i	Syringe Pump, Infusion (Multiple, Mixed Volumes) 95-135V
SP250iZ	Syringe Pump, Infusion (Multiple, Mixed Volumes) 220-240V
SP260p	Syringe Pump, I/W (Double) Single Cycle Action, 95-135V
SP260pZ	Syringe Pump, I/W (Double) Single Cycle Action, 220-240V
	All 240-volt pumps are CE-approved.
####-A	Audible Alarm (add "A" to pump part number)
####-P	Programmable Ramp Option (SP200 Series)

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

15623	Serial Cable, SP Pump-to-IBM 9-pin "D" Connector
13685	SP Pump-to-Pump "Daisy-Chain" Linking Cable, 7 ft.
13962	Foot Switch for SP200 Series Pumps

Dual Rate Syringe Pump

Two separate syringe pumps in one instrument

SPLG-G88PLUS

CE

Features

- TTL, USB & RS-232 Communication
- Compatible with a wide variety of syringes
- Large touch screen display allows quick and easy setup

Benefits

- Two separate syringe pumps in one instrument
- High or low-pressure operation
- Continuous fluid delivery

Applications

- Continuous injection for long-term toxicology testing
- The injection of dyes, perfumes and flavoring in industrial applications
- Applications with liquids or viscous materials in micro-manufacturing
- Continuous injections of reactants into reactor vessels
- Simultaneous samplings from two sites

Various applications can benefit from the. All three conditions come with the Gemini 88 Plus. No additional upgrades are required.

The intuitive Gemini 88 Plus graphical user interface controlled with a large 7" LCD color touch screen display allows quick and easy setup. The display run screen presents the user with all key dispensing parameters in real time. Syringe tables containing all major syringe manufacturers allow simple selection of any compatible syringe size. Audible Alarms, Adjustable Force and Screen Lock are all features that are available with a touch of the screen.

The SPLG-G88PLUS Dual Rate Syringe Pump opens whole new pumping possibilities. Three operating conditions named Independent, Reciprocating and Twin are available as standard features to satisfy various applications in life science.

Connectivity & Communication

The Gemini 88 Plus comes standard with USB and RS-232 for PC communication and RS-485 for pump-to-pump communication. An entire suite of ASCII commands is available to control the pump remotely with a PC. The pump contains a foot switch input and digital input/output for each independent pumping channel.

Independent Condition

Independent Condition allows the Gemini 88 Plus to operate as two separate syringe pumps named P1 and P2. Each syringe will operate independently with different syringe types, sizes, force, or target (volume or time, mode dependent).

Reciprocating Condition

In Reciprocating Condition, both syringe channels move in opposite directions at the same rate using the same syringe size and type. When combined with a valve box, the Reciprocating Condition can provide the continuous fluidic delivery or a peristaltic pump with the accurate, pulseless, low flow rates provided by a syringe pump.

Twin Condition

Twin Condition allows both syringes to operate in the same mode using the exact same syringe type, syringe size, force, target (volume or time) and flow rate settings. The pump also allows the user to combine both flows for higher speed and volume infusion applications

SPLG-G88PLUS SPECIFICTIONS

TYPE	Microprocessor dual rate infuse/withdraw/continuous syringe pump
ACCURACY	±0.25%
REPRODUCIBILITY	±0.05%
SYRINGE TYPE	Glass, plastic and stainless steel
SYRINGE SIZE MINIMUM	0.5 µL (0.103 mm minimum inner diameter)
SYRINGE SIZE MAXIMUM	60 mL (32.573 mm maximum inner diameter)
FLOW RATE MINIMUM	1.02 pL/min (0.5 µL syringe, 0.103 mm inner diameter)
FLOW RATE MAXIMUM	106 mL/min (60 mL syringe, 32.573 mm diameter)
FLOW RATE DISPLAY	7 in. color display with touchscreen
CONNECTORS	USB - Type B RS-232 - 9-pin D-Sub connector RS-485 - IEEE-1394, 6 pos for pump-pump communication TTL Input/Output - Two 15-pin D-sub connectors, one for reach pump mechanism Foot switch - Two phonojack inputs, one for each pump mechanism
AVERAGE LINEAR FORCE	70 lb. (31.75 kg) at 100% force setting up to a flow rate of 90 mL/min using up to a 60 mL syringe with a 32.573 mm inner diameter. 50 lb. (22.6 kg) at 100% Force Setting for flow rates 90 mL/min to 106 mL/min using the same size syringe.
POWER SUPPLY	Input 100-240 VAC, 50-60 Hz, Output 30 V 1.66A 50 Watt
WEIGHT	21 lb. (9.09 kg)
DIMENSIONS (L x D x H)	11 x 15 x 8 in. (28 x 39 x 21 cm)
CLASSIFICATION	Class I
POLLUTION	Degree 1
INSTALLATION	Category II
REGULATORY CERTIFICATIONS	CE, ETL (UL & CSA), CB Scheme, EU RoHS, WEEE

ORDERING INFORMATION

SPLG-G88PLUS Dual Rate Syringe Pump

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China: +86 21 6888 5517 • chinasales@china.wpiinc.com • **www.wpiinc.net**

Programmable Syringe Pump

The best value in syringe pumps on the market!

Features

- Cost-effective
- Program sequences without a computer
- Rich command set
- RS-232 and TTL control

Benefits

- Automatic dispensing of small volumes
- Very precise flow rate control
- Hands-free operation with foot pedal

Applications

- Drug administration
- Chemical applications with slow incorporation of fixed volumes of fluids

AL-1000

AL-4000

AL-6000

AL-8000

Aladdin

The Aladdin pump series arguably offers the best VALUE for any syringe pump on the market.

These pumps are available in single, dual, 4 , 6, and 8 syringe capacities. Although it is one of the most cost-effective pumps available, the Aladdin pump series boasts a versatility that is unmatched in its price range with features typically found only on pumps costing more than twice as much.

The Aladdin series provides the capability to both inject and withdraw. These pumps can be used for manually triggered injections, but also have the capability to be programmed in multi-step pumping sequences without the requirement for a computer. Even so, this series also has both RS-232 and TTL inputs for external control and status feedback to a computer, if desired. The pumps can be daisy chained for multi pump applications involving push/pull protocols or multiple independent channels. The performance characteristics are admirable, considering the price.

For the budget minded lab looking for a versatile and reliable pump, the Aladdin series is an excellent option.

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

ORDERING INFORMATION

AL-300	Non-Programmable Syringe Pump, Infuse Only
AL-1000	Programmable Syringe Pump
AL-1000HP	Programmable Syringe Pump, High Pressure (100 lb.)
AL-1000HP2	Programmable Syringe Pump, High Pressure (200 lb.)
AL-2000	Two AL1000 Syringe Pumps
	Includes CBL-Dual-3 Interconnecting Cable for push/pull or continuous pumping. Valves not included.
AL-4000	Programmable Multiple (up to 4) Syringe Pump
AL-6000	Programmable Multiple (up to 6) Syringe Pump
AL-6000H	Programmable Multiple (up to 6) Syringe Pump
AL-8000	Programmable Multiple (up to 8) Syringe Pump

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

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

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	Foot Switch

ALADDIN SPECIFICATIONS

	AL-300	AL-1000	AL-1000 HP	AL-4000	AL-6000	AL-8000
SYRINGE SIZES	Plastic syringes up to 60 mL	Plastic syringes up to 60mL and selected glass micro syringes from 0.5 to 500 µL.	Plastic syringes up to 60 mL and selected glass micro syringes from 0.5 to 500 µL.	Plastic syringes up to 60 mL	1-60 mL, or 0.5-5 µL micro syringes	Up to 100 mL
NUMBER OF SYRINGES	1	1	1	2 (may be different sizes)	6	8
MOTOR TYPE	Step Motor, ⅛ to ½ step modes	Step Motor, ⅛ to ½ step modes		Step Motor, ⅛ to ½ step modes	Step Motor, ⅛ to ½ step modes	Step Motor
STEPS PER REVOLUTIONS	400	400	200	200	400	200
STEPPING (max./min.)	0.21 µm to 0.850 µm	0.21 µm to 0.850 µm		0.425 µm to 1.7 µm, depending on motor speed	0.21 µm to 0.850 µm	0.132µm to 0.265 µm, depending on motor speed
MOTOR TO DRIVE SCREW RATIO	15/28	15/28	15/28	15/28	15/28	5/1
SPEED (max./min.)	3.774 cm/min. to 0.004 cm/hr	5.1 cm/min / 0.0042 cm/hr	18.370 cm/min / 0.008 cm/hr	18.370 cm/min / 0.008 cm/hr	5.1 cm/min / 0.0042 cm/hr	3.4917cm/min. / 0.0026cm/hr.
PUMPING RATES	1257 mL/hr with 60 mL syringe, to 0.73 µL/hr with 1 mL syringe	1699 mL/hr with 60 mL syringe, to 0.73 µL/hr with 1 mL syringe	6120 mL/hr with 60 mL syringe, to 1.459 µL/hr with 1 mL syringe	6120 mL/hr with 60 mL syringe, to 1.459 µL/hr with 1 mL syringe	1699 mL/hr with 60 mL syringe, to 0.73 µL/hr with 1 mL syringe	0.454 µL/hr. with a B-D 1cc syringe to 1163mL/hr. with a B-D 60 cc syringe
MAXIMUM FORCE	35 lb. at minimum speed, 18 lb. at maximum speed	35 lb. at min. speed, 18 lb. at maximum speed	100 lb. at minimum speed, 18 lb. at maximum speed	100 lb. at minimum speed, 15 lb. at maximum speed	35 lb. at min. speed, 18 lb. at max. speed	160 lbs. at min. speed, 30 lbs. at max. speed
PROGRAM PHASES	n/a	41	41	41	41	41
RS-232 PUMP NETWORK	n/a	100 pumps maximum	100 pumps maximum	100 pumps maximum	100 pumps maximum	100 pumps maximum
POWER SUPPLY	Wall adapter 12V DC @ 850 mA	Wall adapter 12V DC @ 850 mA	Wall adapter 12V DC @ 1000 mA	Wall adapter 12V DC @ 1000 mA	Wall adapter 12V DC @ 850 mA	Unregulated linear external wall adapter, country and power source specific
DIMENSIONS	22.9 x 14.6 x 11.4 cm (8.75 x 5.75 x 4.5 in.)	22.9 x 14.6 x 11.4 cm (8.75 x 5.75 x 4.5 in.)	22.9 x 14.6 x 11.4 cm (8.75 x 5.75 x 4.5 in.)	22.9 x 14.6 x 11.4 cm (8.75 x 5.75 x 4.5 in.)	22.9 x 14.6 x 11.4 cm (8.75 x 5.75 x 4.5 in.)	26x38.1x12.7cm (10.25 x15 x5 in.)
WEIGHT	1.6 kg (3.6 lb.)	1.6 kg (3.6 lb.)	1.6 kg (3.6 lb.)	1.6 kg (3.6 lb.)	1.6 kg (3.6 lb.)	10.125 lbs. (4.595kg)

Microfluidic Pumps

Microfluidic Solenoid Pump

CX-KIMA

Features

- Controlled by the iKima™ application for use with the iPod Touch (included) and iPhone
- Connects easily to Vena8 Endothelial+ biochip and other manufacturer's flow chambers
- Delivers pulses of fresh media to cells seeded inside the microchannels
- Flow rate: 15 - 35 mL/hr ± 4%
- Dead volume: < 300 µL

Benefits

- Fits inside standard CO_2 incubators, maintaining temperature and humidity
- Recirculating long-term perfusion pump
- WiFi communication and control via iPod Touch, even with Kima pump incubated

Applications

- Cell culture under shear stress/flow
- Biofilm studies
- Cell culture in biochips with adherent cells (HUVECs)
- Stem cells
- HepG2 cells (human liver cancer cell line)

Kima pump is a microfluidic pump designed to aid cell culture (*e.g.*, epithelial and endothelial cells) under physiological conditions (shear flow) in various biochips and flow chambers, including Vena8 Endothelial+ biochips where it is possible to culture eight cell monolayers simultaneously over 24-48 hours. The solenoid pump produces a pulsatile flow to mimic the cardiovascular system, delivering a preset volume of liquid as programmed.

ORDERING INFORMATION

CX-KIMAKIT-IPOD	Kima Kit for Cell Culture/Biofilm Studies *Includes Kima Pump, iPod Touch with Controller, 100 mL bottle & cap, tubing kit, Vena Endothelial+ biochips (10-pack).*
CX-KIMAKIT-PC	Kima Kit for Cell Culture/Biofilm Studies *Includes Kima Pump, PC Controller, 100 mL bottle & cap, tubing kit, Vena Endothelial+ biochips (10-pack).*
CX-KIMA-I	Kima Microfluidic Pump with iPod Touch & Controller
CX-KIMA-P	Kima Microfluidic Pump with PC Control Software and Controller
CX-KIMA	Kima Microfluidic Pump

Precision Syringe Pump

CX-EXIGO

Features

- Virtually pulse-free low volume delivery
- Fast response time
- Flow sensor feedback to pump
- Touch control

Benefits

- Pulse-free flow
- Precise multichannel mixing
- Excellent long-term flow stability
- Rapid flow change (ms range)
- WiFi communication and control via iPad mini or USB communication with LabVIEW based PC control software
- Use standard tubing for connection to any microfluidic biochip

Applications

- Microfluidics and nanofluidics
- Droplet generation and manipulation
- Laminar and multilaminar flow studies
- Cell-based shear flow studies
- Cell and particle manipulation studies

ExiGo is a precision syringe pump based on the 5-phase stepper motor drive that has more microsteps per revolution of the lead screw vs. standard syringe pumps on the market. ExiGo has 250,000 microsteps/revolution and even at low rotational speed/low flow rates, it has a very low pulsation and high accuracy. When coupled with the flow sensor and active PID feedback; this results in very fast response times for changing flow rates. A standard syringe pump typically has a smaller number of microsteps and so usually the only way a standard "microfluidic" pump can achieve pulse-free flow control is to use small syringes; *e.g.* 0.5 µL; 1 µL; 5 µL; *etc.*, to achieve non-pulsatile stable flow rates in the nanoliter/minute range. By comparison, the ExiGo pump with the flow sensor can use a standard 250 µL glass syringe to produce stable non-pulsatile flow rates of 10nL/min – 1 mL/min; or a 5 mL plastic syringe to produce stable non-pulsatile flow rates of 100nL/min – 20 mL/min. ExiGo can be used in conjunction with expandable (flexible) element and fluidic resistance in order to dampen any pulsation occurring during the stepper motor operation. As it employs active feedback, the response time of the pumps still remains fast.

ORDERING INFORMATION

CX-EXIGO-IM-7	Exigo with iPad, Manifold, 7µL/min FS
CX-EXIGO-PM-7	Exigo with LabView, Manifold, 7µL/min FS
CX-EXIGO-I-7	Exigo with iPad, 7µL/min FS
CX-EXIGO-P-7	Exigo with LabView, 7µL/min FS
CX-EXIGO-IM	Exigo with iPad, Manifold
CX-EXIGO-PM	Exigo with LabView, Manifold
CX-EXIGO-I	Exigo with iPad, SmartFlo app
CX-EXIGO-P	Exigo with LabView
CX-EXIGO-M	Exigo with Manifold, Tubing Kit
CX-EXIGO	Exigo with Tubing Kit

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Microfluidic Pumps

Microfluidic Pressure Pump

CX-UNIGO

Features

- Precise flow control with active feedback via plug-and-play flow sensor (required add-on)
- Flow rate: 1 µL/min – 1 mL/min; unidirectional (push)
- iPad mini or PC (LabVIEW, Matlab, Python, *etc.*) control which can control/program up to four pump modules independently
- External compressor (required)

Benefits

- 2 modes of pumping: manual flow rate set or preprogrammed flow rate operation
- Preprogrammed mode includes: constant, ramp, step, sine functions
- Side port connections to dock up to four pumps (combination of UniGo and ExiGo) into one setup
- Use standard tubing for connection to any microfluidic biochip.

Applications

- Microfluidics where accurate and stable flow rate delivery is required. The pressure pump component is based on controlled air injection.

The **UniGo™** Microfluidic Pump is a precision, microfluidic, single-channel pressure pump for a variety of microfluidic applications, where accurate and stable flow rate delivery is required. The pressure pump component is based on controlled air injection. The UniGo pump requires a plug-and-play flow sensor for active feedback and increased flow control. **SmartFlo** application executed on the iPad Mini or LabView-based interface communicates with up to four UniGo™ Microfluidic Pumps racked together, allowing simultaneous control and independent programming of each pump's flow profile. Uniquely, the UniGo™ may be docked together with the **ExiGo™** microfluidic syringe pump, combining the best features of both instruments in one microfluidic set-up. *Note: it is necessary to purchase a flow sensor with the UniGo™ pump.*

ORDERING INFORMATION

CX-UNIGO-ECI-80	UniGo with iPad, External Compressor, 80 µL/min Flow Sensor
CX-UNIGO-ECP-80	UniGo with LabView, External Compressor, 80 µL/min Flow Sensor
CX-UNIGO-EC-80	UniGoExternal Compressor, 80 µL/min Flow Sensor
CX-UNIGO-I-80	UniGo with iPad, No Compressor, 80 µL/min Flow Sensor
CX-UNIGO-P-80	UniGo with LabView, No Compressor, 80 µL/min Flow Sensor
CX-UNIGO-80	UniGo, No Compressor, 80 µL/min Flow Sensor

Five flow cells are avilable for your Unigo system. Your choice of one flow sensor is included with your Unigo system. Contact WPI at wpi@wpiinc.com for more information.

Microfluidic syringe pump for shear flow studies

CX-MIRUS

Features

- Unlimited volume
- Low per-channel cost
- Flow rate: 100nL/min - 10 mL/min ± 1%
- Dead volume: ~600 µL

Benefits

- Higher throughput enabling eight assays in parallel
- Flow damper to decrease syringe pump pulses
- PC controlled via VenaFluxAssay software

Applications

- Microfluidic applications
- Single cell analysis
- Microfluidic syringe pump for cell analysis under shear flow in biochips
- Suitable for cell samples and whole blood samples

Mirus is a precision syringe pump, which uses the combination of an expandable (flexible) element and fluidic resistance in order to dampen the pulsation of the syringe pump stepping. The Mirus has a very stable flow profile. Additionally, Mirus is equipped with 3-way valve allowing automatic recharging and washout of syringe. Mirus is also provided with an 8-way flow splitter, allowing multiple executions (eight parallel experiments) simultaneously.

ORDERING INFORMATION

CX-MIRUS-PRO	Microfluidic Syringe Pump *Includes tubing kit, VenaFlux Assay Software PC control and MultiFlow8*
CX-MIRUS	Microfluidic Syringe Pump *Includes tubing kit, VenaFlux Assay Software PC control*
CX-MIRUS-MULTI8	MultiFlow8 Attachment for Mirus Evo Nanopump

Microfluidic Pumps and Accessories

4-channel Microfluidic Pump

CX-4U

Features

- Precise flow control with active feedback via plug-and-play flow sensor (required add-on)
- Flow rate: 1 µL/min – 1 mL/min; unidirectional (push)
- iPad mini or PC (LabVIEW, Matlab, Python, *etc.*) control which can control/program up to four pump modules independently
- External compressor (required)
- Working pressure- Max 10 bars/145 psi

Benefits

- Two modes of pumping: manual flow rate set or preprogrammed flow rate operation
- Preprogrammed mode includes: constant, ramp, step, sine functions
- Side port connections to dock up to four pumps (combination of UniGo and ExiGo) into one setup
- Use standard tubing for connection to any microfluidic biochip

Applications

- Microfluidics where accurate and stable flow rate delivery is required. The pressure pump component is based on controlled air injection.

4U is a 4-channel compact, precise, economical microfluidic pressure pump for a variety of microfluidic applications, where accurate and stable flow rate delivery is required. **SmartFlo** application executed on LabView-based interface communicates with the four separate channels of the **4U** pump, allowing simultaneous control and independent programming of each pump's flow profile. The **4U** pump provides you with the advantage of using four independent flow rates at the same time.

ORDERING INFORMATION	
CX-4UECIPAD-4X80FS	4-channel Microfluidic Pump, External Compressor, iPad, 80 µL/min flow sensors (4)
CX-4UECPC-4X80FS	4-channel Microfluidic Pump, External Compressor, PC, 80 µL/min flow sensors (4)
CX-4UNCIPAD-4X80FS	4-channel Microfluidic Pump, iPad, 80 µL/min Flow Sensors (4)
CX-4UNCPC-4X80FS	4-channel Microfluidic Pump, PC, 80 µL/min Flow Sensors (4)
CX-EC	External Compressor

ExiGo™ Pump Manifold

Features

- Allows you to direct the fluid to three (3) independent ports
- Plug and play connection to the ExiGo™ pump
- Can be programmed to automatically switch between fluidic channels using SmartFlo PC software

CX-MF

Benefits

- Refill syringes automatically

Applications

- Microfluidics and Nanofluidics
- Droplet generation and manipulation
- Laminar and multilaminar flow studies
- Cell-based shear flow studies
- Cell and particle manipulation studies

The Manifold is a specialized microfluidic channel selector which allows the **ExiGo** pump to direct fluid to one of three microfluidic channels at a time. Accurate flow switching and low dead volume provide exceptional performance.

ORDERING INFORMATION	
CX-MF	ExiGo Pump Manifold

Microfluidic Biochips for a Variety of Applications

We offer a range of biochips for many applications. All biochips mimic human capillaries by working in tandem with our different instrumentation platforms.

Our new DropChips are either hydrophilic or hydrophobic based. DropChips comes with 5 different channel sizes from 30 µm to 80 µm. Please refer to the chart on page 69 for information on specific biochips.

ORDERING INFORMATION	
Optional Accessories/Replacement Parts	
CX-018	Vena8 with Glass Coverslip
CX-023	Biochip-CONN, Biochip SNGL IN
CX-024	Biochip-CONN, Biochip SNGL OUT
CX-027	Tygon Tubing for Biochip Conn
CX-032	Kima-Connect Tubing Set
CX-045	Kima Pump Cell Culture Bottle
CX-067	Flow Sensor Exigo 1 mL/min
CX-073	Dropchip, Hydrophobic, 40 µm x 40 µm
CX-084	MF8-Connect Biochip1 Inlet CBL
CX-087	MULTIFLOW8 Nozzles, Standard

Vena8 Fluoro+

Vena8 Endothelial

VenaT4

Vena8 Glass Cover slip

Vena Delta Y1

Vena Delta Y2

Microfluidic Biochips

DROPCHIP (HYDROPHILIC/HYDROPHOBIC) BIOCHIPS ORDERING INFORMATION						
Chip Size (µm)	30 x 30	40 x 40	50 x 50	60 x 60	70 x 70	80 x 80
Junction Width (cm)	0.003	0.004	0.005	0.006	0.007	0.008
Height (cm)	0.003	0.004	0.005	0.006	0.007	0.008
Length (cm)	2.8	2.8	2.8	2.8	2.8	2.8
Substrate Thickness	0.5	0.5	0.5	0.5	0.5	0.5
Hydrophilic (Pack of 2) Hydrophobic (Pack of 2)	**CX-026** **CX-034**	**CX-028** **CX-073**	**CX-029** **CX-035**	**CX-030** **CX-036**	**CX-031** **CX-037**	**CX-033** **CX-038**
Hydrophilic (Pack of 5) Hydrophobic (Pack of 5)	**CX-039** **CX-046**	**CX-040** **CX-047**	**CX-041** **CX-048**	**CX-042** **CX-049**	**CX-043** **CX-050**	**CX-044** **CX-051**
Hydrophilic (Pack of 10) Hydrophobic (Pack of 10)	**CX-052** **CX-058**	**CX-053** **CX-059**	**CX-054** **CX-060**	**CX-055** **CX-061**	**CX-056** **CX-062**	**CX-057** **CX-063**

STANDARD BIOCHIPS ORDERING INFORMATION	Vena8 Fluoro+	Vena8 Endothelial+	VenaT4	Vena8 Glass Coverslip		Vena Delta	
				Low Flow Rates	High Flow Rates	Y1	Y2
Channel width, b (cm)	0.04	0.08	0.08	0.16	0.08	0.008	0.008
Channel height, h (cm)	0.01	0.012	0.01	0.016	0.008	0.012	0.012
Channel length, L (cm)	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Channel volume (cm^3)	0.00112	0.00269	0.00224	0.00717	0.00179	0.00269	0.00269
Channel volume (µL)	1.12	2.69	2.24	7.17	1.79	2.69	2.69
Thickness of bottom substrate (mm)	0.17	0.5		0.17	0.17	0.5	0.5
# of channels / chip	8	8	4	8	8	4	4
# of assays / pack	40/80	40/80	40	80	80	40	40
Pack of 5	**CX-002**	**CX-004**					
Pack of 10	**CX-001**	**CX-003**	**CX-005**	**CX-009**	**CX-010**	**CX-007**	**CX-008**
SPECIFICATIONS							
Brightfield, phase contrast, immunostaining	✓	✓	✓	✓	✓	✓	✓
Confocal microscopy	✓			✓	✓		
Cell types: whole blood (human, animal); PRP; platelets; PBMC; monocytes; T-cells (primary and cell lines); eosinophils; neutrophils etc.	✓	✓	✓	✓	✓	✓	✓
Cell types: adherent cells *e.g.* endothelial – HUVECs; HMVECs etc.; HepG2; stem cells; muscle cells *etc.*	✓	✓	✓	✓	✓	✓	✓
Protein coatings: collagen, fibronectin, fibrinogen, vWF, VCAM, ICAM, selectins, MadCAM *etc.*	✓	✓	✓	✓	✓	✓	✓
APPLICATIONS							
Platelet adhesion, aggregation and thrombi formation; leukocyte rolling, adhesion and migration; thrombosis; immunology (inflammation); infectious diseases (*e.g.* malaria); sickle cell disease; respiratory (asthma and COPD)	✓			✓	✓		
Cell adhesion and culture under perfusion / shear flow; leukocyte cell-cell rolling, adhesion and migration; oncology (melanoma, breast cancer *etc.*); cardiovascular (atherosclerosis, drug eluting stents); immunology (inflammation); respiratory (asthma and COPD)		✓					
Biofilm assays, microbe seeding and culturing; biochips with glass coverslips (attached / not attached; treated / non-treated); biochips for the attachment of coupons for biofilm studies				✓	✓		
Chemotaxis, transmigration and invasion assays; 2D and 3D cell culture; mimicking tumour microenvironment with gels (ECM gel, hydrogel, matrigel, collagen gel)			✓				

All biochips are:

- Disposable plastic; some with glass cover slips.
- Require no assembly; unlike many standard perfusion chambers / flow chambers.
- Require no Luer lock connections which increase dead volume. Cellix's biochips have a unique plug and play connection with tubing connections which are autoclaveable and reusable.

Ergonomic Pipetter Design

Making repetitive procedures more efficient and comfortable

Features

- Lightweight and comfortable ergonomic design
- Easy calibration using provided tool
- Easy for cleaning and parts replacement
- CE and ISO13485 Certified

REG100

Benefits

- Less stress on your hand when you are performing repetitive operations
- Save money by ordering sets of any 5, 6 or 7 pipetters
- Made from biologically inactive and chemical inert polymers

Applications

- Routine laboratory use for accurate and affordable pipetting of liquids and solutions

Regal Pipettes use the air displacement method, where displaced air volume by the motion of the piston is equal to the liquid volume drawn into the pipette. These new pipettes are highly accurate. Within ten complete revolutions of the dial, you can set the minimum and maximum volumes. For ease of use, the dial is fixed to the plunger. Since the light plunger action reduces fatigue, results are more precise.

ORDERING INFORMATION (SINGLES)

Model	Volume Range µL	Increment µL	Nominal Volume µL	Tolerance %	Repeatability %
REG2	0.2 ~ 2	0.01	0.2 0.5 2	±12.0 ±5.0 ±2.0	≤6.00 ≤2.50 ≤0.70
REG10	1 ~ 10	0.1	1 5 10	±3.0 ±1.5 ±1.0	≤1.50 ≤0.60 ≤0.40
REG20	2 ~ 20	0.1	2 10 20	±3.0 ±1.0 ±1.0	≤1.50 ≤0.50 ≤0.30
REG50	5 ~ 50	0.5	5 20 50	±2.0 ±1.2 ±1.0	≤1.50 ≤0.40 ≤0.20
REG100	10 ~ 100	1	10 50 100	±2.0 ±0.8 ±0.8	≤0.50 ≤0.30 ≤0.15
REG200	20 ~ 200	1	20 100 200	±2.0 ±0.8 ±0.8	≤0.50 ≤0.30 ≤0.15
REG1000	100 ~ 1000	5	100 500 1000	±1.5 ±0.8 ±0.8	≤0.30 ≤0.30 ≤0.15
REG5K	1000 ~ 5000	50	1000 2000 5000	±1.0 ±0.7 ±0.7	≤0.50 ≤0.25 ≤0.15
REG10K	1000 ~ 10000	100	1 mL 5 mL 10 mL	±3.0 ±0.7 ±0.7	≤0.30 ≤0.20 ≤0.15

ORDERING INFORMATION (SETS)

REGS5	Regal Pipetters (set of any 5) & Stand
REGS6	Regal Pipetters (set of any 6) & Stand
REGS7	Regal Pipetters (set of any 7) & Stand
504591	Stand for Regal Pipetters (holds 8)

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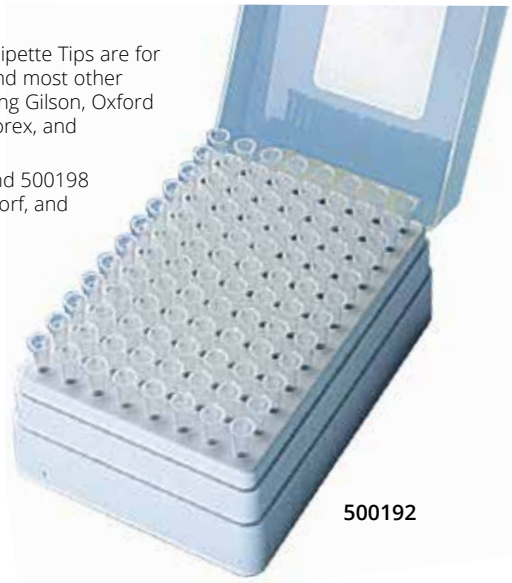
Universal Pipette Tips

Ultra-clear, certified RNase/DNase-free

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

* Tips 500197 and 500198 fit Regal, Eppendorf, and BioHit pipetters.



500192

Same as leading brands—

at about half the price!

ORDERING INFORMATION
UNIVERSAL FILTER TIPS (STERILE)

Tip Volume	For Pipetter	Rack	Part No.
0.1 - 10 µL	REG2 REG10 REG20	960 (10 racks of 96)	**500199**
10 - 200 µL	REG20 REG50 REG100 REG200	960 (10 racks of 96)	**500200**

ORDERING INFORMATION
UNIVERSAL TIPS

Tip Volume	For Pipetter	Bulk	Part No.	Rack	Part No.
0.1 - 10 µL	REG2 REG10 REG20	Bag of 1000	**500191**	960 (10 racks of 96)	**500192**
5 - 200 µL	REG20 REG50 REG100 REG200	Bag of 1000	**500193**	960 (10 racks of 96)	**500194**
100-1000 µL	REG1K	Bag of 1000	**500195**	1000 (10 racks of 100)	**500196**
500 - 5000 µL	REG5K	Bag of 250	**500197 ***	500 (10 racks of 50)	**500198 ***

Mini Vacuum Pump

Small, reliable, durable and accurate

801566

Features

- Durable aluminum exterior
- Minimal vibration
- Low noise
- Extremely long life time

Benefits

- Quiet operation
- Compact (18 x 7 x 7cm) unit takes little of your bench space
- Oil free, maintenance free

Applications

- Commonly sold with Muscle Physiology setups
- Excellent accessory for use with WPI's PV830 Pneumatic PicoPump with vacuum
- Ideal for any application requiring a small, reliable pump that provides vacuum pressure up to 250 mbar

This miniature vacuum pump is durable and accurate. The industrial-strength aluminum exterior, neoprene diaphragm and neoprene/silicone valves ensure this pump will stand up to daily use.

MINI VAC SPECIFICATIONS

POWER SOURCE	230 (50 Hz)	120 (60 Hz)
FREE FLOW	4.0 L/min.	3.0 L/min.
AT -100 MBAR	2.0 L/min.	1.5 L/min.
MOTOR TYPE	Vibrating	
POWER	4.0 W	
MAXIMUM PRESSURE	–	
MAXIMUM VACUUM	–250 mbar	
PUMP HEAD CONSTRUCTION	Aluminum	
DIAPHRAGM	CR-neoprene	
VALVES	CR-neoprene/FPM (Viton)/Silicone	
DIMENSIONS	185 x 72 x 72 mm	
WEIGHT	850 g	

INFORMATION ORDERING

801566	Mini Vacuum Pump, 110 V, US power plug
801963	Mini Vacuum Pump, 220 V, EURO mains plug

Luer Valve Assortment Kit

Build your own liquid flow experiment

Features

- Over 300 assorted parts
- Luer fittings for quick and easy connect and disconnect

Benefits

- Sold individually or in kits

Applications

- Liquid flow experimental setups

A useful kit (right) for building your own liquid flow experiment. It provides the means to start, stop, add, divide and control a flow of liquid or gas. Included in the kit are ***over 300 assorted parts*** such as one-way and three-way stopcocks, manifolds, Y-connectors, injection sites, male and female luer caps, check valves, syringe-activated check valves, slide clamps, roller clamps, and pinch clamps. All (except clamps) have a luer fitting for quick and easy connecting and disconnecting. Includes assorted luer fittings for use with flexible tubing.

The **14011** component parts are also sold individually. See page 220.

ORDERING INFORMATION	
14011	Luer Valve Assortment Kit

Luer-to-Tubing Coupler Assortment Kit

Quick connects in nylon and polypropylene

Features

- Over 250 assorted parts in each kit
- Valves are polycarbonate, and the valve handles are polyethylene. Do not autoclave those parts.

Benefits

- Polypropylene parts (**504954**) can be autoclaved repeatedly at 121°C/15PSI, 15 min. cycle
- Polypropylene fittings are chemically inert and resistant to most organic and inorganic solvents
- Nylon fittings are strong and can be bonded with adhesive.

Applications

- Liquid flow experimental setups

504954

504955

Assemble quick-disconnect luer fittings for use with flexible tubing with internal diameters of 1/16", 3/32" and 1/8". A variety of quick-disconnect connectors can be quickly made for connecting small diameter flexible tubing; 3-way connections can be made with the use of the 3-way luer tee; luer plugs, tees, connectors, bulk-head mounts, color coding rings, locking nuts, male and female luers—are all included to enhance the versatility of this kit. The kit has over 250 assorted parts and is offered in two different types of materials. Nylon parts are not autoclavable.

ORDERING INFORMATION	
504954	Luer-to-Tubing Coupler Assortment Kit (Polypropylene)
504955	Luer-to-Tubing Coupler Assortment Kit (Nylon)

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Electrophysiology

Over 50 years of experience with researchers

From our early beginnings in 1967 working with Yale researchers, electrophysiology has been at the heart of our business. WPI amplifiers, stimulators and isolators are designed with quality components so you get a reliable, low-noise signal every time. Our time-tested designs give you affordable solutions for electrophysiology equipment, electrodes, data acquisition and accessories for applications like:

- Intracellular/Extracellular Recording
- Voltage Clamp for Ussing
- Stimulation and Isolation
- Optogenetics
- Digital Filtering

Bioamplifiers for Electrophysiology

A family of very low noise battery-operated amplifiers

Features

- Battery powered to eliminate line noise
- High pass and low pass filtering
- Single ended or differential operation
- DC/AC amplification
- Variable output positioning
- Constructed of high quality components to ensure minimal intrinsic (shot) noise
- Portable
- Rack mountable

Benefits

- Very low internal noise
- Ultra quiet DC power supply — no AC required
- Instrinsic low susceptibility to ground loops
- Small footprint
- Cost effective
- Electrostatic Discharge Protection!

Applications

- Amplifying biopotentials from metal electrodes
- Brain slice field stimulation
- EAG (Electroantennogram)
- ERG (Electroretinogram)

DAM80— *With low-noise headstage* **DAM80P**

WPI's **DAM** series amplifiers are well known as a standard of the industry for amplification of extracellular potentials. These battery powered bio-amplifiers are designed with a compact chassis profile that enables you to locate the unit closer to the preparation and thereby minimize long lead lengths which contribute to noise. Each amplifier is equipped with selectable high and low filters, and a position control to offset galvanic potentials which may develop during recording.

DAM series amplifiers can be used as stand-alone units on any tabletop or use optional clamp-mounting hardware to locate them conveniently within the work area. Alternatively, a pair of amplifiers can be mounted into a standard equipment rack with a rack mount kit (**3484**). A variety of hook up accessories are available to configure your application.

DAM80 Overview

DAM80, an AC amplifier only, features a very low noise active headstage probe which can be mounted in micromanipulators for up-close cortical recording, for extracellular recording from high impedance glass or metal microelectrodes. The unit also provides a gated current for tissue marking. Microelectrode holder **MEH7W-XX** (sold separately) is recommended for glass microelectrodes. The DAM80 is perfect for gated or manual current generation for histological marking, iontophoresis or cell stimulation. It includes a very low noise remote active headstage that is useful for very high impedance amplification utilizing glass or metal electrodes.

Included with the DAM80 is a **Startup Kit** containing the following accessories needed for basic metal electrode electrophysiology research:

CBL102	(2) Cable, BNC-to-3.5 mm plug, 6 ft (2m)
5469	(2) Adapter, mini-banana to 0.031 socket
13388	(2) Adapter, mini-banana to 2mm socket
3294	Cable, ground clip to wire, 3 ft
2033	Mini-banana plug, black
2034	Mini-banana plug, red
2035	(2) Mini-banana plug solderable turrent
EP1	Ag/AgCl pellet (70 mm wire) 1 mm diam x 2.5 mm long
M3301EH	(2) Electrode Holder, 14cm
5470	0.031-inch jack on 12-inch wire (package of 4)

FEATURE COMPARISON

	DAM50	DAM80
INPUT MODE	AC/DC	AC
INPUT CONFIGURATION	differential/single ended	differential
GAIN RANGE	100-10K (AC), 10-1K (DC)	100-10K (AC)
HIGH/LOW FILTERS	yes	yes
OFFSET POSITION CONTROL	yes	yes
CURRENT GENERATOR	No	Yes
REMOTE ACTIVE HEADSTAGE	No	Yes
OUTPUT CONNECTION	BNC	3.5 mm mini phone
STANDARD INPUT CONNECTION*	unterminated wire	mini banana
POWER SUPPLY	(2) 9V alkaline batteries	(2) 9V alkaline batteries

**See optional accessories for additional alternatives*

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DAM50 References

Liu, Y., Wang, Y., Zhu, G., Sun, J., Bi, X., & Baudry, M. (2016). A calpain-2 selective inhibitor enhances learning & memory by prolonging ERK activation. *Neuropharmacology*, 105, 471–477. http://doi.org/10.1016/j.neuropharm.2016.02.022

Ztaou, S., Maurice, N., Camon, J., Guiraudie-Capraz, G., Kerkerian-Le Goff, L., Beurrier, C., ... Amalric, M. (2016). Involvement of Striatal Cholinergic Interneurons and M1 and M4 Muscarinic Receptors in Motor Symptoms of Parkinson's Disease. *Journal of Neuroscience*, 36(35).

Kentish, S. S. J., Frisby, C. L., Kritas, S., Li, H., Hatzinikolas, G., O'Donnell, T. A., ... Ahern, G. (2015). TRPV1 Channels and Gastric Vagal Afferent Signalling in Lean and High Fat Diet Induced Obese Mice. *PloS One*, 10(8), e0135892. http://doi.org/10.1371/journal.pone.0135892

DAM80 References

Donnelly, W. T., Bartlett, D., & Leiter, J. C. (2016). Serotonin in the solitary tract nucleus shortens the laryngeal chemoreflex in anaesthetized neonatal rats. *Experimental Physiology*, 101(7), 946–961. http://doi.org/10.1113/EP085716

Feng, B., Joyce, S. C., & Gebhart, G. F. (2016). Optogenetic activation of mechanically insensitive afferents in mouse colorectum reveals chemosensitivity. *American Journal of Physiology - Gastrointestinal and Liver Physiology*, 310(10).

Kaldenbach, F., Bleckmann, H., & Kohl, T. (2016). Responses of infrared-sensitive tectal units of the pit viper Crotalus atrox to moving objects. *Journal of Comparative Physiology A*, 202(6), 389–398. http://doi.org/10.1007/s00359-016-1076-1

Mustafina, A. N., Koroleva, K. S., Giniatullin, R. A., & Sitdikova, G. F. (2016). Acid Sensitive Ion Channels as Target of Hydrogen Sulfide in Rat Trigeminal Neurons. *BioNanoScience*, 1–3. http://doi.org/10.1007/s12668-016-0237-6

Orton, L. D., Papasavvas, C. A., & Rees, A. (2016). Commissural Gain Control Enhances the Midbrain Representation of Sound Location. *The Journal of Neuroscience*, 36(16), 4470–81. http://doi.org/10.1523/JNEUROSCI.3012-15.2016

DAM50—*Basic Amplifier*

(Optional **5447** *Electrode Adapter)*

ORDERING INFORMATION

SYS-DAM50	Bio-amplifier with shielded electrode cable
SYS-DAM80	Bio-amplifier with active probe (DAM80P)

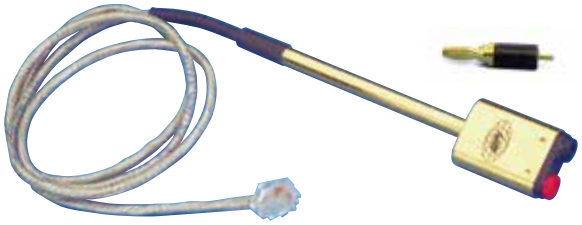
OPTIONAL ACCESSORIES/REPLACEMENT PARTS

DAM80P	Replacement Probe
3072	6 Replacement Modular Cables (DAM50)
3517	2 Optional Shielded Modular Cables (DAM50)
CBL102	3.5 mm Phone plug-to-BNC Cable
2851	BNC-to-BNC Cable
2033	Black Insulated Mini-Banana Plug
2034	Red Insulated Mini-Banana Plug
2035	Uninsulated Mini-Banana Plug
3484	Rack Mount Kit (for 1 or 2 DAM preamps)
3485	Ringstand Mounting Kit
5447	Electrode Adapter (DAM50)
5469	Metal Microelectrode Adapter for DAM80 *(mini-banana plug to 0.031 in. (0.79 mm) socket)*
5489	Adapter for Metal Microelectrode (DAM50)
13388	Adapter, mini-banana plug to 2mm socket
5371	Cable, Low Noise (2 mm pin to 2 mm pin)
3578	Adapter Cable for Ag/AgCl pellets (2 mm pin)
300102	Metal Electrode Extension, 4-in. (2 mm to 0.031 in.)
300647	Shielded Electrode Cable Assembly
MEH7W-XX	Microelectrode Holder- 1.0, 1.5 or 2.0 mm OD

See Cables and Connectors, page 96.
See Metal Microelectrodes, page 94.

DAM SERIES SPECIFICATIONS

INPUT IMPEDANCE	10^{12} Ω
INPUT LEAKAGE CURRENT	50 pA (typical)
MAX. DC DIFFERENTIAL SIGNAL	± 2.5 V (DAM 50)
GAIN	AC: 100x, 1000x, 10000x
	DC: 10x, 100x, 1000x (DAM50)
COMMON MODE REJECTION RATIO	100 dB @ 50/60 Hz
INPUT CAPACITANCE	20 pF
AC MODE NOISE	0.4 µV RMS (2 µV p-p) 0.1-100 Hz
AC MODE NOISE	2.6 µV RMS (10 µV p-p) 1 Hz-10 kH
DC MODE NOISE (DAM50)	7.5 µV RMS (30 µV p-p) 3-10 kHz
BANDWIDTH FILTER SETTINGS	
AC Mode	Low frequency, 0.1, 1, 10, 300 Hz
AC Mode (DAM80)	High frequency, 0.1, 1, 3, 10 kHz
DC Mode (DAM50)	High frequency, 0.1, 1, 3, 10 kHz
OUTPUT CONNECTORS	BNC on DAM50; 3.5 mm MiniPhone connector on DAM80
OUTPUT VOLTAGE SWING	±8 V
OUTPUT IMPEDANCE	470 Ω
BATTERY TEST	Audible tone
CALIBRATOR SIGNAL	10 Hz square wave
POSITION	Approximately 250 mV
CURRENT SOURCE	
DAM80: DC Generator	0 to ±50 µA, variable
EXTERNAL COMMAND	Input Voltage ±10 V commands
AC OR DC CURRENT WAVEFORM	±50 µA max. amplitude @ 200 KΩ
BATTERIES	2 x 9V alkaline (included)
DIMENSIONS	
DAM50	8 x 4 x 1.75 in. (20.3 x 10.2 x 4.4 cm)
DAM80	7 x 4 x 1.75 in. (17.8 x 10.2 x 4.4 cm)
SHIPPING WEIGHT	3.5 lb (1.6 kg)



Optional probe **5489** *(non-active) for use with DAM50 also includes micro-electrode adapter* **5469**.

Which Amplifier is Right for You?

AMPLIFIER COMPARISON CHART								
Amplifier	**AC/DC**	**Differential**	**Active Headstage**	**Stimulation**	**Isolated**	**Multi-channel**	**Battery Powered**	**Connectors**
Intracellular Bioamplifiers								
Electro 705	DC		♦				♦	2 mm pin
Duo773	DC	♦	♦	♦		2		2 mm pin
Extracellular Bioamplifiers								
ISODAM8A	DC	♦	opt		♦	4 - 8		Mini Banana or 8-pin DIN
ISO80	AC	♦	♦	♦	♦		♦	Mini Banana
DAM50	AC/DC	♦					♦	RJ-11
DAM80	AC	♦	♦	♦			♦	Mini Banana
Transducer Amplifiers								
BRIDGE8	DC	♦				4 - 8		8-pin DIN WPI transducers
TBM4M	DC	♦				4		8-pin DIN WPI transducers

WPI's Low-Noise Amplifiers Outperform Cheap Imitations

An amplifier is an electronic device that magnifies an input signal. However, the way an amplifier is designed to handle noise and bandwidth limitations greatly affects the quality and sustainability of the final output signal.

Defining Terms

To knowledgeably discuss amplifiers, let's define a few common terms.

Gain – The gain is the multiplier defining how much the amplitude of an input signal is increased. A signal with an ×1 gain is not amplified. A ×10 gain produces an output signal ten times greater than the input signal.

Noise – Any unwanted signal fluctuations are called noise. While noise can also result from external sources, for the purpose of this discussion, we are primarily concerned with the noise resulting from the inner workings of the electronic device, our amplifier. This intrinsic noise is called shot (or schott) noise.

Signal to Noise Ratio (SNR) – The ratio of the output signal to the noise of the amplifier is called the signal to noise ratio. The smaller the shot noise signal in an amplifier in comparison with the output signal, the easier the desired signal is to discriminate. When engineering an amplifier, the SNR may be improved by boosting the first stage gain to yield a larger output signal or by using quality components to minimize the shot noise level of the amplifier.

Output Range – The output range determines the maximum output signal that can be generated with the amplifier. It is determined by the maximum voltage of the power supply. If the amplitude of the output signal is too large for the output range, part of the signal is cut off (clipped).

Rail – The upper or lower limit of the amplifier range is called a rail. Signals that exceed the rail cannot be faithfully reproduced.

DC Offset – DC offsets can appear in biological preparations. This offset is the amount the output signal is displaced away from a zero reference point. It is usually a result of the potential difference at the electrode's tip.

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How Amplifiers Work

Power Supply Rails Limit the Range

In a perfect world an input signal can be infinitely multiplied by the gain factor to determine the output signal. For example:

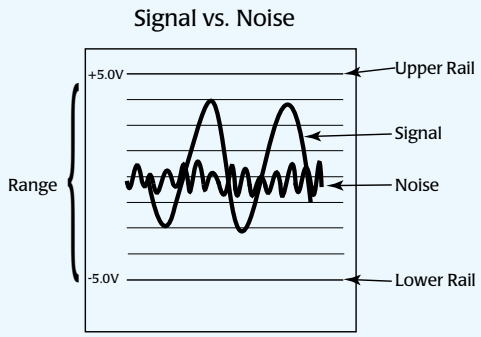
Input Signal	Gain	Output Signal
2 mV	×1	2 mV
2 mV	×2	4 mV
2 mV	×10	20 mV
2 mV	×100	200 mV
2 mV	×10,000	20 V

In the real world, the power supply rails limit the possible output range of the amplifier. For example, a bio-amplifier could have a range of ±5.0V. In order for the output signal to be faithfully reproduced, the input signal times the gain factor must fall within the voltage window set by the power rails. Otherwise, the output signal goes off scale, and the input signal is not faithfully reproduced. This is called "hitting the rail."

In our example, a 1.0 µV input signal at an $\times 10^6$ gain would generate a 1.0V output signal. Since the power supply is rated up to +5.0V, this output signal is clearly visible. If the input signal in this example is greater than 5.0 µV, the output signal would be greater than +5.0V. Since 5.0V is the top of the range that the power supply is capable of producing, the output signal hits the upper rail and gets cut off. This amplifier gives a +5.0V DC output signal for all input signals greater than or equal to 5.0 µV. So, a smaller gain factor should be used to bring the output signal back into the dynamic output range of the amplifier.

Noise Limits Amplifier Usability

All electronic devices produce their own internal electronic noise, an unavoidable signal that can mask the output signal. For example, if



The higher the signal to noise ratio, the more discernible the desired signal.

the input signal is 2mV and the noise is 1 mV, the signal to noise ratio is two to one (2:1), and the output signal would be undetectable. It is nearly impossible to discern which part of this output is generated by noise and which part is the desired signal. (See figure.)

Ideally, the signal to noise ratio should be at least 50 to 1 to produce a quality output signal. A good signal to noise ratio can be achieved in one of two ways:

- Boost the output signal by increasing the gain.
- Reduce the noise.

While increasing the gain is the simplest solution, too much gain can impose a limitation on the dynamic range of the amplifier. Reducing noise is a more complicated solution, but it offers a greater range and more stability.

Two-Stage Amplifiers

Bio-amplifiers usually involve multiple stages of amplification.

Stage One – The unadulterated signal coming into the amplifier is unaffected by the intrinsic noise of the amplifier. Then, it runs through the critical first stage of amplification where the signal is boosted by the primary gain factor to produce an output signal with the desired signal to noise ratio. The intrinsic noise is not amplified in the first stage. Higher gain factors used in the first stage of amplification can seriously limit the dynamic range available at output stage. Large stage one gains also limit the gain factor available in the second stage of amplification.

Stage 2 – The stage one output signal enters the second stage of amplification where both the signal and the noise from the first stage are amplified together by the second stage gain factor so that the signal is large enough to be seen on a chart recorder or data acquisition system. The second stage amplification is the gain the user controls. It does not change the signal to noise ratio.

Instead of using high gains in the first stage of amplification, a well constructed bio-amplifier that uses high quality components, like WPI's DAM series amplifiers, minimizes the noise in the first stage of amplification so that the dynamic range is retained throughout the amplification process. Poorly designed amplifiers simply increase the gain of the first stage amplification until the desired signal to noise ratio is reached.

Boost the power rails?

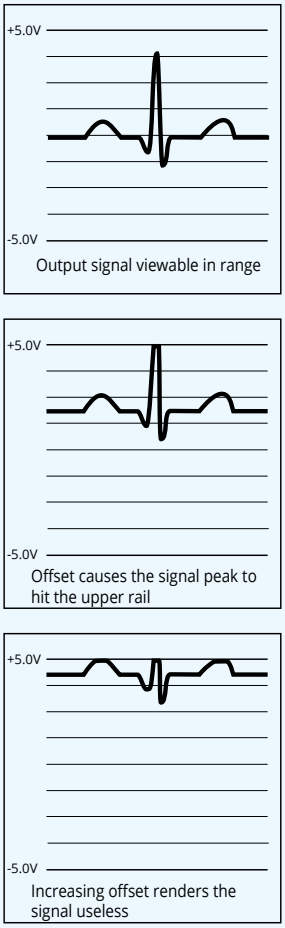
Theoretically, increasing the voltage rails powering the amplifier will increase the available dynamic output range. It would seem natural to increase the power supply rails coming into the amplifier in order to provide the capability for greater first stage gains. However, most data acquisition systems are limited to a maximum input signal ranging between ±10.0V. Therefore, it is not practical to increase the power rails of bio-amplifier beyond ±10.0V. Since the industry standard limits us to ±10.0V power supply rails, the only way to improve the signal to noise ratio is to minimize the shot noise in the first stage of amplification. This is why high quality amplifier components are imperative.

Why a Signal Flatlines

Regardless of the amplifier used, biological potentials are often accompanied by a DC offset, because the electrodes polarize over time. The DC offset naturally increases over time. Since the poorly constructed amplifier that utilizes greater first stage gain has restricted its dynamic range, it has limited ability to handle this offset. As the offset continues to increase, the output signal may eventually be forced by the offset into the rail causing the flat line (clipping the signal). (See Figure.)

The amplifier that minimizes the noise in the first stage amplification offers a larger dynamic output range and handles a much greater offset value.

Result of Amplifier Using Gain to Control Signal to Noise Ratio



As the offset naturally increases over time, a poorly constructed amplifier will not be able to faithfully reproduce the signal. This offset can also result from gain drift as temperature rises.

WPI's Amplifiers

The purchase of a low-noise amplifier pays dividends in the end. WPI's amplifiers were engineered for the bio-medical researcher. While 20-30 µV of noise is common in bio-amplifiers, WPI's DAM series amplifiers generate 0.4 µV RMS (root mean squared) at 0.1-100 Hz. (That's equal to 2 µV peak-to-peak.)

Isolated Differential Amplifier

Excellent recording performance for extracellular nerve AP

Features

- Battery powered, rechargeable
- High pass and low pass filtering
- Active remote headstage
- AC only amplification
- Electrode impedance test function
- Electrode current generation with polarity select
- Variable output positioning

Benefits

- Ultra quiet DC power supply
- Intrinsic low susceptibility to ground loops
- High signal to noise ratio due to remote head stage
- Small footprint
- Stimulation/histological marking current

Applications

- Amplifying bio-potentials using metal microelectrodes
- Brain slice field potentials
- EAG (Electroantennogram)
- ERG (Electroretinogram)
- Monitor extracellular nerve action potentials
- Use for cell marking, stimulation or electrode cleaning
- *In vivo* cortical recording

ISO-80

The **ISO-80** provides low noise AC coupled amplification and offers excellent recording performance for monitoring extracellular nerve action potentials *in vitro* and in living animals. The **ISO-80** is provided with a remote headstage (1 m cable) which incorporates an electrode impedance test function and a constant current stimulator. The constant current stimulator can be used for cell marking, stimulation or electrode cleaning. Typical applications include measuring EMG, EEG, extracellular and action potentials *in vitro* or *in vivo*. The ISO-80 system is DC isolated from the subject ground and employs state of the art electro-magnetic shielding for improved noise rejection. The amplifier employs both high pass and low pass filtering with gain from 100 to 10,000. The lowest low-pass setting is 5 Hz and the upper passband is 10 kHz.

Included with the ISO-80 is a Startup Kit containing the following accessories needed for basic metal electrode electrophysiology research:

CBL102	Cable, BNC-to-3.5 mm plug, 6 ft (2m) (two)
5469	Adapter, mini-banana to 0.031 skt. (two)
13388	Adapter, mini-banana to 2mm skt. (two)
3294	Cable, ground clip to wire, 3 ft
2033	Mini-banana plug, black
2034	Mini-banana plug, red
2035	Mini-banana plug solderable turrent (two)
EP1	Ag/AgCl pellet (70 mm wire) 1 mm diam x 2.5 mm long
M3301EH	Electrode Holder, 14cm (two)
5470	0.031-inch jack on 12-inch wire (package of 4)

ISO-80 SPECIFICATIONS

INPUT RESISTANCE	$>10^{11}$ Ω, Common mode and differential
INPUT LEAKAGE CURRENT	50 picoamperes, max.
AMPLIFICATION	$\times10^2$, $\times10^3$, $\times10^4$
COMMON MODE REJECTION RATIO	100 dB typ. @ 50/60 Hz
EQUIVALENT NOISE SIGNAL INPUT	0.4 µV rms (0.1-100 Hz)
	2.0 µV rms (1 Hz - 10 kHz)
FILTER SETTINGS	
Low frequency	5, 10, 100, 300 Hz
High frequency	100 Hz, 1, 3, 10 kHz
MAX. OUTPUT VOLTAGE SWING	±8 volts
ELECTRODE IMPEDANCE RANGE	100 kΩ - 10 MΩ @ 300 Hz
STIMULATION CURRENT	0 to ±20 µA (constant current)
MAXIMUM STIMULATION VOLTAGE	±15 V
MAXIMUM ELECTRODE VOLTAGE	±40 V
DISPLAY	3½-digit LCD
BATTERY TEST	Low battery display
POWER	(2) 9V Ni-MH batteries & charger, supplied
SHIPPING WEIGHT	4 lb (1.8 kg)

ORDERING INFORMATION

ISO-80	Isolated Bioamplifier w/ active probe (ISO80P)
	Specify line voltage

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

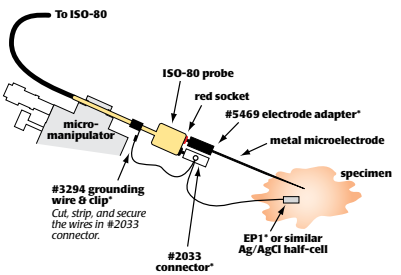
ISO-80P	Replacement ISO-80 Probe
CBL102	3.5 mm phone plug-to-BNC cable

References

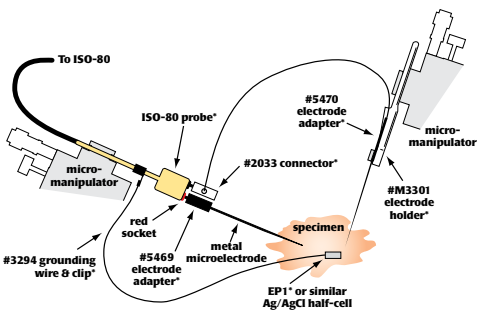
Lynn, P. A., et. al. (2003). Rectal intraganglionic laminar endings are transduction sites of extrinsic mechanoreceptors in the guinea pig rectum. Gastroenterology, 125(3), 786–94. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12949724

Vastani, N., et. al. (2013). Sensitivities of rat primary sensory afferent nerves to magnesium. European Journal of Anaesthesiology, 30(1), 21–28. http://doi.org/10.1097/EJA.0b013e32835949ab

Vastani, N., et. al. (2013). Sensitivities of rat primary sensory afferent nerves to magnesium. European Journal of Anaesthesiology, 30(1), 21–28. http://doi.org/10.1097/EJA.0b013e32835949ab



Single-Ended Application



Optional Differential Application

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Low Noise Modular Amplifier System

Isolated, low noise bio-amplifier

Features (Iso-DAM8A)

74020 CE

- High pass and low pass filtering
- Optional active remote head stage
- AC/DC amplification
- Variable gain adjustment
- Input is optically isolated
- 50/60 Hz notch filter
- Pre-optical isolation DC offset
- Post-optical isolation zeroing
- Independent module power switch

Benefits (Iso-DAM8A)

- Chassis accepts combination of bioamplifiers and transducer amplifiers
- Flexible channel count (1–8) allows expandability
- Notch filter targets AC line noise sources
- Variable gain output amplitude
- Wide ±10V output range

Applications (Iso-DAM8A)

- Amplifying biopotentials unsing metal microelectrodes
- Brain slice field potentials
- EAG (Electroantennogram)
- ERG (Electroretinogram)

Iso-DAM8A Modules Isolated Low Noise Bio-Amplifier

The **ISO-DAM8A** is a compact modular standard rack-mountable DC amplifier system. Each channel is electrically isolated from the others and from ground. No current can flow from the input terminals and electrodes, thus, the instrument is intrinsically safe and cannot cause any electrical stimulus or shock to the preparation, in addition ground loop noise is minimized. Systems can be purchased with one, two, three or up to eight preamplifier modules or mixed with **Bridge8** transducer amplifier modules (see next page). The user can then select an appropriate low pass filter setting, gain and offset on the channel amplifier panel. A notch filter has been added to reduce line frequency interference. An optional headstage preamplifier (10x gain) allows low noise extracellular (DC) recording with **Iso-DAM8A** and adds greater signal bandwidth than a shielded cable of the same length. The **Iso-DAM8A** amplifier and headstage configuration is optimally suited for use with our metal microelectrodes and can be easily configured for many applications. Each amplifier channel has a coaxial (BNC) connector located on the rear panel.

ISO-DAM8A SPECIFICATIONS

EACH CHANNEL	
INPUT IMPEDANCE	> 10^{12} Ohms
INPUT LEAKAGE CURRENT	10 pA (typical)
INPUT DC OFFSET	± 100 mV
GAIN	×10, ×100, ×1000, ×10,000
COMMON MODE REJECTION	> 100 dB @ 50/60 Hz
EQUIVALENT NOISE SIGNAL INPUT	< 0.36 µV rms (1.8 µV p-p) 0.1-10 Hz, Gain>10 < 1 µV rms (5 µV P-P) 0.1-10 kHz
BANDWIDTH FILTER SETTINGS	
High Filter (Low Pass) (kHz)	0.1, 0.5, 1, 3, 10
Low Filter (High Pass) (Hz)	0.1, 1, 10, 300
Notch Filter (Hz)	50, 60
OUTPUT VOLTAGE SWING	± 7.5 Volts
OUTPUT RESISTANCE	220 Ohms
ENCLOSURE DIMENSIONS	7 × 17 × 9.2 in. (18 × 43 × 23 cm)
SHIPPING WEIGHT	10 to 21 lb (4.5 to 9.5 kg)

Low noise tranducer amplifier

Features (BRIDGE8)

BRIDGE8 CE

- Wide range of fixed gains with independent variable gain adjustment
- Low pass filter
- Single ended or differential transducer compatibility
- Dual range output offset correction
- Independent module power switch
- Provides ± voltage excitation to transducers

Benefits (BRIDGE8)

- Chassis accepts combination of bioamplifiers and transducer amplifiers
- Flexible channel count (1–8) allows expandability
- Output LEDs confirm transducer output balance

Applications (BRIDGE8)

- WPI force transducers
- Wheatstone bridge transducers
- Muscle force measurement

Bridge8 Modules Low Noise Transducer Amplifier

Bridge8 is a modular, rack-mountable amplifier system. It is specifically designed for use as a signal conditioning amplifier with strain gages and other powered transducers. **Bridge8** includes differential amplifiers featuring high input impedance, high common mode rejection and low current leakage input terminals for low noise operation. It features a half bridge switch and channel offset A wide variety of WPI transducers are available for force, temperature, pressure and light measurements. The **Bridge8** amplifier is a clear choice for convenience and quality.

BRIDGE8 SPECIFICATIONS

INPUT IMPEDANCE	> 10^{12} Ohms
AMPLIFICATION	1, 10, 50, 100, 500, 1000 & Adjustable
INPUT LEAKAGE CURRENT	0.1 pA at 25 °C
VOLTAGE OFFSET ADJUSTMENT	±50 mV (low); ±100 mV (high)
AMPLIFIER OUTPUT VOLTAGE	±4.4 V (10 mA, max.)
EXCITATION VOLTAGE	10 V (±5.0 V) 100 mA, max.
EQUIVALENT NOISE SIGNAL INPUT	< 0.4 µV RMS (2 µV p-p) 0.1-10 Hz Gain >10 < 3 µV RMS (15 µV p-p) 0.1-100 Hz Gain >10
LOW PASS FILTER BAND (KHz)	0.03, 0.1, 0.3, 1, 5, 10, "Wide Band" R-C Butterworth 6 dB /octave)

ORDERING INFORMATION

74020	Iso-DAM8A Single Channel Module
74030	ISDB chassis and power supply
74040	Iso-DAM8A Active Headstage (separate)
BRIDGE8	Bridge8 Transducer Amplifier Module

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

74050	ISDB Blank panels
74016	Replacement Cable, Input bare 5-ft wire
2933	ISDB Rack Mount Kit, 5¼-in. High
FORT10g	Force Transducer 10 g
FORT25	Force Transducer 25 g
FORT100	Force Transducer 100 g
FORT250	Force Transducer 250 g
FORT1000	Force Transducer 1000 g
500184	BNC to BNC 10 foot cable
3161	8-pin DIN plug
3718	Package of 4, 8-pin DIN (startup kit)
3491	Extension Cable (DIN male, DIN female), 5 ft (1.5 m)

Dual Microprobe Intracellular Amplifier

2-Channel intracellular amplifier for dual and differential studies

SYS-773

2547 *Driven Guard Shield*

Features

- Two channels for differential or intracellular ISE
- Built in DC current generator with external control input
- Built in low pass filter
- Bridge balance circuit to null out electrode voltage drop
- Tickle circuit
- Built in test ports for each channel
- Dual capacitance compensations and output offset controls

Benefits

- Dual channel, single ended recording
- Differential recording
- Bridge circuit nulls electrode voltage drop
- Assign low pass filter to either channel
- Very high impedance channel can be used with intracellular ISE

Applications

- Intracellular electrophysiology using sharp micropipettes
- Brain slice intracellular recording
- In vivo intracellular recording from brain and spinal cord

For intracellular dual or differential studies, the **Duo773** has separate negative capacity controls and built-in active filtering that allows the precise balancing of time constants for artifact-free differential measurement. Comes complete with two probe headstages, $10^{15}\Omega$ and $10^{11}\Omega$ probes to monitor signals from ion-specific micro-electrodes as well as KCl-filled electrodes.

Headstage for precise positioning

Two gold-plated, epoxy sealed miniature active probes can be positioned directly to the measurement site. Microelectrode holders containing an Ag/AgCl electrochemical half-cells plug directly into the probes. Stray capacitance can be reduced by placing the included driven guard shield over the microelectrode holder at the end of the probe.

Capacity compensation

Channel A can compensate up to 10 pF of electrode shunt capacity and Channel B can compensate up to 50 pF.

Tickler circuit for penetration

A Tickler Circuit assists in cell penetration. The frequency and amplitude of the oscillations may be varied for differences in membrane thickness or cell size. The duration of tickle can be controlled either by using the momentary switch, a foot switch, or by applying a signal to the remote tickler input.

Active filters

Low pass settings on a -40 dB/decade active filter vary the cutoff from 1 to 30 kHz. Either probe or bridge outputs may be selected for filtering.

Current injection

Channel B can eject current through the microelectrode by applying a command signal to the stimulus input connector. The resulting output from the probe will be a constant current replica of the input signal. Two ranges of current delivery are provided: 50 nA and 500 nA or by an external source. This source can be useful for delivering hyperpolarizing currents to stabilize the cell membrane potential and as a holding current for microiontophoresis.

Bridge balance

Subtracts the excess electrode voltage associated with delivering current through the recording micropipette. Electrode resistances up to 1000 MΩ can be balanced in two ranges. The balanced signal is available from x10 or x50 front panel output connectors.

Independent outputs

The **Duo773** has an output for each probe independent of gain filtering or balancing. In addition the **Duo773** has a 10x and a 50x output for easy integration to most data acquisition programs.

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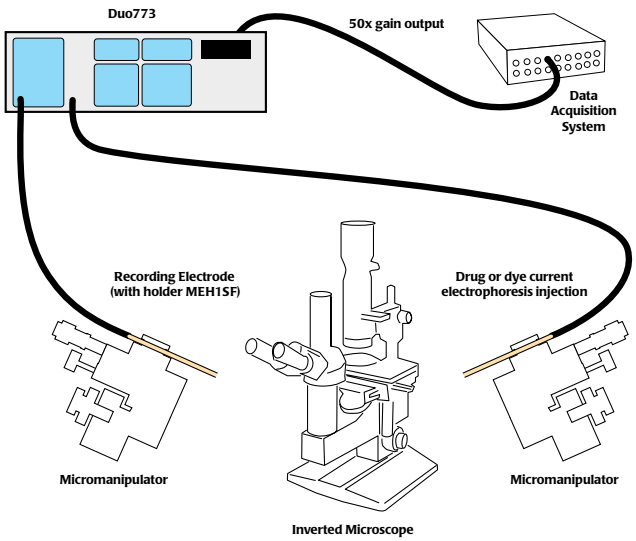
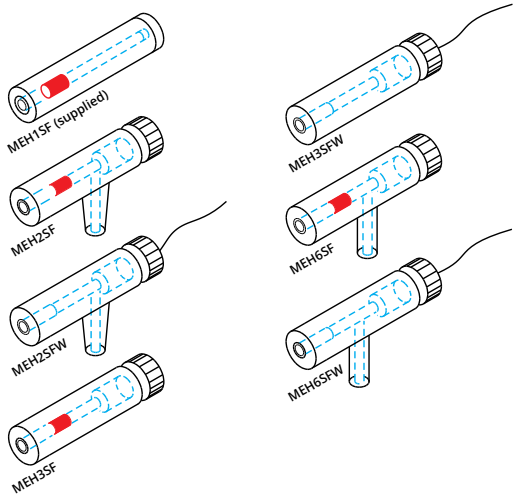
Typical setup



See cables and connectors, page 96
SeeDri-Ref, page 158.

Optional holders for intracellular amplifiers



See Microelectrode Holders, page 98.

References

Huo, Q., Chen, M., He, Q., Zhang, J., & Li, B. (2016). Prefrontal Cortical GABAergic Dysfunction Contributes to Aberrant UP-State Duration in APP Knockout Mice. Cerebral .... Retrieved from http://cercor.oxfordjournals.org/content/early/2016/08/23/cercor.bhw218.short

Spong, K. E., Rodríguez, E. C., & Robertson, R. M. (2016). Spreading depolarization in the brain of Drosophila is induced by inhibition of the Na+/K+-ATPase and mitigated by a decrease in activity of protein kinase G. *Journal of Neurophysiology*, jn.00353.2016. http://doi.org/10.1152/jn.00353.2016

Zhang, J., Chen, M., Li, B., Lv, B., Jin, K., & Zheng, S. (2016). Altered striatal rhythmic activity in cylindromatosis knock-out mice due to enhanced GABAergic inhibition. .... Retrieved from http://www.sciencedirect.com/science/article/pii/S002839081630274X

Bredeloux, P., Finday, I., & Pasqualin, C. (2016). 0194: Functional consequences of-adrenergic receptors activation in the rat pulmonary veins and left atria. Archives of .... Retrieved from http://www.sciencedirect.com/science/article/pii/S1878648016304311

DUO 773 SPECIFICATIONS

HEADSTAGE (PROBE)	**712P** (red, port "B")	**715P** (blue, port "A")
ACTIVE PROBE INPUT IMPEDANCE	$>10^{11}\ \Omega$	$10^{15}\ \Omega$
GAIN	x1, x10	x1
OUTPUT RESISTANCE	100 Ω	100 Ω
OUTPUT VOLTAGE RANGE	±10 V	± 10V
MAXIMUM INPUT VOLTAGE	±15 V	±15 V
PROBE LEAKAGE CURRENT	5×10^{-12} A	10^{-14} A
DC POSITION ADJUST RANGE	± 300 mV	± 300 mV
ELECTRODE RESISTANCE TEST CURRENT	1 nA	1 pA, 1 nA selectable
INPUT CAPACITY COMPENSATION	+10 to -50 pF	0 to -10 pF
NOISE		
Input shorted	<50 µV p-p 10kHz bandwidth	<50 µV p-p 10kHz bandwidth
20 MΩ carbon resistor	<200 µV p-p 10kHz bandwidth	<200 µV p-p 10kHz bandwidth
RISE TIME		
10-90% direct input small signal	1 µs, typical	
10-90% through 20 MΩ (-C "on")	25 µs, typical	
CURRENT INJECTION	(712P only)**	
Internal DC Current	± 50 nA low range, ± 500 nA high range	
Externally commanded Current	± 500 nA low range, ± 5 µA high range	
External current command factor	20 mV/nA low range, 2 mV/nA high range	
Current monitor	100 mV/nA low range, 10 mV/nA high range	
Compliance	3V low range, 10V high range	
Bridge balance	0-100 MΩ, 0-1000 MΩ	
Bridge amplifier gain	x 10, x 50	
LOW PASS FILTER	40 dB/decade, continuously variable 1-30 kHz	
METER SECTION		
Display	3.5-digit LED	
Ranges	200 mV, 2000 mV, 20 V, 200 nA, 2000 nA	
Accuracy and resolution	1 digit	
DIMENSIONS		
Instrument	17 x 5.25 x 10 in. (43 x 13 x 25 cm)	
Probe	Diameter: 12 mm Length: 34 mm	
POWER	95-135 V or 220-240 V, 50/60 Hz	
SHIPPING WEIGHT	15 lb (7 kg)	
CERTIFICATION	CE, CSA	

** Although injected currents are "constant," the maximum current in a given situation will always be limited by the system compliance of 10 V.*

***The 712P headstage may be used on either A or B channels, however Current Injection specifications do not apply when used on channel A. The 715P headstage may not be used on the B channel.*

ORDERING INFORMATION

SYS-773 Duo 773 Electromete

Includes two probes (712P and 715P or two 712P) with driven guard shields and eight MEH1SF microelectrode holders for 1.0, 1.2, 1.5 or 2.0 mm glass electrodes. Specify line voltage

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

712P	Replacement probe (includes calibration)*
715P	Replacement probe (includes calibration)*
	**Instrument should be returned to WPI for free calibration with new probe.*
2933	Rack Mount Kit, 5¼-in. high
2547	Driven Guard Shield for 712P & 715P Probes
15790	Replacement Probe Handle
TW100F-4	Glass capillary with filament
TW150F-4	Glass capillary with filament
3259	Foot Switch

Dual Channel Differential Electrometer

Electrochemical measurements with ion specific electrodes

Features

- Dual channel with very high input impedance
- Separate outputs for Channel A, B and A-B (Differential)
- Independent DC offset controls
- Test port
- Standby mode

Benefits

- Measure changes in intracellular ion content electrochemically
- Stable and drift free
- Excellent amplification with low noise
- Driven guard shield for reduced noise and stray capacitance
- Set probe leakage current

Applications

- Measure intracellular ion concentrations for K+, Ca2+, H+ and other

The **FD223a** electrometer was designed specifically for use with intracellular ion selective electrodes fabricated using glass micropipettes and liquid ion exchangers.

The active head stages allow the researcher to locate the probes directly at the measurement site to minimize noise that would normally be picked up by longer cable runs. Driven guard shields cover the micropipette holders to further reduce the potential for interference from external sources of electromagnetic noise.

The **FD223a** is equipped with a test resistance port which is used to measure and adjust each probe for minimum leakage current. Each channel has a standby mode which clamps the head stage input voltage to zero, preventing extreme saturation or possible damage to the high impedance input amplifier.

References

E. Ermolayeva, H. Hohmeyer, E. Johannes, D. Sanders
"Calciumdependent membrane depolarisation activated by phytochrome in the moss Physcomitrella patens" *Planta* 199. 1996: 352-358

FD223A SPECIFICATIONS

INPUT IMPEDANCE	> 10^{15} Ω, shunted by 0.5 pF
INPUT CAPACITANCE	1 pF, nominal
LEAKAGE CURRENT	75 fA max
GAIN	1.000 ± 0.1%
OUTPUT RESISTANCE	50 Ω
INPUT SWING VOLTAGE	±10 V
RISE TIME (10 TO 90%)	5 µs, small signal
NOISE (0.1 Hz TO 10 KHz)	<100 µV p-p, input shorted
BASELINE STABILITY	±0.1 mV/day
POSITION CONTROLS RANGE	±600 mV
PHYSICAL DIMENSIONS	Case: 8.8 x 21.0 x 17.5 cm (H x W x D) Probe: 12.7 x 65 mm (D x L), 1.8 m cable
POWER	90-265 VAC, 50/60 Hz, 10 VA
PROBE HANDLE	6.5 x 65 mm (D x L)
SHIPPING WEIGHT	2.5 kg

OPERATING CONDITIONS: Equipment is intended to be operated in a controlled laboratory environment. Temperature: 0-40 °C; altitude: sea level to 2000 m; relative humidity: 0-95%.

ORDERING INFORMATION

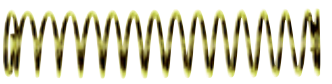
FD223A	FD223a Dual Channel Differential Electrometer

2 probes, driven guard shields and micropipette holder MEH1SF included for all glass microelectrodes O.D. 1.0, 1.2, 1.5 or 2.0 mm.

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

M3301L	Left-hand Micromanipulator
M3301R	Right-hand Micromanipulator
M-3	80° Tilting base
RC1T	Reference cell (Ag/AgCl)
2547	Driven guard shield for FD223AP Probe
MEH1SF	Microelectrode holder
FD223AP	Replacement probe (includes calibration)

See cables and connectors, page 96.
See microelectrode holders, page 101.
See capillary glass, page 104.



2547 Driven Guard Shield

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Ultra Quiet Intracellular Amplifier

High quality, intracellular amplifier perfect for students

Features

- Driven guard shield
- Test port
- Ground port
- Portable
- Remote headstage

Benefits

- Cost effective
- Battery powered
- Capacitance compensation

Applications

- Measure intracellular action potentials

Photo shows two units.
Manipulators sold separately.

SYS-705

Electro 705, a battery operated, low noise, wide band electrometer preamplifier, is designed for intracellular voltage measurement. Two 705's can be linked together to form a high impedance differential electrometer pair. Each instrument includes a miniature gold plated active probe to which a microelectrode can be attached using the WPI microelectrode holder supplied.

Remote headstage

Easily mounted in any manipulator, this compact probe, containing the first stage of amplification, includes a microelectrode holder, which plugs directly into the probe input.

Battery power

Four 9V alkaline batteries (included) power the **Electro 705** for approximately 500 hours giving a clean, low noise source of power, making the **Electro 705** the quietest amplifier available. Batteries can be easily tested by the press of a button.

Capacitance Compensation

Corrects for loss of rise time caused by the presence of electrode capacity. Up to 50 pF of electrode shunt capacity may be neutralized.

Driven Guard Shield

Stray capacitance can be further reduced by placing the driven guard shield (included) over the microelectrode holder at the input end of the probe.

Test Features

A Tickler Circuit offers a momentary oscillation that helps achieve cell penetration. The **Electo 705** provides a 1 nA electrode test current. Electrode resistance is monitored at the 1X output as a voltage (1 mV/M). The Probe Test Port allows the convenience of testing the amplifier's intrinsic noise and gain without cumbersome external test hookups. Head stage leakage current can also be adjusted with minimum effort. The Baseline Position Control adds or subtracts up to 300 mV to the headstage output, allowing artifact voltages such as liquid junction potentials to be nulled prior to recording.

Differential Output

Two **Electro 705** units can be connected in tandem to create an optional differential amplifier probe system.

References

Wan, E., Kushner, J. S., Zakharov, S., Nui, X.-W., Chudasama, N., Kelly, C., ... Marx, S. O. (2013). Reduced vascular smooth muscle BK channel current underlies heart failure-induced vasoconstriction in mice. *FASEB Journal : Official Publication of the Federation of American Societies for Experimental Biology*, 27(5), 1859–67. http://doi.org/10.1096/fj.12-223511

Gokina, N. I., Bonev, A. D., Gokin, A. P., & Goloman, G. (2013). Role of impaired endothelial cell Ca2+ signaling in uteroplacental vascular dysfunction during diabetic rat pregnancy. *American Journal of Physiology - Heart and Circulatory Physiology*, 304(7).

Thomas, R. C., & Bers, D. M. (2013). How to make calcium-sensitive minielectrodes. *Cold Spring Harbor Protocols*, 2013(4), 370–3. http://doi.org/10.1101/pdb.prot072850

ELECTRO 705 SPECIFICATIONS

Probe Input Resistance	10^{12} Ω
Probe Input Leakage Current	± 10 pA, adjustable to 0
Input Capacitance Compensation	0 to 50pF
Noise level	500 uV peak to peak
Rise time	15 uS, 10 - 90%
Output impedance	100 ohms , both outputs
Tickle	9V p-p adjustable from 200 Hz to 3000 Hz
Stepped Voltage Rise Time	<25 µs, 10–90%, through 20 MΩ*
Voltage Gain	x1 ±0.1%
Input Voltage Range	±5V
Position Range	±300mV
Electrode R Test	1mV/M ohm
Common Mode Rejection	> 104, in paired operation
Power	Four 9V alkaline cells, supplied
Dimensions	21.6 x 8.9 x 14.3cm (8.5 x 3.5 x 5.6˝)

* Dependent on measuring technique.

ORDERING INFORMATION

SYS-705	Electro 705 Electrometer

Probe, driven guard shield and micropipette holder MEH1SF included for glass microelectrodes O.D. 1.0 mm, 1.2 mm, 1.5 mm, or 2.0 mm.

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

M3301L	Left-hand Micromanipulator
MM3301R	Right-hand Micromanipulator
M-3	80° Tilting base
RC1T	Reference cell (Ag/AgCl)
2541	Driven guard shield for 705PF Probe
MEH1SF	Microelectrode holder
15804	Replacement Probe Handle & Clip
705PF	Replacement probe (includes calibration)*

**Instrument must be returned to WPI for free calibration with new probe.*

See cables and connectors, page 96.
See microelectrode holders,page 98.
See capillary glass, page 104.

Single Channel Pulse Generator

The accuracy of digital electronics and convenience of analog controls

CE

SYS-A310

3259 *Optional foot switch*

Features

- Single channel pulse generator with train capability
- TTL and variable voltage output

Benefits

- Variety of pulses: continuous run, single-shot, train/burst
- Multiple outputs available: monitor, isolator, sync and variable

Applications

- Electrophysiology

The **A310** pulse generator/stimulator combines the reproducibility and accuracy of digital electronics with the fine resolution and continuous adjustment possible with analog circuitry. All timing parameters are entered with high resolution, ten-turn potentiometers and six-position range switches. Timing is accurate to within 1% of the set value.

Variety of Pulses

Pulses can be created in continuous run, single-shot or train/burst modes. Duration of the train/burst is controlled using the onboard envelope generator or by using either of two external gating inputs. Used in conjunction with the **A360**, **A365**, **A385** or **A395**, constant current pulses and trains can be created easily. A foot switch allows hands-free, manual triggering.

Multiple Outputs Available

Five separate standard BNC outputs are available on the front panel. The isolator output sends full pulse width control signals to any TTL triggered stimulus isolator, such as WPI's **A360**, **A365** or **A385** and others. The monitor output sends synchronized large scale full pulse width signals to recording or monitoring instrumentation such as a data acquisition system or oscilloscope. The sync output provides an additional synchronized 5 µs TTL pulse for triggering external instrumentation. A variable voltage output provides two separate full pulse width signals in both positive and negative polarities in two ranges for applications that require a specific output voltage other than TTL.

References

Cha, R., Marescaux, J., & Diana, M. (2014). Updates on gastric electrical stimulation to treat obesity: Systematic review and future perspectives. *World Journal of Gastrointestinal Endoscopy*, 6(9), 419–31. http://doi.org/10.4253/wjge.v6.i9.419

SPECIFICATIONS

TIMING PARAMETERS		
EVENT INTERVAL	100 µs to1000 s*	
EVENT DELAY	10 µs to 100 s *	
PULSE WIDTH	10 µs to 100 s *	
TRAIN DURATION (ENVELOPE)	100 µs to 1000 s*	
PULSE INTERVAL	20 µs to 100 s*	
OUTPUTS		
SYNC	5 µs, TTL, and 5 V CMOS compatible, 20 mA max.	
MONITOR	10-15 V, 50 mA max.	
ISOLATOR	TTL & 5 V CMOS compatible, 20 mA max.	
VARIABLE (Pos or Neg)		
PULSED/DC	LOW RANGE	HIGH RANGE
Range	0 to ±1 V	0 to ±10 V
Resolution	1 mV	10 mV
NOISE		
Pulsed at 100 kHz bandwidth	<500 µV	
DC Wide Band	<500 µV	
OUTPUT IMPEDANCE	<1 Ω	
INPUTS		
EXTERNAL SYNC	Accepts 1-µs minimum pulses TTL, CMOS compatible	
EXTERNAL GATE	Accepts 1-µs pulse to continuous TTL, CMOS compatible	
POWER	95-130 V or 190-260 V, switch selectable single phase, 50/60 Hz	
DIMENSIONS	17 x 5.25 x 10 in. (43 x 13 x 25 cm)	
SHIPPING WEIGHT	14 lb (6.4 kg)	

**Continuously variable in six ranges. All accuracies better than 1% of set value. 50kHz maximum pulse frequency.*

ORDERING INFORMATION

SYS-A310	Accupulser™ Signal Generator
	Specify line voltage

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

3259	Foot Switch for A310
2933	Rack Mount Kit, 5¼ in. high

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Constant Current Stimulus Isolator

Automated bipolar pulsing for zero net charge on biological preparations

Features

- Constant current
- Unipolar and bipolar stimulation modes
- Built-in non-compliance alarm
- Input is optically isolated
- Standard TTL triggering
- DC test mode
- Powered by 9V alkaline or rechargeable batteries

Benefits

- Compliance voltage is 100V or better
- Bipolar mode auto generates alternating positive and negative pulses from TTL input
- Test mode simplifies performance verification
- Optical isolation enhances safety of the preparation and reduces noise susceptibility

A365RC

Applications

- Electrophysiology
- Brain slice stimulation
- *In vivo* brain and CNS stimulation

Activated by conventional logic-level commands, Model **A365** can be gated by any pulse generator, stimulator, or computer output; automated bipolar pulsing for zero net charge on biological preparations.

Dual Tone Audible Alarms

A tone sounds when an open electrode circuit is detected or when system compliance is reached. A second optional tone sounds when a signal is applied to the input. A test switch is also provided to check battery charge.

Current Delivery up to 10 mA at More than 100V

Stimulus currents are set using a three-digit control knob and a three-position range switch. Output current tracks control settings to better than 1%. Output current is load independent; voltage sufficient to push the desired current through the load is automatically developed, subject only to compliance limits. Model **A365** produces up to 10 milliampere current, in three ranges, at more than 100 volts compliance.

Bipolar Output Polarity

Output polarity is determined by a push switch on the front panel. Bipolar current is toggled by the command waveform, setting alternating pulses as positive or negative.

References

Lee, E., Hong, J., Park, Y.-G., Chae, S., Kim, Y., & Kim, D. (2015). Left brain cortical activity modulates stress effects on social behavior. **Scientific Reports**, 5, 13342. http://doi.org/10.1038/srep13342

Gindrat, A.-D., Quairiaux, C., Britz, J., Brunet, D., Lanz, F., Michel, C. M., & Rouiller, E. M. (2015). Whole-scalp EEG mapping of somatosensory evoked potentials in macaque monkeys. *Brain Structure & Function*, 220(4), 2121–42. http://doi.org/10.1007/s00429-014-0776-y

Younce, J. R., Albaugh, D. L., & Shih, Y.-Y. I. (2014). Deep Brain Stimulation with Simultaneous fMRI in Rodents. *Journal of Visualized Experiments*, (84), e51271–e51271. http://doi.org/10.3791/51271

Avila, I., & Lin, S.-C. (2014). Motivational Salience Signal in the Basal Forebrain Is Coupled with Faster and More Precise Decision Speed. *PLoS Biology*, 12(3), e1001811. http://doi.org/10.1371/journal.pbio.1001811

Herrera, C., Directores, R., Panetsos, F., Carlos, P., & Trueba, A. (2014). TESIS DOCTORAL Efectos de la estimulación artificial de un nervio periférico seccionado sobre la vía somatosensorial desaferentizada de la rata.

A365 SPECIFICATIONS

OUTPUT WAVEFORM	DC or current pulse
OUTPUT CURRENT RANGES	0.1, 1.0, and 10 mA
CURRENT AMPLITUDE ERROR	0.5% of full scale, max.
CURRENT RESOLUTION	0.1% of full scale, typical
OUTPUT LOAD VOLTAGE EXCURSION (COMPLIANCE)	100 V (typically 144 V)
EXTERNAL COMMAND VOLTAGE	5.0 V at 3.0 mA (TTL level), 10 V max.
TRIGGER THRESHOLD	2.0 V at 0.5 mA
OUTPUT POLARITY	Reversible, manual switch or automatic
CURRENT RISE TIME & DELAY	6 µs, typical (1 KΩ load)
CURRENT FALL TIME & DELAY	10 µs, typical (1 KΩ load)
OUTPUT TO GROUND RESISTANCE	$10^{12}\Omega$
OPTOCOUPLER	2500 V, rated min. breakdown voltage
POWER	
Model **A365D** (Dry Cell)	16 alkaline 9 V batteries, included
Model **A365R** (RECHARGEABLE)	16 rechargeable NiMH 9 V batteries incl.
DIMENSIONS	8.5 x 3.5 x 5 in. (22 x 9 x 12 cm)
SHIPPING WEIGHT	4 lb. (1.8 kg)

ORDERING INFORMATION

SYS-A365D	High Voltage Isolator, Bipolar, alkaline batteries
A365RC	A365R with charger (A362)
SYS-A365R	High Voltage Isolator, Bipolar, rechargeable
SYS-A362	Battery Charger for A320R, A365R, A395R

Specify line voltage

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

DRL	Dummy Load Resistor Kit (set of 3)
13347	BNC-to-Double Banana Adapter

A362 Battery Charger

Required for A320R, A365R, A395R

Recharges the high-voltage nickel-cadmium or NiMH battery stack in the A320R, A365R or A395R. LED lamp indicates charging status. Full charge overnight. Dimensions: 2.8 x 4.1 x 5 in. (7 x 10 x 13 cm). Shipping weight: 4 lb (1.8 kg).

High Current Stimulus Isolator

Constant current stimulus isolator with 100 mA current range

Features

- Constant current to 100 mA
- Unipolar or bipolar stimulation modes
- Built-in non-compliance alarm
- Input is optically isolated
- Standard TTL triggering
- DC test mode
- Powered by six rechargeable lead acid batteries
- 36V compliance
- Output polarity and output "on/off" switches

A385RC CE

Benefits

- 100 mA current capability
- Bipolar mode automatically generates alternating positive and negative pulses from TTL input
- Test mode simplifies performance verification
- Optical isolation enhances safety of the preparation and reduces noise susceptibility
- Battery charge status LEDs keep the experimenter informed of battery status
- Charger included at discounted price when system is purchases as **A385RC**

Applications

- Muscle electrophysiology
- *In vivo/in vitro* muscle stimulation

The **A385** is an optically isolated current source, which can generate up to 100 mA of unipolar or biphasic constant current pulses or DC. Pulse duration is controlled manually or by an external 5V command. Output current amplitude is determined by a 3-digit 10-turn potentiometer. Maximum output voltage between the stimulating electrodes is +36V.

Delivers Positive, Negative or Bipolar Currents

For bipolar delivery, the polarity of the output can be toggled to the opposite polarity state with each successive pulse presented to the input. Pulse duration is controlled by an externally applied voltage. The input connector is a standard BNC, allowing TTL signals from a data acquisition system to be used.

Excellent Accuracy and Repeatability

The output amplitude is controlled by a 3-digit, ten-turn dial as a percentage of the range selected: for example, a setting of 45.6 in the 0-10 mA range translates to 4.56 mA at the output. Accuracy and repeatability are excellent. Designed for subcutaneous stimulation, maximum output voltage at the stimulating electrodes is 36 volts, reducing the possibility of accidental transcutaneous shocks. A compliance/output alarm sounds when the 36V limit is reached. Internal circuitry ensures electrodes are short-circuited during inactive periods ("electrode exhauster" feature). The **A385** is not appropriate for transcutaneous stimulation.

Rechargeable Battery

The 1.2 amp-hour rating of the six heavy-duty lead-acid rechargeable batteries ensures that all day experiments will not be interrupted by dead batteries when charged daily. Indicator lights and audible alarms keep the user constantly apprised of the battery charge status. The batteries are recharged by the **A382** System Charger, which is designed especially for the **A385**, and included with the **A385RC**.

References

Lin, C., Disterhoft, J., & Weiss, C. (2016). Whisker-signaled Eyeblink Classical Conditioning in Head-fixed Mice. *Journal of Visualized Experiments*, (109), e53310–e53310. http://doi.org/10.3791/53310

Li, T., Finch, E. A., Graham, V., Zhang, Z.-S., Ding, J.-D., Burch, J., ... Rosenberg, P. (2012). STIM1-Ca(2+) signaling is required for the hypertrophic growth of skeletal muscle in mice. *Molecular and Cellular Biology*, 32(15), 3009–17. http://doi.org/10.1128

A385 SPECIFICATIONS

OUTPUT WAVEFORM	DC or current pulse
OUTPUT CURRENT RANGES	1, 10, and 100 mA
CURRENT AMPLITUDE ERROR	0.5% of full scale, max.
CURRENT RESOLUTION REPEATABILITY	0.1% of full scale, typical
OUTPUT LOAD VOLTAGE EXCURSION (COMPLIANCE)	36 V (typically 40 V)
EXTERNAL COMMAND VOLTAGE	5 V at 3 mA minimum, 8.5 V max.
EXTERNAL COMMAND VOLTAGE: OUTPUT POLARITY	Reversible, manual switch, monophasic or electronically switched bipolar delivery
EXTERNAL COMMAND VOLTAGE: CURRENT RISE TIME AND DELAY	6 µs, typical (1 KΩ load)
EXTERNAL COMMAND VOLTAGE: CURRENT FALL TIME AND DELAY	10 µs, typical (1 KΩ load)
EXTERNAL COMMAND VOLTAGE: OUTPUT TO GROUND RESISTANCE	10^{12} Ω
EXTERNAL COMMAND VOLTAGE: OPTOCOUPLER	2500 V, rated minimum breakdown voltage
POWER	Six rechargeable lead-acid batteries (Requires companion charger A382)
DIMENSIONS	8.5 x 3.5 x 5 in. (22 x 9 x 12 cm)
SHIPPING WEIGHT	5 lb. (2.3 kg)

ORDERING INFORMATION

A385RC	A385R with A382 Charger
SYS-A385R	High Current Isolator, rechargeable
SYS-A382	Battery Charger for A385 (see below)

Specify line voltage

Smart Battery Charger

Required for A385

An innovative three-step charger, the **A382** employs fast, medium, and trickle charges at a safe, low current, greatly extending battery life. After a fast initial phase, the charger automatically switches to a constant voltage mode. When charging is complete, the charger switches to the trickle-charge mode. LED lamps indicate charging status. *(For use only in charging the lead acid batteries installed in the* **A385***.)*

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Linear Stimulus Isolator

Replicates a programmed waveform of any shape or polarity

Features

- Creates a constant current replica of analog waveforms
- Amplitude of the output current is voltage controlled
- Input voltage from –10V to +10V
- 3 current ranges from 100 µA to 10 mA
- Built-in test resistors
- Digital display shows current being delivered for non-varying currents of adequate duration
- Output offset adjustment
- ±70V compliance range

A395RC

Benefits

- Amplitude of current is voltage controlled
- Built-in test resistances
- Error LEDs illuminate when current is less than commanded by control voltage

Applications

- Neuroscience
- Muscle Physiology

All WPI stimulus isolators are designed to supply constant current, because current threshold (not voltage) is the most quantitatively reproducible parameter for stimulation of nerve and muscle. Model **A395** dispenses current reproducibly from its Output terminals; the amplitude being determined by the selected current RANGE and the input voltage. Current amplitude is "constant", that is, load resistance independent, provided that the I x R (load) product does not exceed the available battery supply voltage. A visual indicator (the compliance LEDs) displays if I x R reaches this limit. When the unit is out of compliance, one of the two LEDs (labeled - and +) illuminate, depending in which direction the current is flowing. Model **A395D** can generate a voltage of 70Vor more across its OUTPUT terminals. You can be sure that the amplitude of the current is as dialed as long as the voltage drop across the load (stimulus electrode path) does not reach the magnitude of the supply voltage. The compliance LEDs will then be visible. Then, you would know that:

- Too much current was dialed for a given load or
- Inter-electrode resistance was too high or the electrode circuit path was open.

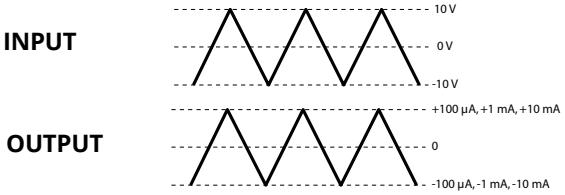
User Defined Output Current of Various Forms

Model **A395** generates a user-defined output current of wave shape; DC, AC, pulse and combinations. Battery operated, photoelectrically-isolated from the input voltage drive, the instrument regenerates output currents which are linearly proportional to the analog voltage waveforms provided by your D/A converter or signal generator (see diagram below).

The **A395** is ideally suited for data acquisition and stimulator generators.

Current Delivery for Selected Ranges

A 10 V input produces the maximum output current for the current range selected. (For example, 100 µA, 1 mA, or 10 mA) Front panel controls allow DC current to be generated. Externally applied signals can be superimposed simultaneously (DC offset). Warning lamps indicate open circuit or excessive current conditions.



Digital Meter Shows DC or Average Output

The digital display meter shows the measures DC current or the average output current. Overload lamps indicate when output voltage has reached positive or negative compliance voltage limit.

References

E.D. Zonnevijille, N.N. Somia, g.Perez Abadia, R.W. Stremel, C.J. Maldonado, P.M.N. Werker, M. Kon, J.H. Barker "Sequential Segmental Neuromuscular Stimulation Reduces Fatigue and Imrproves Perfusion in dynamic Gracilolasty" *Ann Plast Surg* 45. 2000: 292-297

A395 SPECIFICATIONS	
OUTPUT CURRENT, Imax	3 ranges: 100 µA, 1 mA, and 10 mA
OUTPUT VOLTAGE RANGE	±70 V
OUTPUT BANDWIDTH	10 kHz (measured across 1KΩ load R)
INPUT RESISTANCE	>20 mΩ
INPUT VOLTAGE @ Imax	±10 V
INPUT/OUTPUT LINEARITY ERROR	<0.5%
RISE, FALL TIME	26 µs @ 10 KΩ
POWER: Model A395D	17 alkaline 9 V batteries
POWER: Model A395R	17 rechargeable NiMH 9 V batteries
DIMENSIONS	6.5 x 4 x 3.5 in. (16 x 10 x 9 cm)
SHIPPING WEIGHT	4 lb. (1.8 kg)

ORDERING INFORMATION	
A395RC	A395R with Charger (A362)
SYS-A395D	Linear Stimulus Isolator
SYS-A395R	Linear Stimulus Isolator, Rechargeable
SYS-A362	Battery Charger

Specify line voltage

A362 Battery Charger

Required for A320R, A365R, A395R

Recharges the high-voltage nickel-cadmium or NiMH battery stack in the **A320R**, **A365R** or A395R. LED lamp indicates charging status. Full charge overnight.

Dimensions: 2.8 x 4.1 x 5 in. (7 x 10.5 x 12.7 cm).

Shipping weight: 4 lb. (1.8 kg).

SYS-A362

4-Channel Transducer Amplifier

Amplify output voltage signals

Features

- Use with many different types of resistive based transducers
- WPI resistive force transducers plug in directly
- Supports full resistive bridge or single ended operation
- Output offset control
- Four gain ranges from 1–1000 ×
- Provides ±5V "excitation" voltage for resistive bridge transducers

Benefits

- Provided with blank connectors to rewire to any resistive bridge transducer
- Bridge balance LEDs provide visual cue that unloaded transducers are at zero output state
- Low noise amplifier

Applications

- Amplify signals from resistive strain gages and other resistive bridge configured transducers

Transducers available separately

Transbridge (**TBM4M**) is a four-channel analog transducer manifold, specifically designed to amplify output voltage signals from pressure, force, displacement, and temperature transducers as well as a wide variety of other signal sources. Analog output signals are available from each channel for input to a data acquisition system for digital signal processing in a computer. Each channel contains a regulated 10-volt power supply (+5 and -5 volts with respect to signal ground) to provide DC power to transducers, and a precision differential amplifier with selectable voltage amplification and variable position adjustment control.

Transducers can be connected to Transbridge via any of the 8-pin connectors on the front panel. Four spare 8-pin DIN plugs are provided with each instrument to allow you to rewire cables of other manufacturers' transducers and connect them to Transbridge. Each Transbridge channel may be used in either Full Bridge or the Half Bridge mode independently. For transducer types other than resistive bridges, such as active transistor circuits, magnetic, photocell or piezoelectric devices, the instrument's differential amplifiers may still be used effectively for signal amplification in differential (full bridge) and single-ended (half bridge) modes.

ORDERING INFORMATION

SYS-TBM4M	Transbridge Transducer Amplifier
	Specify line voltage

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

13024	Single Rack Mount Kit
13025	Dual Rack Mount Kit
500184	BNC-to-BNC cable, 10 ft
3161	8-pin DIN plug
3718	Package of 4, 8-pin DIN (startup kit)

Battery Operated Impedance Measurement

Measure mV and MΩ impedance of metal or glass microelectrodes

Features

- Battery operated

Benefits

- Determine impedance of electrode during micropipette beveling process for pipette reproducibility

Applications

- Measure impedance of metal or glass capillary microelectrodes

ORDERING INFORMATION

SYS-OMEGAZ	Omega-Tip-Z™ with Probe & Holder

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

711P	Replacement Probe
5468	Adapter to connect metal microelectrodes to probe, 2 mm socket to .031 in. receptacle

Omega-Tip-Z™ was created especially for measuring impedance in etched tungsten, platinum-iridium* and steel microelectrodes, as well as electrolyte-filled micropipettes. The meter's AC impedance-measuring circuit is unaffected by electrode offset or tip junction potentials. The gold-plated miniature probe lets you conveniently monitor micro-electrode impedance in electrolytes, and an electrode tip cleaning feature lets you remove buildup quickly. **Omega-Tip-Z** can also measure DC electrode tip potentials up to 2000 millivolts. The instrument operates for hundreds of hours without battery failure.

*See Metal Microelectrodes, page 94.

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Force Transducers

These rigid-lever force transducers transform applied force into proportional voltage. Using balanced strain gages, **FORT** transducers produce linear output voltage vs. applied force input with very little deflection.

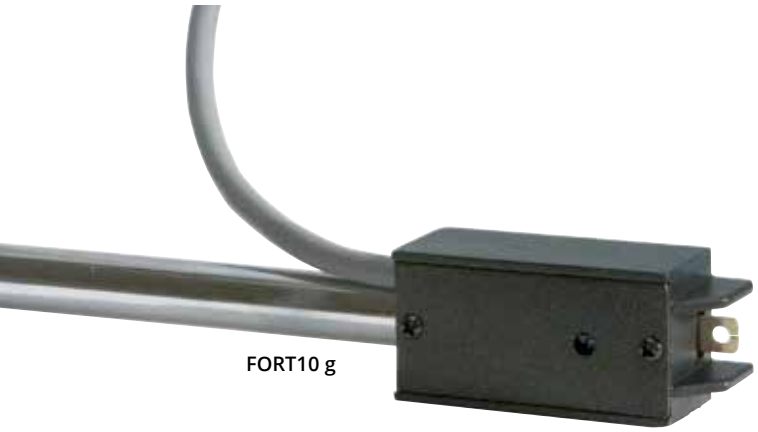
To use, clamp the handle of the **FORT** transducer in a horizontal position and apply the forces to be measured to a rivet or hook mounted in the hole at the end of the flat sensing leaf.

ORDERING INFORMATION

FORT100	Force Transducer (100 g)
FORT250	Force Transducer (250 g)
FORT1000	Force Transducer (1000 g)
FORT5000	Force Transducer (5000 g)

FORT SPECIFICATIONS

	FORT100	FORT250	FORT1000	FORT5000
FORCE RANGES, FULL SCALE	100 g	250 g	1000 g	5000 g
OUTPUT SENSITIVITY (± 10%)	7 µV/V/g	3 µV/V/g	0.84 µV/V/g	0.38 µV/V/g
INPUT & OUTPUT RESISTANCE	350 Ω	350 Ω	350 Ω	350 Ω
RESOLUTION	0.01% of full scale force	0.01% of full scale force	0.01% of full scale force	0.1% of full scale force
RESONANT FREQUENCY	300 Hz	300 Hz	300 Hz	60 Hz
LINEARITY ERROR	Less than 0.1% of full scale	Less than 0.1% of full scale	Less than 0.1% of full scale	Less than 0.1% of full scale
MAX. OPERATING VOLTAGE	10 V AC or DC	10 V AC or DC	10 V AC or DC	10 V AC or DC
MAXIMUM APPLIED FORCE	3× rated full scale force	3× rated full scale force	3× rated full scale force	3× rated full scale force
DRIFT	thermally compensated	thermally compensated	thermally compensated	thermally compensated
DIMENSIONS	0.3 inch diam × 4 in. (7.6 mm diam × 10.2 mm)	0.3 inch diam × 4 in. (7.6 mm diam × 10.2 mm)	0.3 inch diam × 4 in. (7.6 mm diam × 10.2 mm)	0.3 inch diam × 4 in. (7.6 mm diam × 10.2 mm)
WEIGHT (excluding cable)	0.3 oz (8 g)	0.3 oz (8 g)	0.3 oz (8 g)	0.3 oz (8 g)



FORT10 g

10g & 25 Force Transducers

FORT SPECIFICATIONS

	FORT10g	FORT25
FORCE RANGE, FULL SCALE	0-10 g	0-25 g
OUTPUT SENSITIVITY	2.75 mV/g, nominal	3 mV/g, nominal
INPUT & OUTPUT RESISTANCE	4000 Ω	1500 Ω
RESOLUTION	< 1 mg	< 2 mg
RESONANT FREQUENCY	480 Hz	450 Hz
LINEARITY ERROR	<0.2% of full scale	<0.2% of full scale
MAXIMUM OPERATING VOLTAGE	10 V DC (-5V ~ +5V or 0 ~ 10V)	10 V DC (-5V ~ +5V or 0 ~ 10V)
MAXIMUM APPLIED FORCE	2× rated full scale force	3× rated full scale force
DRIFT	<30 mg/hr	<50 mg/hr
DIMENSIONS	46 x 22 x 15 mm Handle 100 mm x 9.8 mm diam	40 x 22 x 17 mm Handle 109 mm x 9.8 mm diam
WEIGHT	135 g	200 g

These 10 g and 25 g force transducers are reliable tools for high precision force measurement. Using balanced semiconductor strain gages, both produce linear output voltage *vs.* applied force input with very little deflection. The rigid lever force transducer transforms the applied force into a proportional voltage. Featuring a temperature-compensated, full-bridge configuration with four high sensitivity semiconductor strain gages, these transducers have broad dynamic measuring range and very high sensitivity.

To use, clamp the handle of the **FORT10** or **FORT25** transducer in a horizontal position and apply the forces to be measured to a rivet or hook mounted in the hole at the end of the flat sensing leaf.

Metal Microelectrodes

Superior microelectrodes for outstanding extracellular recording— tungsten, iridium, platinum-iridium and Elgiloy®

Features

- Available in Tungsten, Platinum/Iridium, Elgiloy and Pure Iridium metal, and are insulated with a thin film of vapor-deposited Parylene-C
- Four different tip profiles also available (Standard, Heat-Treated, Blunt, and Fine tips)
- High corrosion resistance offers consistent long-term performance.

Benefits

- Many standard types available (web) and custom
- Connecting pin fits Amphenol series 220-223 connectors.

Applications

- Type C: Excellent for bipolar stimulation.
- For acute and chronic recording.

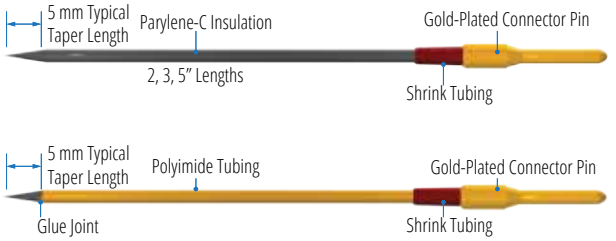
EXPOSED TIP DIMENSIONS (nominal)				
Nominal Impedance	Tungsten	Elgiloy	Platinum Iridium	Pure Iridium
10 kΩ	250 µm	—	—	—
50 kΩ	200 µm	—	—	—
0.1 MΩ	100 µm	120 µm	60 µm	45 µm
0.5 MΩ	55 µm	66 µm	18 µm	14 µm
1.0 MΩ	30 µm	36 µm	10 µm	10 µm
2.0 MΩ	12 µm	15 µm	6 µm	5 µm
5.0 MΩ	5 µm	6 µm	3 µm	2.5 µm

Heat Treated Tip is ideal for penetrating tough membranes (not recommended for chronic implantation). This process is performed using a microforge in which the heating element is positioned in close proximity to the tip in order to melt the Parylene-C distal to the exposed metal. It provides a smooth transition and produces better adherence of the Parylene-C to the metal.

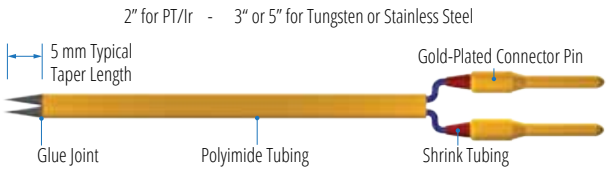
Kapton* tubing, indicated by "KT" in the part number, extends from the connector to within 5 mm of the tip, providing stiffness and additional insulation to the electrode shaft. Kapton-clad electrodes are recommended when the electrode is to be inserted through a cannula for extra deep penetration.

** Parylene is a trade mark of Union Carbide. Kapton is a trade mark of DuPont. Elgiloy is a trade mark of Elgiloy Ltd.*

Monopolar



Bipolar

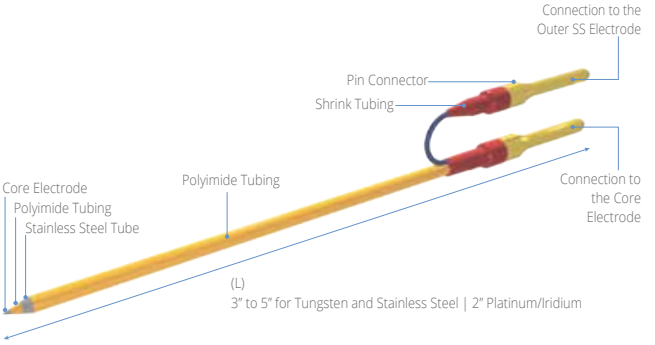


NOTE: Electrode diagrams are not shown to scale.

Concentric Bipolar Electrodes

Excellent for shielded macro recording as well as evoked potentials — especially well suited for bipolar stimulation

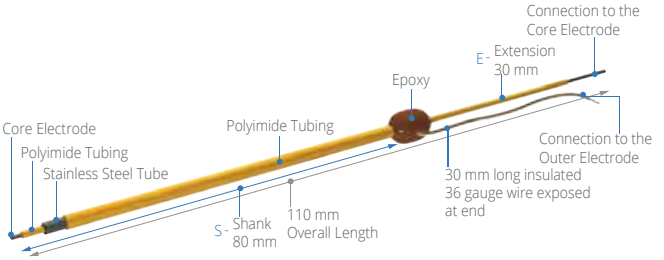
The tungsten, platinum-iridium and elgiloy electrode is sharpened to a point and is 75 µm in diameter. The outer stainless steel conductor is insulated with Polyimide tubing to within 0.2 mm of the end of the stainless steel tube. Also available without the outer Polyimide insulation.



Insulated metal conductor with exposed concentric surface

Concentric Bipolar, Rhodes Style Tips

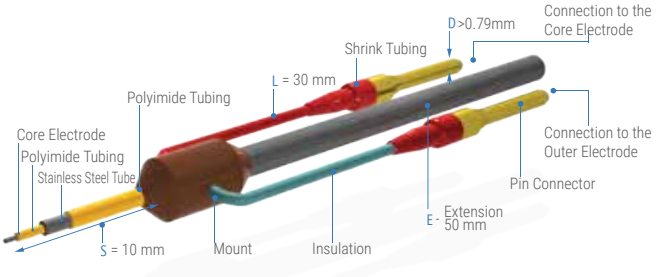
This electrode is designed to replicate the Peter Rhodes-produced semi-micro concentric, and features the same length, thickness and tip dimensions. These probes feature a stepped tip with well-defined element lengths, allowing surface area to be easily determined for charge density calculations. Featuring a shaft diameter considerably thinner than the standard biplar electrodes, this electrode is ideal for localized stimulation or population recording in fixed preparations and acute animal experiments where implant size is a critical concern.



Concentric Bipolar with Extension, Rhodes Style Tips

These Concentric Bipolar Electrodes are designed for Neurological recording and stimulation and are ideal for acute applications (part numbers without the X) or chronic applications (part number ends with X).

The Concentric Bipolar Electrodes, designed for neurological recording and stimulation and are ideal for acute applications. The Stainless Steel external tubing (E) provides support for accurate placement and manipulation during acute research. The extra extension may be cut off after insertion leaving only a small protrusion.



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CONCENTRIC ELECTRODES* ORDERING INFORMATION

Item	Metal Core	Length	Imp	Probe Outer Diameter (total)	Tip Diam.	Core diam.	Y dim.	X dim. w/ polyimide	(pkg. of 5)
TM33CCNON	Tungsten	3" (76 mm)	10-15 KΩ	0.013" uninsulated (325 µm)	3-4 µm	.003" (76 µm)	0.4 mm	.005" (127 µm)	
TM33CCINS	Tungsten	3" (76 mm)	10-15 KΩ	0.016" insulated (400 µm)	3-4 µm	003" (76 µm)	0.4 mm	.005" (127 µm)	
TM53CCINS	Tungsten	5" (127 mm)	10-15 KΩ	0.018" insulated (450 µm)	3-4 µm	005" (127 µm)	0.4 mm	.008" (203 µm)	
PTM3CC02INS	Pt/Ir NS fine	3" (76 mm)	200 KΩ	0.013" insulated (325 µm)	2-4 µm	0.002" (50.8 µm)	.25 mm	.004" (114 µm)	

**All have a stainless steel outer shaft*

METAL ELECTRODES ORDERING INFORMATION

Item	Length	Insul. Thick	Shaft Diam.	Nominal Impedance (± 20%)	Tip Diam.	Typical Use
Tungsten — Profile A						**Package of 10**
TM31A10	76 mm	1 µm	0.127 mm	1.0 MΩ	1 µm	Multi unit and single unit recording
TM31A20	76 mm	1 µm	0.127 mm	2.0 MΩ	1 µm	Multi unit and single unit recording
TM33A05	76 mm	3 µm	0.127 mm	0.5 MΩ	1 µm	Multi unit and single unit recording
TM33A10	76 mm	3 µm	0.127 mm	1.0 MΩ	1 µm	Multi unit and single unit recording
TM33A20	76 mm	3 µm	0.127 mm	2.0 MΩ	1 µm	Multi unit and single unit recording
TM33B01	76 mm	3 µm	0.254 mm	0.1 MΩ	1-2 µm	Single and multi unit recording
TM33B05	76 mm	3 µm	0.254 mm	0.5 MΩ	1-2 µm	Single and multi unit recording
TM33B10	76 mm	3 µm	0.254 mm	1.0 MΩ	1-2 µm	Single and multi unit recording
TM33B20	76 mm	3 µm	0.254 mm	2.0 MΩ	1-2 µm	Single and multi unit recording
TM33C10	76 mm	1 µm	0.085 mm	1.0 MΩ	1 µm	Single and multi unit recording
Tungsten — Profile C						**Package of 10**
TM33A10KT	76 mm	3 µm	0.216 mm	1.0 MΩ	1 µm	Multi unit and single unit recording
TM33B01KT	76 mm	3 µm	0.356 mm	0.1 MΩ	1-2 µm	Single and multi unit recording
Elgiloy®/Stainless — Profile A						**Package of 10**
SSM33A70	76 mm	3 µm	0.229 mm	7.0 MΩ	1-2 µm	Recording and Stimulating (Prussian blue staining)
SSM33A20KT	76 mm	3 µm	0.356 mm	2.0 MΩ	1-2 µm	Recording and Stimulating (Prussian blue staining)
Tungsten — Profile B						**Package of 10**
TST33A001KT	76 mm	3 µm	0.356 mm	10 kΩ	1 µm	Tissue slice stimulation
TST33A05KT	76 mm	3 µm	0.356 mm	0.5 MΩ	1 µm	Stereotrode / Bipolar, differential measurements
TST33A10KT	76 mm	3 µm	0.356 mm	1.0 MΩ	1 µm	Stereotrode / Bipolar, differential measurements
TST33A20KT	76 mm	3 µm	0.356 mm	2.0 MΩ	1 µm	Stereotrode / Bipolar, differential measurements
TST33C05KT	76 mm	3 µm	0.216 mm	0.5 MΩ	1 µm	Stereotrode / Bipolar, diff. meas. — extra fine (75 µm separation)
TST53A10KT	127 mm	3 µm	0.356 mm	1.0 MΩ	1-2 µm	Stereotrode / Bipolar, differential measurements
Pure Iridium — Profile A						**Package of 10**
IRM23E10	50 mm	3 µm	0.106 mm	1.0 MΩ	1-2 µm	Single and multiunit recording and stimulation
IRM23E15	50 mm	3 µm	0.106 mm	1.5 MΩ	1-2 µm	Single and multiunit recording and stimulation
IRM23E25	50 mm	3 µm	0.106 mm	2.5 MΩ	1-2 µm	Greater selectivity - small cells
IRM23E30	50 mm	3 µm	0.106 mm	3.0 MΩ	1-2 µm	Greater selectivity - small cells
Pure Iridium — Profile B						**Package of 10**
IRM23E20KT	50 mm	3 µm	0.180 mm	2.0 MΩ	1-2 µm	Greater selectivity & microstimulation
IRM23E30KT	50 mm	3 µm	0.180 mm	3.0 MΩ	1-2 µm	Greater selectivity - small cells

*Elgiloy Steel *Cobalt/chromium/nickel alloy. The KT suffix refers to Kapton™ cladding.*

All Metal Microelectrodes are available in custom lengths, blunt or heat treated (extra charge).

Assorted kits may be customized.

Ordering:

Add the **B** suffix where blunt electrodes are desired. (For example, an IRM123A10KT ordered as a blunt will be IRM123A10KTB.)

Add the **H** suffix where heat treated electrodes are desired. (For example, an IRM123A10KT ordered with heat treatment will be IRM123A10KTH.)

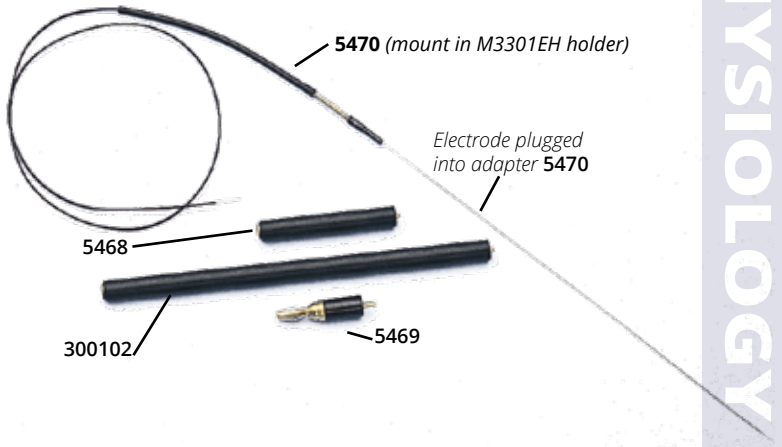
ORDERING INFORMATION

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

300102	Micromanipulator holder, 4 in., 2mm to 0.031 socket
5468	2 mm receptacle to 0.031-inch jack (for Omega-TipZ)
5469	Adapts mini banana plug (DAM80) to 0.031-inch receptacle (metal microelectrode)
5470	0.031-inch jack, 28 ga. wire, 12 inch (pkg. of 4)
5482*	Pins, 0.031-inch, gold-plated (pkg. of 50)
5483*	Sockets, 0.031-inch gold-plated (pkg. of 50)

***Gold-plated pins (#5482) and sockets (#5483) may be attached to 24-, 26-, or 28-gauge wire.*

Gold-plated pins (5482) and sockets (5483) may be attached to 24-, 26-, or 28-gauge wire.

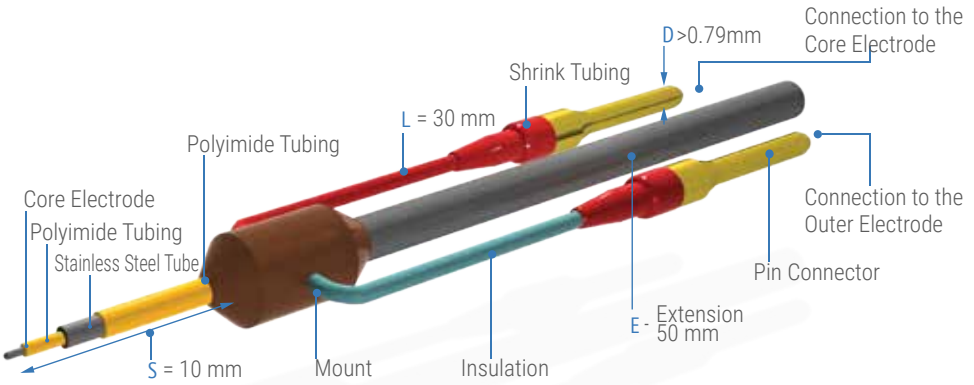


Metal Electrodes,Rhodes Style Tips with Extension

Concentric bipolar electrodes for neurological recording and stimulation

Features

- Rhodes-style tips are great for those that require a precisely controlled electrode surface area
- The stainless steel external tubing provides support for accurate placement and manipulation during acute research
- These are an excellent replacement for long-term Rhodes electrodes (originally made by Peter Rhodes)



Benefits

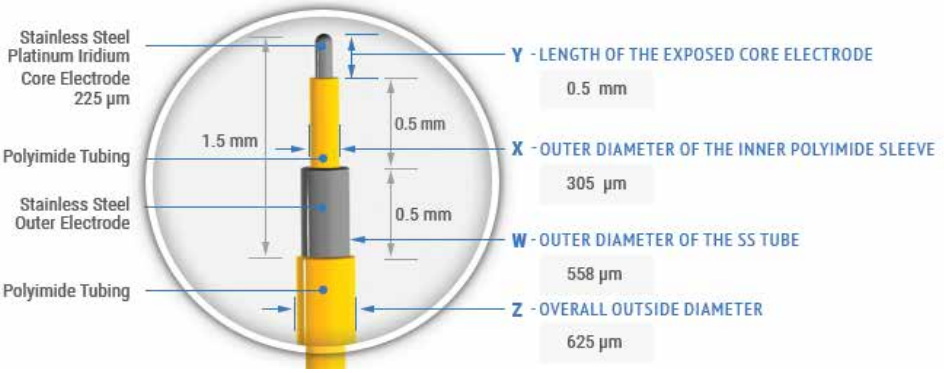
- Concentric bipolar electrodes are ideal for bipolar stimulation paradigms
- Tools are available for shielded macro recordings, as well as evoked potential
- Electrodes may be acutely reused many times (> 20-30 insertions), if they are properly cared for:
  - Avoid bending the shaft and blunting/hooking the tip
  - Clean electrode carefully between session

Applications

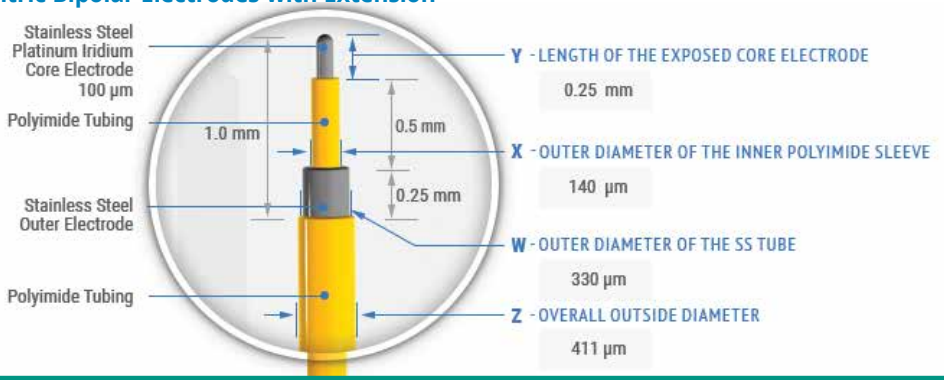
- Designed for neurological recording and stimulation and are ideal for chronic applications

The Concentric Bipolar Electrodes, designed for Neurological recording and stimulation, are ideal for acute applications (without the X) or chronic applications (ends with X). The stainless steel external tubing (E) provides support for accurate placement and manipulation during acute research. The extra extension may be cut off after insertion leaving only a small protrusion.

Concentric Bipolar Electrodes with Extension



Semi-Micro Concentric Bipolar Electrodes with Extension



ORDERING INFORMATION

Item	Type	Metal Core	Length (s)	Probe Total OD (z)	OD Inner sleeve (x)	Extension (E)
SSM04RC100	Semi micro concentric with extension	Stainless Steel	0.4" (10 mm)	Insulated (411 µm)	140 µm	50 mm
PTM04RC100	Semi micro concentric with extension	Platinum Iridium	0.4" (10 mm)	Insulated (411 µm)	140 µm	50 mm
SSM041RC225	Concentric bipolar with extension	Stainless steel	0.4" (10 mm)	insulated (625 µm)	305 µm	50 mm
PTM041RC225	Concentric bipolar with extension	Platinum iridium	0.4" (10 mm)	insulated (625 µm)	305 µm	50 mm

**All have a stainless steel outer shaft. Package of 5.*

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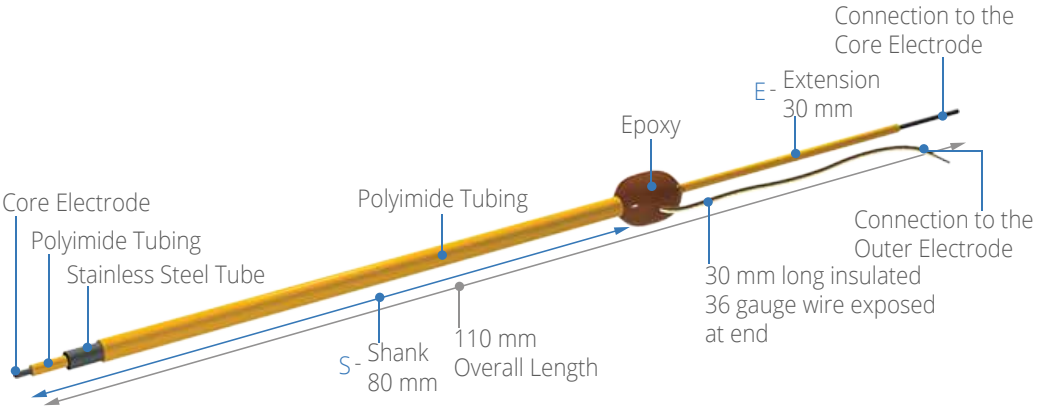
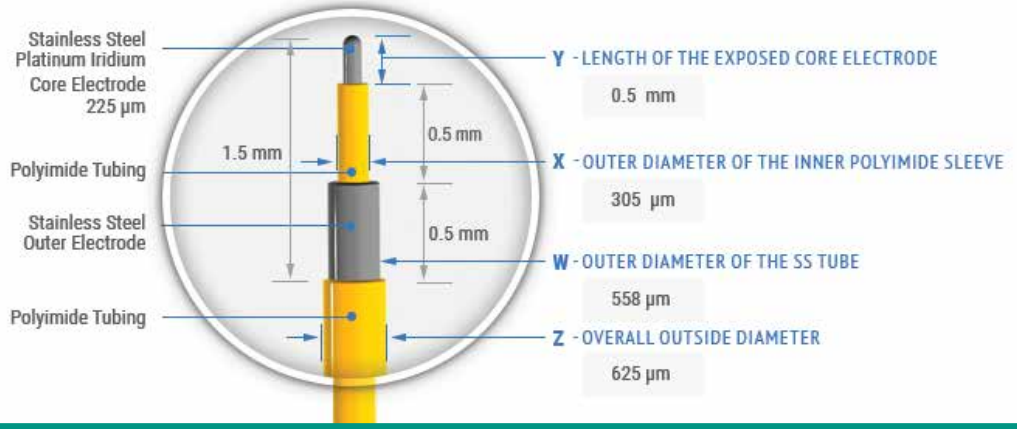
Metal Electrodes,Rhodes Style Tips, No Extension

Concentric bipolar electrodes for neurological recording and stimulation



Concentric Bipolar Electrodes

Choose stainless steel or platinum iridium.

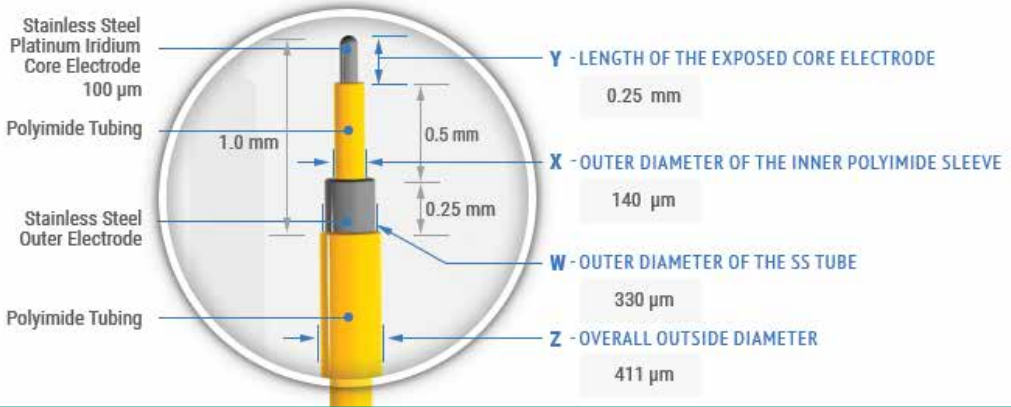


ORDERING INFORMATION

Item	Metal Core	Length (s)	Probe Total OD (z)	OD of Inner Sleeve (x)	Outer Polyimide	Extension (E)
SSM321RC225	Stainless steel	3.125" (80 mm)	insulated (625 µm)	225 µm	Yes	30 mm
PTM321RC225	Platinum iridium	3.125" (80 mm)	insulated (625 µm)	225 µm	Yes	30 mm

Semi-Micro Concentric Bipolar Electrodes

Choose stainless steel or platinum iridium.



ORDERING INFORMATION

Item	Metal Core	Length (s)	Probe Total OD (z)	OD of inner sleeve (x)	Outer Polyimide	Extension (E)
SSM321RC100	Semi micro concentric	Stainless steel	3.125" (80 mm)	insulated (411 µm)	140 µm	30 mm
PTM321RC100	Semi micro concentric	Platinum iridium	3.125" (80 mm)	insulated (411 µm)	140 µm	30 mm

**All have a stainless steel outer shaft.*

Nerve Cuff Electrodes

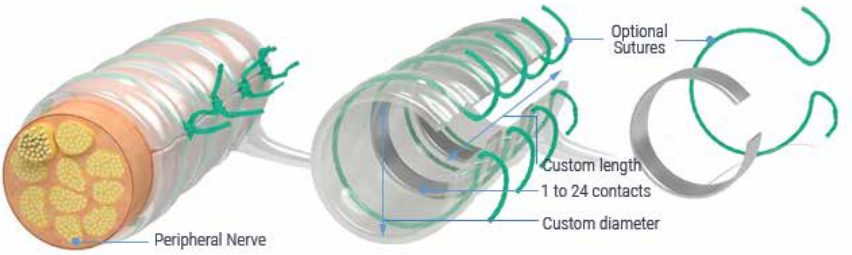
For acute/chronic experiments

Features

- For both acute and chronic experiments
- 1-24 electrode sites
- Broad range of available inner diameters, from 5 mm down to as small as 56 µm
- Platinum, stainless steel and platinum/iridium metal electrodes

Benefits

- Customizable electrode arrangements, including concentric and tri-bipolar
- Adaptable to interface with the acquisition system of your choice



Applications

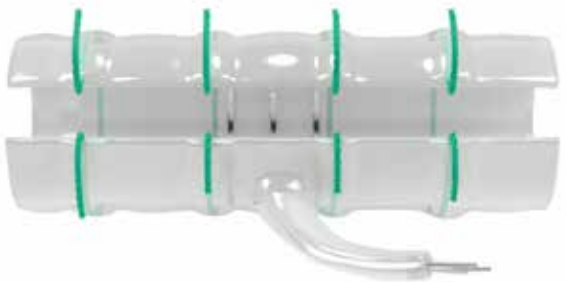
- Suitable for rodent, feline, bird and primate research

Nerve cuff electrodes are designed for reliable recording and/or stimulation of any peripheral nerve. They can be used acutely or for chronic implantation, with a wide selection of inner diameters available to be selected based on the nerve diameter. The nerve cuffs are designed to provide flexibility in electrode contact location for recording and stimulation protocols. Three different electrode variations are available:

- Standard, Micro Cuff and Nanocuff
- Concentric Nerve Cuff
- X-wide Nerve Cuffs

1. Standard, Micro Cuff and Nano Cuff

Many custom combinations of inner diameters and contact arrangements are available. Standard nerve cuffs have a variety of configurable parameters.



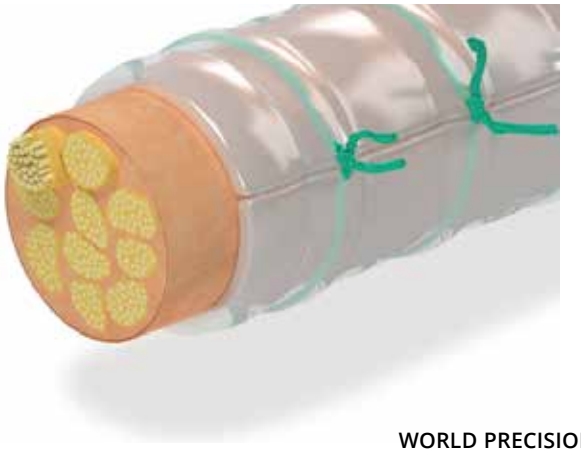
2. Concentric Nerve Cuff

Concentric electrodes have multiple contacts around a single point of the nerve, allowing recording or stimulation at different locations around the same point.

AVAILABLE OPTIONS

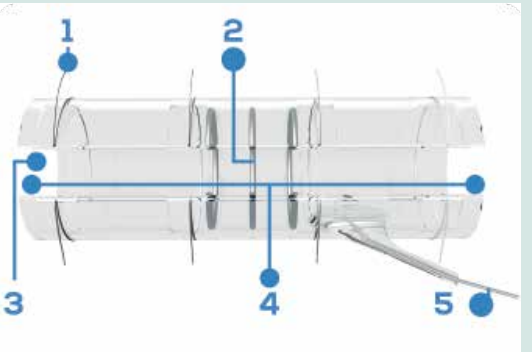
Configuration	Metal Type	ID
Standard	125µm stranded Stainless Steel	1.0 – 5.0 mm
	100µm Platinum	1.0 – 2.0 mm
	250µm Platinum*	2.0 – 5.0 mm
Micro Cuff	100µm Platinum	0.5 – 0.75 mm
	50µm Platinum/Iridium	0.3 mm
Nano Cuff	25µm Platinum/Iridium	160 - 250 µm
	12.5µm Platinum/Iridium	56 - 140 µm

** Recommended for stimulation*



Configuration Options for Standard, Micro Cuff, Nano Cuff & Concentric Nerve Cuffs

Many custom combinations of inner diameters and contact arrangements are available for standard, micro and nano nerve cuffs.



1 Optional Sutures
2 1 to 24 Contacts (Platinum, Platinum/Iridium or Stainless Steel)
3 Custom diameter
4 Custom length
5 Stranded stainless steel leads. The angle is selectable.

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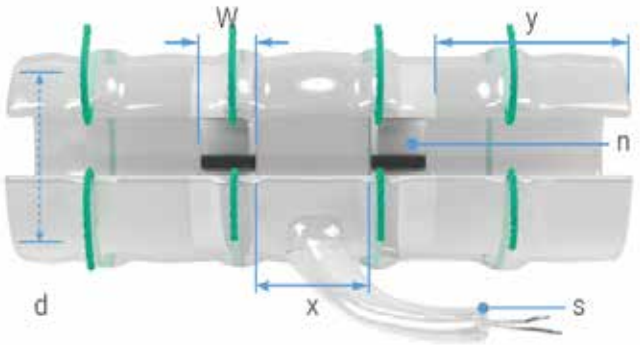
3. X-Wide Contact Nerve Cuffs



d Inner diameter
x Spacing between contacts
n Number of contacts
y Distance from the last contacts to the edge of the cuff
s Stranded stainless steel leads with Teflon insulation 300 mm long (typical)
w Width of the contact, Pt/Ir 90/10

- Extra large platinum ribbon contacts maximize electrode surface area while maintaining the reliability and customizability
- Ideal for any electrical stimulation studies, especially those using KHz stimulation to block activity of peripheral nerves
- Lower thresholds and increased safety margins provide you with new freedom to develop even more effective stimulation paradigms
- The same reliability enhancement features as our standard cuffs, including reinforced bonds and specially-designed helical leads, providing exceptional implanted longevity
- Fully-customizable specifications, including contact spacing, cuff length and lead features, with a wide range of available inner diameters from over 6 mm down to 300 µm.
- Configurable for both acute and chronic use
- Connector options for any available stimulation or recording system

The key utility for these cuffs is provided by the very large contact surface area, which is ideal for studies with high current levels and when using kilohertz electrical stimulation to achieve block of activity in peripheral nerves. The reduced impedances ensure that the output of stimulation sources is not attenuated, that no destructive charge builds up, and that true block of nerve activity is achieved.

Types of Nerve Cuff Electrodes

Application	Electrode Type	d (mm)	x (mm)	y (mm)	W (mm)
Sciatic	Rat, 1.4 mm avg. nerve OD, 2.5 mm cuff ID	2.5	1	1.5	0.5
Tibial	Rat, 1.2 mm avg. nerve OD, 1.5 mm cuff ID	1.5	1	1.5	0.5
Cervical Vagus	Rat, 0.5 mm avg. nerve OD, 0.75 mm cuff ID	0.75	1	1.5	0.5
Subdiaphragmatic Vagus	Rat, 0.3 mm avg. nerve OD, 0.5 mm cuff ID	0.5	1	1.5	0.5
Custom Standard		1.0–5.0			
Custom Microcuff		0.5 or 0.75			

Sterilization

Nerve cuffs are made entirely of autoclavable materials — silicone rubber, Teflon and stainless steel. They can be steam autoclaved without special precautions. If gas sterilization (EtO) is preferred, pack the nerve cuffs in a gas-permeable bag and allow adequate outgassing time (at least 48 hrs.) to be sure all toxic gases have been desorbed from the silicone rubber.

Order online at
www.wpiinc.com/nce

Nerve Cuff Connectors

Omnetic connectors may be ordered separately. Other connectors must be ordered with nerve cuff electrodes. Connector options include:


Banana Terminal


Touch Proof Connector


Invivo1

- No connector
- Invivo1 (not sold separately)
- Banana Terminal (not sold separately)
- Touch Proof Connector (not sold separately)
- Omnetic Connectors

Male Implant Connector	Description
	**MP-A11365-001** Male Omnetics connector - 8 channel, 10-pin 0.050" pitch
	**MP-A12623-001** Male Omnetics connector- 8 channel, 10-pin, 0.050" pitch with latching mechanism
	**MP-A8393-001** Male Omnetics connector- 8 channel, 10-pin, 0.025" pitch, 2 guide post
	**MP-A79000-001 (NPS-09-DD-GS)** Male Omnetics connector- 7 channel, 9-pin, 0.050" pitch
	**MP-A79014-001 (NPD-18-DD-GS)** Male Omnetics connector- 16 channel, 18-pin, 0.025" pitch, 6 guides posts
	**MP-A70242-001** Male Omnetics connector- 16 channel, 18-pin, 0.025" pitch, 6 guides posts; Nickel free, MRI compatible
	**MP-A79038-001 (NPD-18-DDGS)** Male Omnetics connector- 16 channel, 18-pin, 0.025" pitch, 2 guide posts
	**MP-A79022-001 (NPD-36-DD-GS)** Male Omnetics connector -32 channel, 36-pin, 0.025" pitch, 4 guide posts
	**MP-A72312-001** Male Omnetics connector -32 channel, 36-pin, 0.025" pitch, 4 guide posts; Nickel free, MRI compatible

References

Guillem, K., & Ahmed, S. H. (2017). Preference for Cocaine is Represented in the Orbitofrontal Cortex by an Increased Proportion of Cocaine Use-Coding Neurons. Cerebral Cortex, 28(3), 819–832. http://doi.org/10.1093/cercor/bhw398

Uy, J., Yu, M., Jiang, X., Jones, C., Shen, B., Wang, J., ... Tai, C. (2017). Glutamatergic Mechanisms Involved in Bladder Overactivity and Pudendal Neuromodulation in Cats. The Journal of Pharmacology and Experimental Therapeutics, 362(1), 53–58. http://doi.org/10.1124/jpet.117.240895

Khurram, A., Ross, S. E., Sperry, Z. J., Ouyang, A., Stephan, C., Jiman, A. A., & Bruns, T. M. (2017). Chronic monitoring of lower urinary tract activity via a sacral dorsal root ganglia interface. Journal of Neural Engineering, 14(3), 036027. http://doi.org/10.1088/1741-2552/aa6801

Restaino, S. M., Abliz, E., Wachrathit, K., Krauthamer, V., & Shah, S. B. (2014). Biomechanical and functional variation in rat sciatic nerve following cuff electrode implantation. Journal of NeuroEngineering and Rehabilitation, 11(1), 73. http://doi.org/10.1186/1743-0003-11-73

Lissandrello, C. A., Gillis, W. F., Shen, J., Pearre, B. W., Vitale, F., Pasquali, M., ... Gardner, T. J. (2017). A micro-scale printable nanoclip for electrical stimulation and recording in small nerves. Journal of Neural Engineering, 14(3), 036006. http://doi.org/10.1088/1741-2552/aa5a5b

Cables & Connectors

For wiring any laboratory setup

BNC Cables
2851 *(6 ft)*
500184 *(10 ft)*
500257 *(6 in.)*
500258 *(12 in.)*
500259 *(18 in.)*

3142

3161

3294

3417-10

3491

3492

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3670

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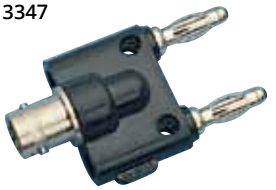

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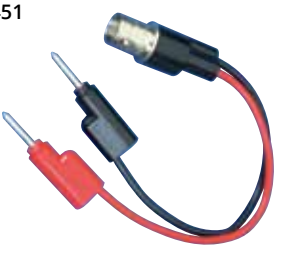

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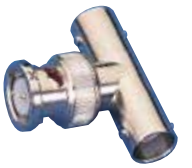

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ORDERING INFORMATION

Part #	Application/Description	Connector A	Connector B	Cable Length
2026-10	2 mm Socket, unwired (pkg. of 10) (Not Shown)	2 mm socket	unwired	none
2851	Standard BNC Cable	BNC (male)	BNC (male)	6 ft. (1.8 m)
3142	Mini-Banana Adapter	Screw Terminals	Dual Mini-Banana	none
3161	Connector for input to TBM4M and BP-1	DIN (male)	unwired	none
3294	Ground Wire for DAM80 probe	Clip	none	3 ft. (0.9 m)
3417-10	2 mm Plug, unwired (pkg. of 10)	2 mm pin	unwired	none
3491	Extension for any 8-pin DIN	DIN (male)	DIN (female)	5 ft. (1.5 m)
3492	Connector, adapts WPI transducers to non-WPI equipment	DIN (female)	unwired	none
3517	DAM50, DAM60, DAM70, shielded (two cables/pkg)	Modular phone plug, 4 wire	none	3 ft. (0.9 m)
3578	Adapter cable for Ag/AgCl pellets	2 mm pin	none	5 ft. (1.5 m)
3670	Double banana plug with solder turret terminals	Dual Banana (male)	Dual Banana (female)	none
5371	Low-noise cable for microelectrode holders	2 mm gold pin/jack	2 mm gold pin/jack	2 ft. (0.6 m)
5373	Low-noise cable for microelectrode holders	2 mm gold pin/jack	2 mm gold pin/jack	2 ft. (0.6 m)
5374	Low-noise cable for microelectrode holders	BNC (male)	2 mm gold pin	4 ft. (1.2 m)
5375	Low-noise cable for microelectrode holders	BNC (male)	2 mm gold jack	4 ft. (1.2 m)
5385	Cable, shielded transducer stock	none	none	25 ft. (7.6 m)
13324	Adapter	Double-banana (female)	BNC (male)	none
13347	ISO2 (chart recorder adapter)	Double-banana (male)	BNC (female)	none
13388	Electrode adapter for DAM probes	Miniature banana (male)	2 mm jack	none
13451	Adapter: Iso-DAM, Iso-DAM8	BNC (female)	two 2 mm pins	6 in. (15 cm)
13620	Low-noise cable for microelectrode holders	2 mm gold pin	2 mm gold jack	2 ft. (0.6 m)
13685	SP Series pump-to-pump linking cable	Modular phone plug	Modular phone plug	7 ft. (2.1 m)
13776	Adapts reference electrode to VF4 ground jack	Banana (male)	2 mm jack	none
13854	BNC T-connector, male to:	BNC (female)	BNC (female)	none
14254	BNC Straight Adapter	BNC (female)	BNC (female)	none
15623	Serial cable and adapter, SP Series pump	SP Pump	IBM 9-pin "D" connector	5 ft. (1.5 m)
15975	Adapter	2 mm socket	1 mm pin	none
15976	Adapter	1 mm socket	2 mm pin	none
300040	Adapter Extension	2 mm socket	2 mm socket	4 in. (10 cm)
500184	Standard BNC Cable	BNC (male)	BNC (male)	10 ft. (3 m)
500256	BNC Right Angle Adapter	BNC (male)	BNC (female)	none
500257	Standard BNC Cable	BNC (male)	BNC (male)	6 in. (15 cm)
500258	Standard BNC Cable	BNC (male)	BNC (male)	12 in. (30 cm)
500259	Standard BNC Cable	BNC (male)	BNC (male)	18 in. (46 cm)
503301	Cable, Extension	8-pin miniDIN (male)	8-pin miniDIN (female)	10 ft. (3 m)
503536	Cable, USB	USB (male)	USB (female)	10 ft. (3 m)
504713	Cable (red and black pair)	Banana (male)	Banana (male)	36 in. (91 cm)
504714	Cable (red and black pair)	Banana (male)	Mini-Gator	36 in. (91 cm)
504715	Cable (red and black pair)	Banana (male)	Mini-Clip	36 in. (91 cm)
504716	Cable (red and black pair)	Banana (male)	Micro-Clip	36 in. (91 cm)
CBL100	MiniPhone Patch Cable	3.5 mm MiniPhone plug	3.5 mm MiniPhone plug	6 ft. (1.8 m)
CBL102	DAM Series, PM Series	3.5 mm MiniPhone plug	BNC (male)	6 ft. (1.8 m)


504716


504713


CBL100


CBL102


503536


504715


504714

Micropipette Holders & Half-Cells

Couple fluid filled glass micropipettes to high input impedance amplifiers

Features

- Connector pin, jack, luer ports, Ag/AgCl half-cells, wire selections available
- Optional handles (for some varieties) allow for easy manipulation. Handles are sold separately.
- Screw cap for tight fitting of glass electrode to avoid drifting of electrode

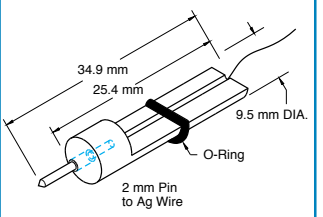
Benefits

- Available for 1.0, 1.2, 1.5 and 2.0 mm OD glass electrodes
- Spare gaskets available
- Optional handles available in two different sizes for some holders

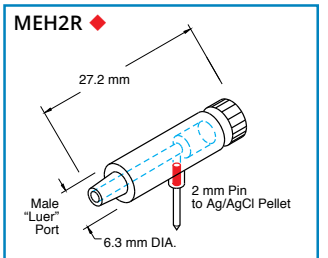
Applications

- Microinjection
- Electrophysiology recording
- Fluid handling

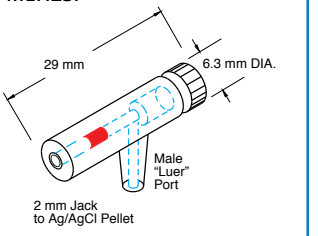
EHB1



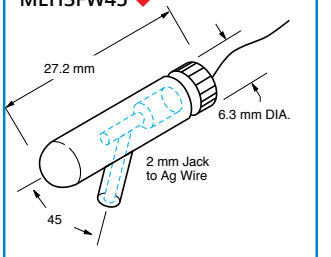
MEH2R ◆



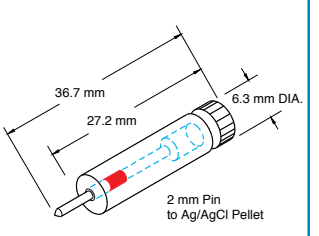
MEH2SF



MEH3FW45 ◆



MEH3S



◆ *denotes holder manufactured for you as custom orders. Call for price.*

The most popular micropipette holders are stock items. Custom holders (designated by ◆) can be manufactured on demand but require an additional setup fee. Call for a quote. See all the options at www.wpiinc.com/MEH.

WPI's microelectrode holder-half-cells couple fluid-filled glass micropipettes to high input impedance amplifiers. A Ag/AgCl pellet (or a silver wire) molded into the holder body provides stable potential. Electrical connection is made via male 2 mm pins or female 2 mm sockets. The pipette may be mounted axially or at right angles to the holder. Pipettes are held with screw-caps or rubber gaskets (without caps). Filling WPI microelectrode holders with electrolytes containing chloride results in stable electrode potential. Suitable electrolytes include KCl, NaCl and $CaCl_2$. Holders are supplied for standard WPI single capillary tubing of 1.0, 1.2, 1.5 and 2.0 mm outside diameters. (Call WPI regarding custom designs for other glass diameters.) The holder style you select will depend on your experimental application, space, and instrumentation.

Hints for selecting and ordering micropipette holders

1. Determine the required electrical connection on the holder: for example, if you wish to connect the holder to a 2 mm pin you should select a holder equipped with a 2 mm jack. Most WPI probes require a holder equipped with a 2 mm jack.
2. Decide on the required alignment of the electrical connection: either in-line with the glass pipette, or at a right angle to it. Space considerations in your experimental setup and requirements imposed by other pieces of equipment typically determine which alignment is appropriate.
3. Determine if you want to hold the glass pipette by a rubber gasket (*e.g.*, **MEH1S**) or a screw-cap (*e.g.*, **MEH3S**). Rubber gaskets offer easier insertion and removal of glass pipettes whereas screw-caps provide more secure mounts for micropipetters.
4. Choose a holder with either a silver wire or a silver/silver chloride pellet for the metal/liquid coupling. Silver/silver chloride pellets provide a more stable low-noise baseline which is important for low-noise DC recording. Pellets require the glass pipette and holder to be free of air bubbles to achieve a good connection. Silver wire holders are durable and are easier to use when the holder is equipped with a pressure port because the fluid in the pipette does not have to be filled to the top of the pipette to achieve a good electrical connection
5. Choose a holder equipped with a pressure port only when you want to pressure inject liquid from the pipette. Two types of ports are available: 2.0 mm O.D. and standard "syringe-style" Luer. The Luer port is often recommended because it makes assembly and disassembly much easier. Quick-connect Luer fittings for four common sizes of tubing ($1/16$", $3/32$", $1/8$", $5/32$" I.D.) are included with each Luer-equipped holder.
6. Some non-WPI preamplifiers or headstages cannot be mounted on micromanipulators. In such cases, a holder equipped with a rod (*e.g.*, MEH8) permits the holder to be conveniently mounted on a micromanipulator.
7. Finally, remember to specify the O.D. of the glass you will be using when you place your order.

MEH6RF/SF is designed primarily for use with the Model 900A Micropressure System; **EHB1** for use in electrode beveling; and **MEH3SW** for microtitration of chloride with a silver wire as the electrode and a solution of silver nitrate filling the holder. **MPH** models do not contain Ag/AgCl half-cells and are used for pressure injection of substances through microelectrodes. **PicoNozzle**, used for pressure injection with PV800 Series PicoPumps, includes an **MPH6S** holder — which may also be used to couple a micropipette to a syringe.

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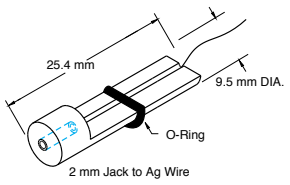
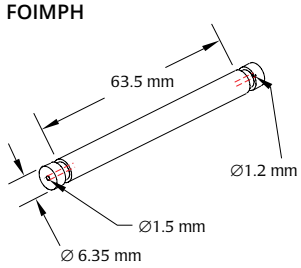
◆ *denotes holder manufactured for you as custom orders. Call for price.*

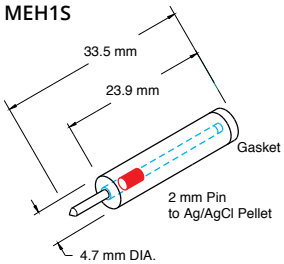
EHBF



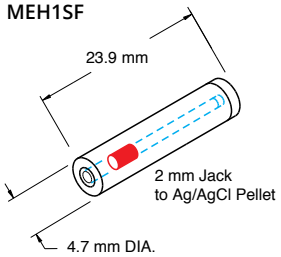
FOIMPH



MEH1S



MEH1SF



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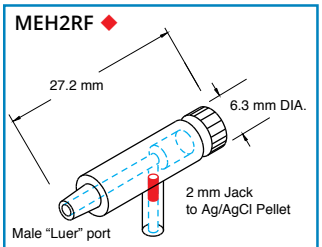
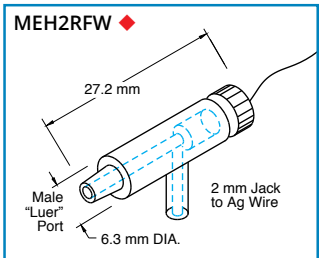


MEH2RFW ◆



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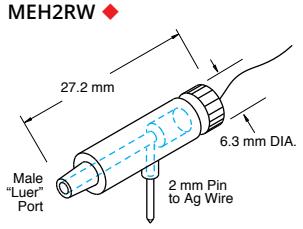

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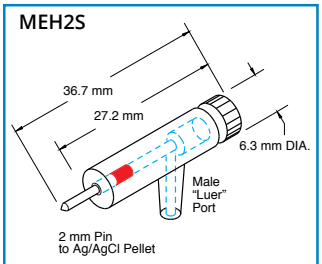

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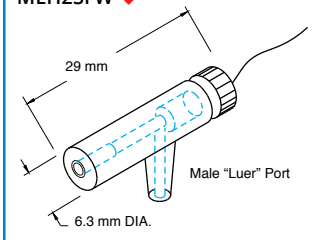

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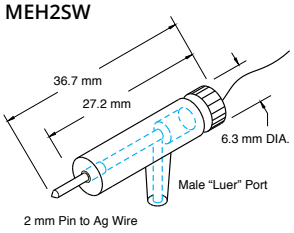
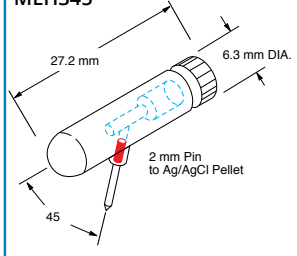
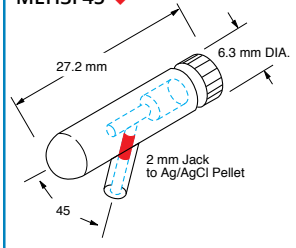


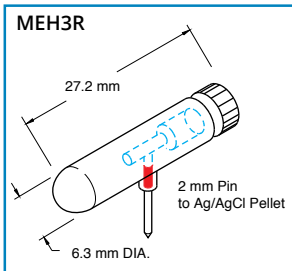
MEH345



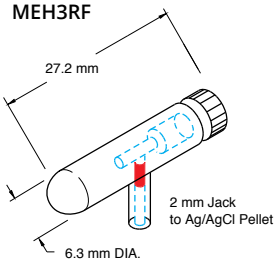
MEH3F45 ◆



MEH3R



MEH3RF



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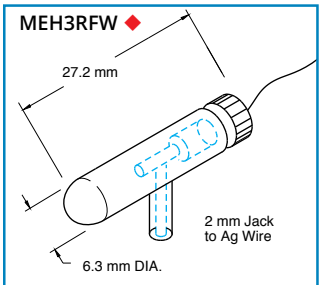
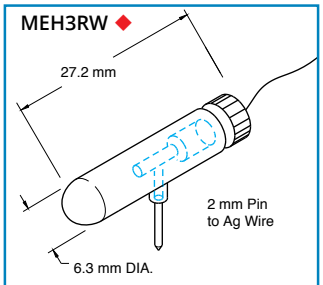


MEH3RW ◆



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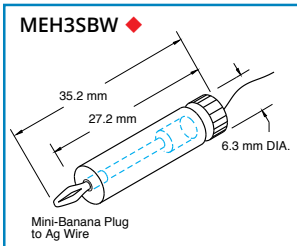
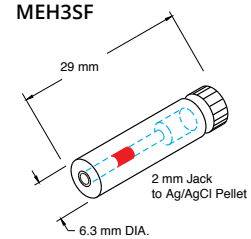


MEH3SF



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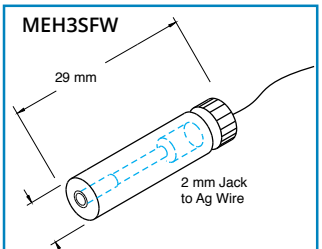
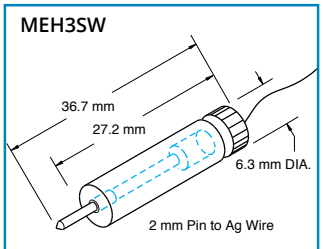


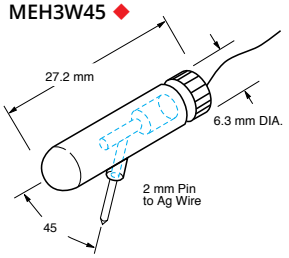
MEH3SW



Micropipette Holders & Half-Cells

Couple fluid filled glass micropipettes to high input impedance amplifiers

MEH3W45 ◆



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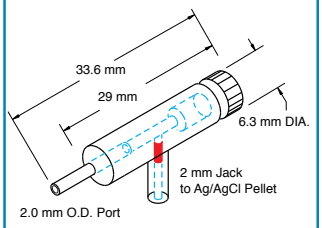
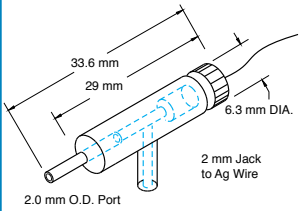


MEH6RFW ◆



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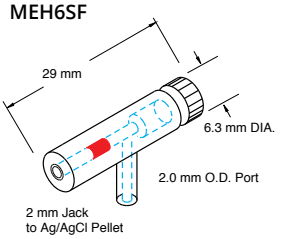

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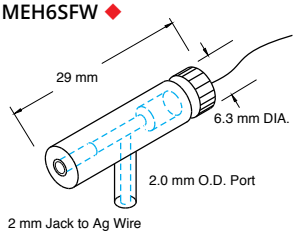
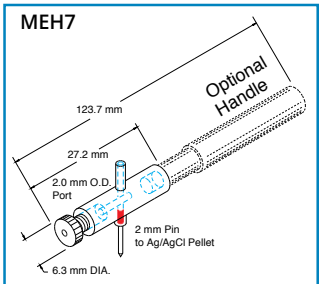
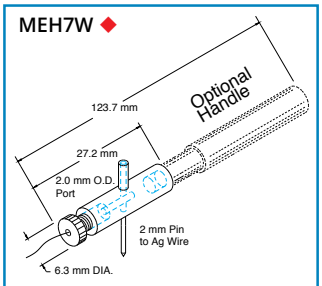


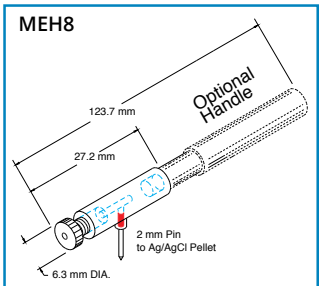
MEH7



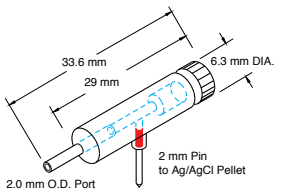
MEH7W ◆



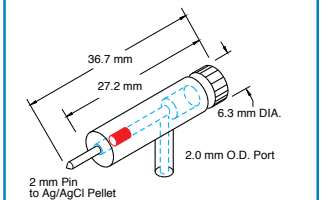
MEH8



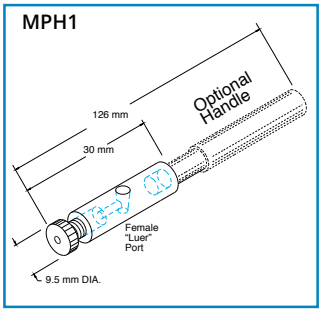
MEH900R



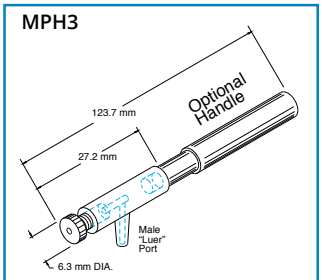
MEH900S



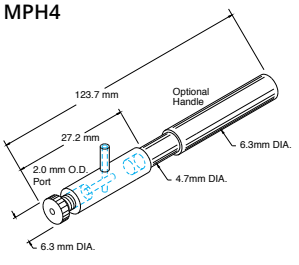
MPH1



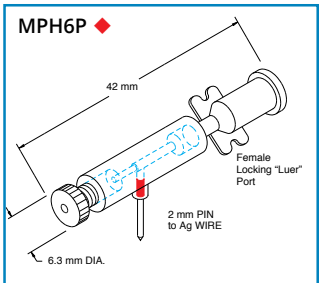
MPH3



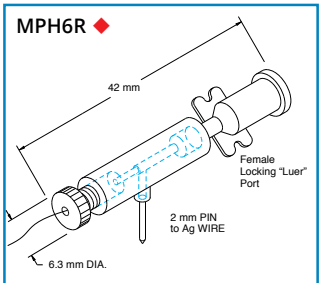
MPH4



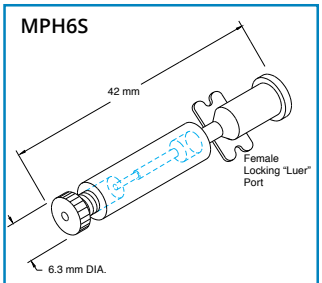
MPH6P ◆



MPH6R ◆



MPH6S



◆ ***denotes holder sizes manufactured for you as custom orders. Call for price.***

WORLD PRECISION INSTRUMENTS
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Brazil: 011 55 13 40629703 • info@brazil.wpiinc.com • **www.wpiinc.com**
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MICROELECTRODE HOLDERS ORDERING INFORMATION

◆ = custom order (call for price)

Order Number Replace XX with glass OD *	Custom Order	Electric Connection Angle	Connector	Half-Cell	Pressure Port	Screw Cap	Designed for WPI Products
EHBF		Straight	Female	Wire	No Port	N/A	MBS, 48000
FOIMPH		Straight	Fiber Optic	None	No Port	w/Cap	MBS, 48000
MEH1Sxx		Straight	Male	Pellet	No Port	No Cap	
MEH1SFxx		Straight	Female	Pellet	No Port	No Cap	705, 773, 767, 721, FD223
MEH2Rxx	◆	Right	Male	Pellet	Male Luer	w/Cap	
MEH2RFxx	◆	Right	Female	Pellet	Male Luer	w/Cap	705, 773, 767, 721, FD223
MEH2RFWxx	◆	Right	Female	Wire	Male Luer	w/Cap	705, 773, 767, 721, FD223
MEH2RWxx	◆	Right	Male	Wire	Male Luer	w/Cap	
MEH2Sxx		Straight	Male	Pellet	Male Luer	w/Cap	
MEH2SFxx		Straight	Female	Pellet	Male Luer	w/Cap	705, 773, 767, 721, FD223
MEH2SFWxx	◆	Straight	Female	Wire	Male Luer	w/Cap	705, 773, 767, 721, FD223
MEH2SWxx		Straight	Male	Wire	Male Luer	w/Cap	
MEH345xx		45°	Male	Pellet	No Port	w/Cap	
MEH3F45xx	◆	45°	Female	Pellet	No Port	w/Cap	705, 773, 767, 721, FD223
MEH3FW45xx	◆	45°	Female	Wire	Port	w/Cap	
MEH3Rxx		Right	Male	Pellet	No Port	w/Cap	
MEH3RFxx		Right	Female	Pellet	No Port	w/Cap	705, 773, 767, 721, FD223
MEH3RFWxx	◆	Right	Female	Wire	No Port	w/Cap	705, 773, 767, 721, FD223
MEH3RWxx	◆	Right	Male	Wire	No Port	w/Cap	
MEH3Sxx		Straight	Male	Pellet	No Port	w/Cap	
MEH3SBWxx	◆	Straight	Banana	Wire	No Port	w/Cap	ISO-80, ISO-DAM8A
MEH3SFxx		Straight	Female	Pellet	No Port	w/Cap	705, 773, 767, 721, FD223
MEH3SFWxx		Straight	Female	Wire	No Port	w/Cap	705, 773, 767, 721, FD223
MEH3SWxx		Straight	Male	Wire	No Port	w/Cap	
MEH3W45xx	◆	45°	Male	Wire	No Port	w/Cap	705, 773, 767, 721, FD223
MEH6RFxx		Right	Female	Pellet	2.0-mm Port	w/Cap	705, 773, 767, 721, FD223
MEH6RFWxx	◆	Right	Female	Wire	2.0-mm Port	w/Cap	705, 773, 767, 721, FD223
MEH6SFxx		Straight	Female	Pellet	2.0-mm Port	w/Cap	705, 773, 767, 721, FD223
MEH6SFWxx	◆	Straight	Female	Wire	2.0-mm Port	w/Cap	705, 773, 767, 721, FD223
MEH7xx		Right	Male	Pellet	2.0-mm Port	w/Cap	
MEH7Wxx	◆	Right	Male	Wire	2.0-mm Port	w/Cap	
MEH8xx		Right	Male	Pellet	No Port	w/Cap	
MEH900Rxx		Right	Male	Pellet	2.0-mm Port	w/Cap	900A
MEH900Sxx		Straight	Male	Pellet	2.0-mm Port	w/Cap	900A
MPH1xx		—	None	None	Female Luer	w/Cap	
MPH3xx		—	None	None	Male Luer	w/Cap	
MPH4xx		—	None	None	2.0-mm Port	w/Cap	
MPH6Pxx	◆	Right	Male	Pellet	Female Luer	w/Cap	Piconozzle Kit (5430-XX)
MPH6Rxx	◆	Right	Male	Wire	Female Luer	w/Cap	Piconozzle Kit (5430-XX)
MPH6Sxx		—	None	None	Female Luer	w/Cap	Piconozzle Kit (5430-XX)

** Specify O.D. of glass (1.0, 1.2, 1.5 or 2.0 mm) by replacing XX in the Order Number with 10, 12, 15 or 20.*

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

Handle **2505** *is for use with WPI manipulators. The smaller diameter handle* **5444** *is required for use with Narishige and Zeiss manipulators.*

2505	1/4-in (6.3 mm) diameter handle
5444	3/16-in (4.8 mm) diameter handle
GO1-100	Replacement gasket 1.0 mm, Package of 100
GO2-100	Replacement gasket 1.2 mm, Package of 100
GO3-100	Replacement gasket 1.5 mm, Package of 100
GO4-100	Replacement gasket 2.0 mm, Package of 100
1571	Clear Silicone Rubber Sealant (-4.7 oz-)

Precious Metal and Specialty Wire

Bare and coated metal wire for most laboratory applications

Micro coaxial cables (MAXxxxx) are ideal for microelectrode fabrication and construction of similar research tools. The dual shielding eliminates electrical interference caused by radio frequencies (RF), electrostatic and microphonics (e.g., bending and vibration. Available with single or dual (twin) conductors.

Teflon-coated stainless steel (type 304) wire (**SSTxxxx**) is available in 25-ft and 50-ft lengths. The Teflon coating is 150 micro-in. thick (4 µm). The Teflon coating is designed to reduce surface friction, only. It is not insulation.

Carbon wire (**C3005**) is a single 30-micron fiber of electrochemically activated carbon. This fiber is especially useful in micro-electrochemical experiments.

Platinum/iridium wire — uncoated (**PTxxxx**) and Teflon-coated (**PTTxxxx**) — is an alloy of 90% platinum and 10% iridium, giving excellent tensile strength and corrosion resistance. Uncoated pure platinum wire (**PTPxxx**) is 99.95% pure.

Indium wire (IN1003) is 99.99% pure, with a melting point of 156.4°C.

Annealed silver wire (**AGWxxxx**), 99.99% pure, is available in five diameters; three of those sizes are also available with a Teflon coating (**AGTxxxx**).

Tungsten wire (**TGWxxxx**), available in three diameters, is 99.95% pure.

Gold wire (**AUWxxxx**) is 99.99% pure.

Stainless steel wire (**SSxxxxx**) is type 316.

ORDERING INFORMATION

Catalog No.	Metal	Coating	AWG*	Diameter	Precut Length
AGT0510	Silver	Teflon	36	0.005 in. (0.125 mm)[1]	10 ft (3 m)
AGT0525	Silver	Teflon	36	0.005 in. (0.125 mm)[1]	25 ft (7.6 m)
AGT05100	Silver	Teflon	36	0.005 in. (0.125 mm)[1]	100 ft (30 m)
AGT1010	Silver	Teflon	30	0.010 in. (0.25 mm)[1]	10 ft (3 m)
AGT1025	Silver	Teflon	30	0.010 in. (0.25 mm)[1]	25 ft (7.6 m)
AGT10100	Silver	Teflon	30	0.010 in. (0.25 mm)[1]	100 ft (30 m)
AGT1510	Silver	Teflon	26-27	0.015 in. (0.38 mm)[1]	10 ft (3 m)
AGT1530	Silver	Teflon	26-27	0.015 in. (0.38 mm)[1]	30 ft (9.1 m)
AGW0510	Silver	—	36	0.005 in. (0.125 mm)	10 ft (3 m)
AGW0530	Silver	—	36	0.005 in. (0.125 mm)	30 ft (9.1 m)
AGW1010	Silver	—	30	0.010 in. (0.25 mm)	10 ft (3 m)
AGW1030	Silver	—	30	0.010 in. (0.25 mm)	30 ft (9.1 m)
AGW1510	Silver	—	26-27	0.015 in. (0.38 mm)	10 ft (3 m)
AGW1530	Silver	—	26-27	0.015 in. (0.38 mm)	30 ft (9.1 m)
AGW2010	Silver	—	24	0.020 in. (0.5 mm)	10 ft (3 m)
AGW2030	Silver	—	24	0.020 in. (0.5 mm)	30 ft (9.1 m)
AGW4010	Silver	—	18	0.040 in. (1.0 mm)	10 ft (3 m)
AUW0170	Gold	—	50	0.001 in. (0.025 mm)	70 ft (21 m)
AUW201	Gold	—	24	0.020 in. (0.5 mm)	1 ft (30 cm)
C3005	Carbon	—	49	0.0012 in. (30 µm)	5 ft (1.5 m)
PT1002	Platinum / Iridium	—	30	0.010 in. (0.25 mm)	2 ft (61 cm)
PT0402	Platinum / Iridium	—	38	0.004 in. (0.102 mm)	2 ft (61 cm)
PT0203	Platinum / Iridium	—	44	0.002 in. (0.051 mm)	3 ft (91 cm)
PT0110	Platinum / Iridium	—	50	0.001 in. (0.025 mm)	10 ft (3 m)
PTP101	Platinum	—	30	0.010 in. (0.25 mm)	1 ft (30 cm)
PTP201	Platinum	—	24	0.020 in. (0.5 mm)	1 ft (30 cm)
PTP401	Platinum	—	18	0.039 in. (1.0 mm)	1 ft (30 cm)
PTP406	Platinum	—	18	0.039 in. (1.0 mm)	0.5 ft (15.2 cm)
PTT0502	Platinum / Iridium	Teflon	36	0.005 in. (0.125 mm)[1]	2 ft (61 cm)
PTT0203	Platinum / Iridium	Teflon	44	0.002 in. (0.051 mm)[1]	3 ft (91 cm)
PTT0110	Platinum / Iridium	Teflon	50	0.001 in. (0.025 mm)[1]	10 ft (3 m)
SS31605	Stainless Steel	—	36	0.005 in. (0.125 mm)	50 ft (15.2 m)
SS31614	Stainless Steel	—	27	0.014 in. (0.36 mm)	30 ft (9.1 m)
SST30407-25	Stainless Steel	Teflon	33	0.007 in. (0.18 mm)[3]	25 ft (7.6 m)
SST30407-50	Stainless Steel	Teflon	33	0.007 in. (0.18 mm)[3]	50 ft (15.2 m)
TGW0325	Tungsten	—	40	0.003 in. (0.075 mm)	25 ft (7.6 m)
TGW0515	Tungsten	—	36	0.005 in. (0.125 mm)	15 ft (4.6 m)
TGW1510	Tungsten	—	26-27	0.015 in. (0.38 mm)	10 ft (3 m)

MICROCOAXIAL CABLES

MAX3820	Tinned Cu Alloy	Coaxial		0.0173 in. (0.44 mm)	20 ft (6 m)[4]
MAX4020	Tinned Cu Alloy	Twin Coaxial	0.0158x0.024 in. (0.4x0.61 mm)		20 ft (6 m)[5]

*Brown & Sharpe
[1] Plus 0.002 in. for Teflon coating
[3] Teflon adds 0.00015 in. (4 µm) to diameter
[4] Impedance: 50 ohm; capacitance: 95 pF/m; resistance: 5 ohm/m
[5] Impedance: 100 ohm; capacitance: 54 pF/m; resistance: 1.9 ohm/m

Wire Cutters and Scissors

ORDERING INFORMATION

504749	Ergonomic Micro-Shear Flush Cutters, 12.7 cm (5 in.) Micro-shear flush cutters for delicate wires
504750	Ergonomic Mini-Scissors, 12.7 cm (5 in.) for cutting fine or delicate items with a clean, square edge. Handle design is advantageous for users with arthritic hands.
504751	Ergonomic Micro-Shear Flush Cutters, 12.7 cm (5 in.) for delicate wires. ESD safe. Extra tough high carbon steel blades. Sized for smaller hands and maximum maneuverability

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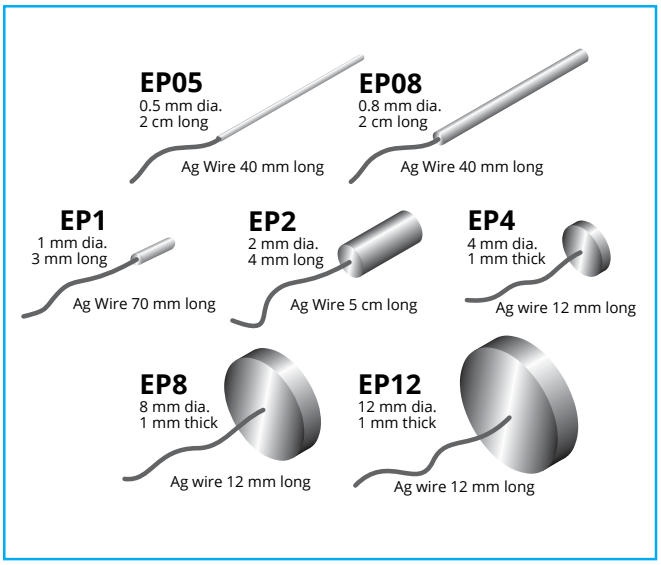
Ag/AgCl Half-Cells

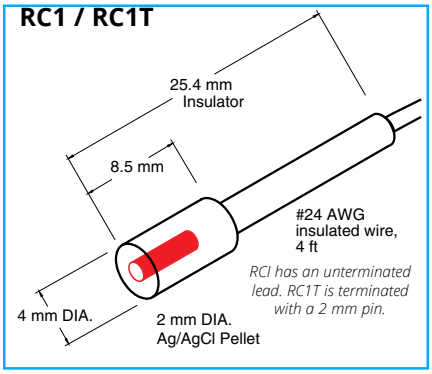
Sintering pellets with low resistance and high strength

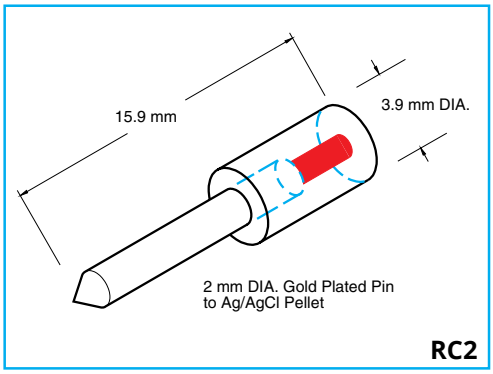


New, improved sintered pellets with lower resistance and high strength. Stable and well balanced in the presence of current, these small and inexpensive half-cells are easy to work with as bath electrodes.

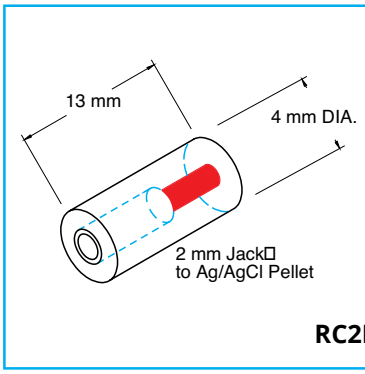
ORDERING INFORMATION	
RC1	Reference Cell with 1.5 m lead
RC1T	Reference Cell, 1.5 m lead, 2 mm pin
RC2	Reference Cell with 2.0 mm pin
RC2F	Reference Cell with female connector
RC3	Ref. Cell with epoxy body, 4.5 mm diam x 50 mm
RC6	Reference Cell with glass body, 1.5 mm diam x 50 mm
EP05	Ag/AgCl Electrode 0.5 mm diam x 20 mm
EP08	Ag/AgCl Electrode 0.8 mm diam x 20 mm
EP1	Ag/AgCl Electrode 1.0 mm diam x 3 mm
EP2	Ag/AgCl Electrode 2.0 mm diam x 4 mm
EP4	Ag/AgCl Electrode 4.0 mm diam x 1 mm
EP8	Ag/AgCl Electrode 8.0 mm diam x 1 mm
EP12	Ag/AgCl Electrode 12.0 mm diam x 1 mm
3578	Adapter Cable for Ag/AgCl Pellets

RC1 / RC1T

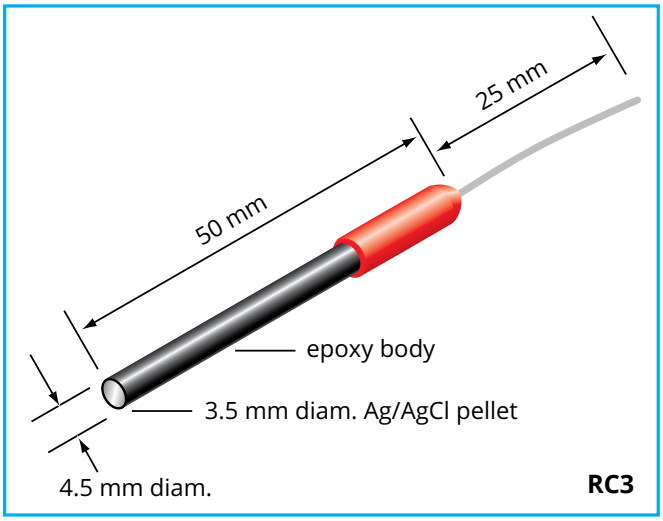




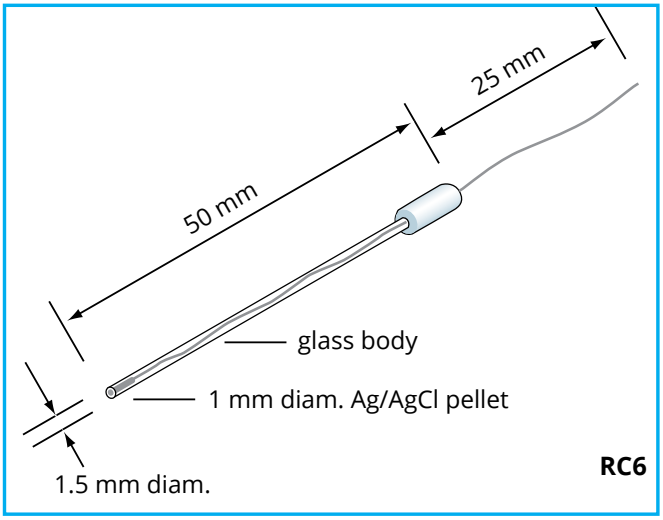
RC2



RC2F



RC3



RC6

Glass Capillaries

Quality glass, superior prices for microinjection/microelectrodes

Features

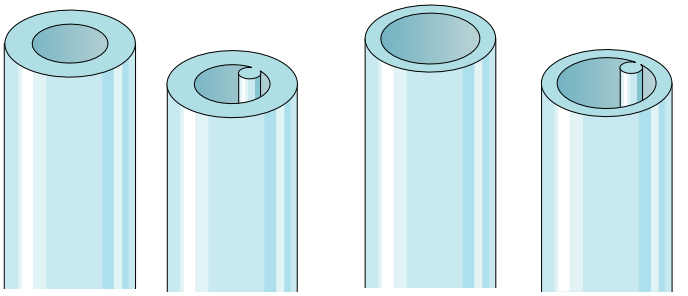
- Quality borosilicate glass capillaries
- Large variety available, including fire polished, filaments, thin wall, specialty glass and multi-barrel

Benefits

- Superior pricing
- Most glass orders ship within 48 hours

Applications

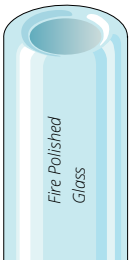
- Microinjection
- Electrophysiology
- Patch clamp
- Fluid Handling



Standard, no Filament | *Standard Filament* | *Thin Wall, no Filament* | *Thin Wall Filament*

FIre Polishing

Fire-Polished glass capillaries are easier to insert into microelectrode holders without damaging the gasket. More importantly, fire-polished glass won't scratch the chloridized wire used in a recording electrode. Fire-polishing does not affect the glass's mechanical or electrical properties.



Making Uniform, Reproducable Microelectrodes

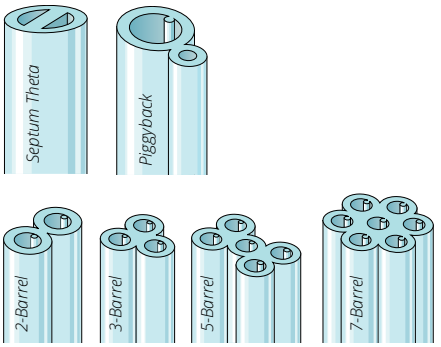
Borosilicate glass capillaries: Close dimensional tolerances assure microelectrode uniformity and reproducibility. Capillaries are available in 1, 2, 3, 5 and 7-barrel configurations, complete range of single barrel thin-wall sizes and a variety of special configurations. Capillaries with filaments contain a solid filament fused to the inner wall, which speeds filling of electrodes. Capillaries with or without inner filaments are available for making microelectrodes in a wide range of diameters.

Filament Glass Capillaries

Single Barrel standard wall thickness capillaries are offered either with or without inner filaments for quick filling in a variety of lengths and diameters.

Thin Wall Glass Capillaries

Thin Wall single barrel capillaries are offered both with or without inner filaments.



Specialty glass is also available. See page 105.

ORDERING INFORMATION

	Length	OD(mm)	ID(mm)	Filament	Fire-Polished	Quantity	Item
Single Barrel Standard Borosilicate Glass	3 in. (76 mm)	1.0	0.58	✔		500	**1B100F-3**
	3 in. (76 mm)	1.0	0.58			500	**1B100-3**
	3 in. (76 mm)	1.2	0.68	✔		350	**1B120F-3**
	3 in. (76 mm)	1.2	0.68			350	**1B120-3**
	3 in. (76 mm)	1.5	0.84	✔		225	**1B150F-3**
	3 in. (76 mm)	1.5	0.84		✔	300	**1B150-3**
	4 in. (100 mm)	1.0	0.58	✔	✔	500	**1B100F-4**
	4 in. (100 mm)	1.0	0.58		✔	500	**1B100-4**
	4 in. (100 mm)	1.2	0.68	✔	✔	400	**1B120F-4**
	4 in. (100 mm)	1.2	0.68			350	**1B120-4**
	4 in. (100 mm)	1.5	0.84	✔	✔	300	**1B150F-4**
	4 in. (100 mm)	1.5	0.84		✔	300	**1B150-4**
	4 in. (100 mm)	2.0	1.12	✔		125	**1B200F-4**
	4 in. (100 mm)	2.0	1.12		✔	200	**1B200-4**
	6 in. (152 mm)	1.0	0.58	✔		500	**1B100F-6**
	6 in. (152 mm)	1.0	0.58			500	**1B100-6**
	6 in. (152 mm)	1.2	0.68	✔		350	**1B120F-6**
	6 in. (152 mm)	1.2	0.68			350	**1B120-6**
	6 in. (152 mm)	1.5	0.84	✔		225	**1B150F-6**
	6 in. (152 mm)	1.5	0.84			225	**1B150-6**
	6 in. (152 mm)	2.0	1.12	✔		125	**1B200F-6**
	6 in. (152 mm)	2.0	1.12			125	**1B200-6**
Thin-Wall Single-Barrel Standard	3 in. (76 mm)	1.0	0.75	✔		500	**TW100F-3**
	3 in. (76 mm)	1.0	0.75			500	**TW100-3**
	3 in. (76 mm)	1.2	0.90	✔	✔	400	**TW120F-3**
	3 in. (76 mm)	1.2	0.90			350	**TW120-3**
	3 in. (76 mm)	1.5	1.12	✔		225	**TW150F-3**
	3 in. (76 mm)	1.5	1.12		✔	300	**TW150-3**
	4 in. (100 mm)	1.0	0.75	✔		500	**TW100F-4**
	4 in. (100 mm)	1.0	0.75		✔	500	**TW100-4**
	4 in. (100 mm)	1.2	0.90	✔		350	**TW120F-4**
	4 in. (100 mm)	1.2	0.90			350	**TW120-4**
	4 in. (100 mm)	1.5	1.12	✔		225	**TW150F-4**
	4 in. (100 mm)	1.5	1.12		✔	300	**TW150-4**
	6 in. (152 mm)	1.0	0.75	✔		500	**TW100F-6**
	6 in. (152 mm)	1.0	0.75		✔	500	**TW100-6**
	6 in. (152 mm)	1.2	0.90	✔	✔	400	**TW120F-6**
	6 in. (152 mm)	1.2	0.90			350	**TW120-6**
	6 in. (152 mm)	1.5	1.12	✔		225	**TW150F-6**
	6 in. (152 mm)	1.5	1.12		✔	300	**TW150-6**

Single barrel glass is Kimble N51A. All thin wall glass is Schott Duran 8330. Tolerance ±10%

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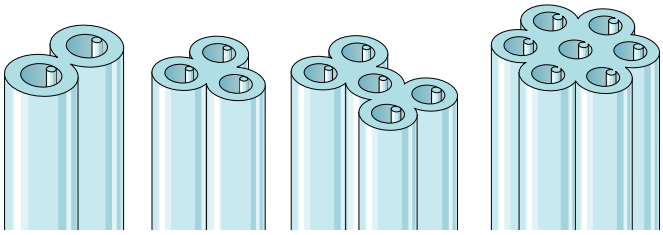
Multi-Barrel Glass Capillaries

Multi-barrel configurations are designed especially for micro-iontophoresis. Because the capillaries are fused together during manufacturing, you will not need to twist them while pulling to seal the tips together. An inner filament in each barrel makes filling easy and fast.

Also see PolyFil for a novel way to connect multi-barrel pipettes



2-Barrel *3-Barrel* *5-Barrel* *7-Barrel*

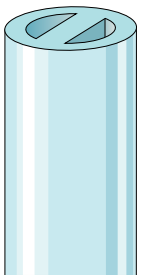
ORDERING INFORMATION

Multi-Barrel Borosilicate Glass Tubing with Filaments

Length	Description	OD/ID (per barrel)	Filament	Qty	Item
4" (102mm)	2-Barrel	1.5/0.84 mm	✔	100	**2B150F-4**
4" (102mm)	3-Barrel	1.2/0.68 mm	✔	100	**3B120F-4**
4" (102mm)	5-Barrel	1.2/0.68 mm	✔	65	**5B120F-4**
4" (102mm)	7-Barrel	1.0/0.58 mm	✔	60	**7B100F-4**
4" (102mm)	7-Barrel	1.2/0.68 mm	✔	75	**7B120F-4**
6" (152mm)	2-Barrel	1.5/0.84 mm	✔	100	**2B150F-6**
6" (152mm)	3-Barrel	1.2/0.68 mm	✔	100	**3B120F-6**
6" (152mm)	5-Barrel	1.2/0.68 mm	✔	65	**5B120F-6**
6" (152mm)	7-Barrel	1.0/0.58 mm	✔	60	**7B100F-6**

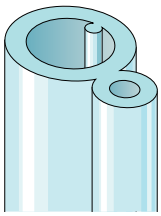
Special Configuration Glass Capillaries

Septum Theta



Septum Theta offers superior cell impalement. The natural bevel resulting from the prominent spear-like projection of the septum gives microelectrodes a sharp, spear-point tip. This style has low resistance for use as a single microelectrode, and it can be used to make superior double-tipped microelectrodes with low transtip coupling. The natural bevel of Septum Theta also significantly increases the effective tip cross-section. As supplied, the width of the septum is approximately 0.2 mm; wall thickness is approximately 0.2 mm.

Piggyback



Piggyback glass consists of a pair of borosilicate capillaries fused together during manufacturing. One barrel is larger than the other, and both have inner filaments for quick filling. Piggyback glass makes it simple to fabricate two-barrel electrodes with a significant tip diameter differential.

ORDERING INFORMATION

Special Configuration Borosilicate Glass Tubing

Description	OD/ID (mm)	Length	Qty	Item
Septum Theta	1.5/1.02	6 in. (152 mm)	100	**TST150-6**
Piggyback	1.51/0.84 0.75/0.35	4 in. (102 mm)	50	**PB150F-4**
Piggyback	1.51/0.84 0.75/0.35	6 in. (152 mm)	50	**PB150F-6**

Borosilicate Glass Rod

1.0 mm diameter — for making tools, probes, tips

ORDERING INFORMATION

Borosilicate Glass Rod

Description	OD (mm)	Length	Qty	Item
Glass Rod	1.0	4 in. (102mm)	500	**GR100-4**
Glass Rod	1.0	6 in. (152mm)	500	**GR100-6**

Multi-barrel pipette coupling kit

Securely couple multi-barrel pipettes to a pressure source

Features

- Complete kit (all in one) for making multi-barrel pipettes
- Secure coupling of multi-barrel micropipettes to a pressure source

Benefits

- Allows for microinjection to multi-barrel micropipette independently for one pressure source
- Pressure safe and convenient luer lock connections

Applications

- Multi-port microinjection

PolyFil™ allows easy and secure coupling of a multi-barrel micropipette to a pressure source. Coupling is achieved by bonding temperature-resistant and flexible **MicroFil** to the capillary tube with hot melt adhesive. The luer end of each **MicroFil** is connected to PVC tubing (200 PSI rated). Kits also include a five-port manifold that allows use of a single **PV800** Series PicoPump to drive up to six micropipette barrels independently by switching on only the barrels to be injected. All connections are locking luers — pressure safe and convenient.

ORDERING INFORMATION

5440	PolyFil™ Multi-Barrel Micropipette Coupling Kit
	Includes: 1 pipette holder/handle, plastic; 7 pieces MF28G MicroFil; 7-pieces tubing with male luer lock fittings; 1 flow-thru manifold with five luer lock ports; 1 hot melt glue gun (110V only); 3 glue sticks.
13316	Mini Glue Gun and (3) glue sticks

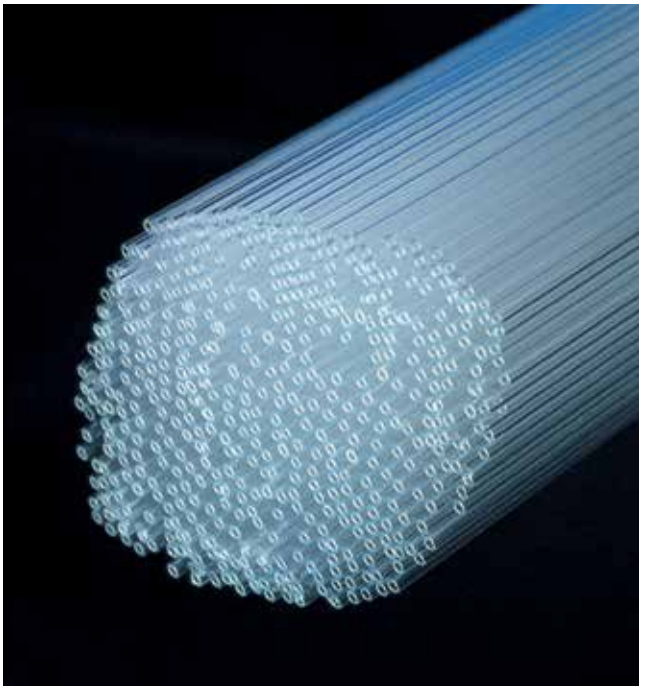
Patch Clamp Capillary Glass

Evaluated for best softening temperature, electrical properties, sealability, leachable components

PG52151-4 and **PG52165-4** are prepared from Schott #8250 glass (equivalent to Corning #7052), one of the most widely used patch clamping glasses. This is a specially formulated borosilicate glass with a softening temperature that is 110°C lower than regular borosilicate glass (Corning 7740, or Pyrex). It has excellent sealing properties for most cells. Electrical properties are also very good.

PG10150-4 and **PG10165-4** are composed of Corning #0010 glass, a high lead content (22% PbO) glass. Its thermal and electrical performance is between the Schott #8250 and Corning #8161 glasses described above. It is much more economical than Corning #8161 glass. It has been found that this glass causes much less alteration in channel behavior than Corning #8161 and Schott #8250 glass (Furman and Tanaka, *Biophys. J.* 53, p287, 1988).

Patch clamp capillaries do not have microfilaments.



ORDERING INFORMATION

Patch Clamp Capillary Glass

Catalog#	Glass Type	OD/ID (mm)	Dielectric Constant	Softening Point °C	QTY
PG52151-4	#8250	1.5/1.0	4.9	720°	100
PG52165-4	#8250	1.65/1.1	4.9	720°	100
PG10150-4	#0010	1.5/0.75	6.7	625°	100
PG10165-4	#0010	1.65/1.1	6.7	625°	100

Glass Handling Forceps

Firmly hold your capillary glass without risk of breaking it

Ever had difficulty picking up a glass capillary? Special tips on these forceps solve the problem, holding glass firmly without risk of breakage. They also keep the glass clean and avoid contamination from skin oils.

77020

ORDERING INFORMATION

77020	Glass Handling Forceps

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Borosilicate Glass Micropipettes

Eliminate the cost and trouble of making your own micropipettes

µTip™

Features

- Schott Duran borosilicate glass
- 0.5 µm and smaller ID micropipettes include internal glass fiber for easy filling
- Tip inner diameter tolerance ±20%
- Short taper yields high strength
- Nominal length ≈ 50 mm
- OD:ID = 1.33:1
- Standard capillary outer diameters are 1.0 mm (thin-wall) or 1.14 mm
- Every pipette individually tested and inspected
- Vacuum sealed packs of 10

Benefits

- Plain Shank or Luer Fittings

Applications

- Injection of dyes or proteins into cells, oocytes or othe biomedical laboratory applications

WPI can quickly supply your need for consistently sized pre-pulled glass micropipettes.

Tip diameters (ID) range from 0.1 to 15 µm.

Silanized Tips (Luer Shank) are available. Silanization waterproofs the glass to retard water when inserting into cell. This will not let the outside fluid run down the pipette and get inside so easily.

ORDERING INFORMATION

Shank	Tip I.D.	Silanize Coating Length	Glass O.D.	Filament	Fire Polished	Catalog #	
PLAIN	0.1 µm	—	1.0 mm Thin-Wall	Yes	No	**TIP01TW1F**	
	0.2 µm	—	1.0 mm Thin-Wall	Yes	No	**TIP02TW1F**	
	0.3 µm	—	1.0 mm Thin-Wall	Yes	No	**TIP03TW1F**	
	0.4 µm	—	1.0 mm Thin-Wall	Yes	No	**TIP04TW1F**	
	0.5 µm	—	1.0 mm Thin-Wall	Yes	No	**TIP05TW1F**	
	1 µm	—	1.0 mm Thin-Wall	No	Yes	**TIP1TW1**	
	2 µm	—	1.0 mm Thin-Wall	No	Yes	**TIP2TW1**	
	5 µm	—	1.0 mm Thin-Wall	No	Yes	**TIP5TW1**	
	10 µm	—	1.0 mm Thin-Wall	No	Yes	**TIP10TW1**	
	10 µm	—	1.14 mm A203XV glass *	No	Yes	**TIP10XV119**	
	—	—	1.0 mm Thin-Wall	No	Yes	**TIP10LT**	Long Taper †
	—	—	1.0 mm Thin-Wall	Yes	Yes	**TIP10FLT**	Long Taper †
	—	—	1.5 mm Thin-Wall	No	Yes	**TIP15LT**	Long Taper †
	—	—	1.5 mm Thin-Wall	Yes	Yes	**TIP15FLT**	Long Taper †
	30 µm	—	1.0 mm Thin-Wall	No	Yes	**TIP30TW1**	
LUER	0.1 µm	—	1.0 mm Thin-Wall	Yes	—	**TIP01TW1F-L**	
	0.2 µm	—	1.0 mm Thin-Wall	Yes	—	**TIP02TW1F-L**	
	0.3 µm	—	1.0 mm Thin-Wall	Yes	—	**TIP03TW1F-L**	
	0.5 µm	—	1.0 mm Thin-Wall	Yes	—	**TIP05TW1F-L**	
	1 µm	—	1.0 mm Thin-Wall	No	—	**TIP1TW1-L**	
	2 µm	—	1.0 mm Thin-Wall	No	—	**TIP2TW1-L**	
	5 µm	—	1.0 mm Thin-Wall	No	—	**TIP5TW1-L**	
	10 µm	—	1.0 mm Thin-Wall	No	—	**TIP10TW1-L**	
	30 µm	—	1.0 mm Thin-Wall	No	—	**TIP30TW1-L**	
LUER/ SILANIZED	5 µm	1 inch	1.0 mm Thin-Wall	No	—	**TIP5TW1LS01**	
	5 µm	2 inch	1.0 mm Thin-Wall	No	—	**TIP5TW1LS02**	
	10 µm	1 inch	1.0 mm Thin-Wall	No	—	**TIP10TW1LS01**	
	10 µm	2 inch	1.0 mm Thin-Wall	No	—	**TIP10TW1LS02**	
	30 µm	1 inch	1.0 mm Thin-Wall	No	—	**TIP30TW1LS01**	
	30 µm	2 inch	1.0 mm Thin-Wall	No	—	**TIP30TW1LS02**	

* *10 µm (ID), 1.14 mm capillary pipettes are for use in WPI's* ***Nanoliter 2010****.*

† *Long Taper micropipettes are pulled with a 12-15 mm taper which the customer cuts back to obtain the desired tip diameter.*

µTIP SAMPLER ASSORTMENTS

TIPMIX01-05	Two each, 0.1, 0.2, 0.3, 0.4, 0.5 µm ID, plain shank
TIPMIX05-10	Two each, 0.5, 1, 2, 5, 10 µm ID, plain shank
TIPMIX01-05-L	Two each, 0.1, 0.2, 0.3, 0.4, 0.5 µm ID, Luer
TIPMIX05-10-L	Two each, 0.5, 1, 2, 5, 10 µm ID, Luer

Micropipette Storage Jar

Protect your micropipettes until ready to use them

Stores up to 30 micropipettes, filled or unfilled, up to three inches in length. A gentle sliding action inserts or removes pipettes without damage to the delicate tips.

ORDERING INFORMATION

E210	Storage Jar for 1.0 mm OD Micropipettes
E212	Storage Jar for 1.2 mm OD Micropipettes
E215	Storage Jar for 1.5 mm OD Micropipettes
E220	Storage Jar for 2.0 mm OD Micropipettes

REPLACEMENT PARTS

1965	Foam Ring for 0.75 - 1.0 mm glass
1966	Foam Ring for 1.2 - 1.5 mm glass
1967	Foam Ring for 2.0 mm glass

Microelectrode Puller

A compact, versatile and reliable workhorse

PUL-1000

Features

- Program sequences up to four steps
- Store up to 95 programs in memory for easy recall
- Supplied with a vial of capillary glass

Benefits

- Tempered glass cover to reduce the effects of humidity on puller reproducibility
- Switchable power supply ensures that line voltage fluctuations don't affect reproducibility

Applications

- Pull your own microelectrodes and micropipettes

PUL-1000 is a microprocessor controlled horizontal puller for making glass micropipettes or microelectrodes used in intracellular recording, patch clamp studies, microperfusion or microinjection. The puller was designed with tight mechanical specifications and precision electronics for complete control of the pulling process and accurate reproducibility. It offers programmable sequences of up to four steps with heating, force, movement and cooling time. This allows graduated cycles for applications like patch clamp recording.

This puller is a reasonably priced, compact, versatile and reliable workhorse. The microprocessor, combined with the LCD display, makes the **PUL-1000** easy to use.

Tempered Glass Cover

The cover of pulling chamber is made with tempered glass to minimize the humidity effect on the reproducibility of pulled pipettes.

Switchable Power Supply

PUL-1000 has a high quality switching power supply for use anywhere in the world without worry about the line voltage differences. Pulling reproducibility is unaffected by line voltage fluctuation. Heating voltage can be controlled to within 0.1% accuracy even when line voltage fluctuates from 90 to 240 VAC.

References

Plautz, C. Z., Williams, H. C., & Grainger, R. M. (2016). Functional Cloning Using a Xenopus Oocyte Expression System. *Journal of Visualized Experiments*, (107), e53518–e53518. http://doi.org/10.3791/53518

Komarova, Y., Peloquin, J., & Borisy, G. (2011). Components of a microinjection system. *Cold Spring Harbor Protocols*, 2011(8), 935–9. http://doi.org/10.1101/pdb.ip27

PUL-1000 SPECIFICATIONS

HEATER ELEMENT	Platinum/Iridium
PULLING FORCE	Solenoid, adjustable
CAPILLARY OD RANGE	1.0–2.0 mm
MAXIMUM CAPILLARY LENGTH	170 mm
MINIMUM CAPILLARY LENGTH	55 mm
MEMORY SETS	95
POWER	90–240 VAC, 50/60 Hz
DIMENSIONS	34 x 24 x 12 cm
SHIPPING WEIGHT	15 lb.
REPLACEMENT FILAMENTS	2.5 mm Square Box Filament, 2.5 mm wide (**13834**)

ORDERING INFORMATION

PUL-1000	Micopipette Puller
13834	Filaments, Platinum/Iridium, 2.5mm wide 2.5mm Square Box
504951	Filaments, Platinum/Iridium, 4.5mm wide Trough

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Micropipette Puller for Quartz and Glass

CO_2 laser-based heat source for pulling quartz pipettes

new

Features

- Capable of pulling quartz, borosilicate and aluminosilicate glass
- Fully programmable, including heating filament characteristics
- Pulls electrodes with tip diameters smaller than 0.03 µm
- Preprogrammed sample programs for intracellular and patch pipettes

Benefits

- The laser has no melting point limit as with conventional metal filaments and cannot be burned out
- Optimized velocity sensing circuit for maximized sensitivity and reproducibility
- Operating life of the CO_2 laser is expected to be in excess of ten years with normal use, after which the laser can be refurbished
- Individual programs can be write-protected in order to secure them from inadvertent changes
- The total time that the heat is on during the pull is displayed for improved program development and troubleshooting
- A date and time stamp is displayed to show the last time that a program has been changed

Applications

- Patch clamp, single isolated and whole cell
- Intracellular recording
- Microinjection
- Nano probe research
- SECM
- P-2000/F is ideal for applications such as nanospray and NSOM

The **SU-P2000** micropipette puller represents a significant advance in the technology of fabrication of micropipettes, optical fiber probes, and nanospray tips. The **SU-P2000** integrates a CO_2 laser-based heat source with the technology derived from our extensive experience with conventional pullers. This system offers capabilities unmatched by other pullers.

While the **SU-P2000** is suitable for working with most conventional glasses, its primary advantage is the ability to work with quartz glass (fused silica). Quartz offers superior material properties for a variety of research applications. Quartz is stronger than other glasses and can facilitate penetration through tough tissues which would normally break conventional pipettes. For applications requiring a low noise glass, users will find that quartz is the lowest noise glass available. Quartz contains none of the metals used in conventional glasses. Optically, quartz is virtually free from fluorescence when illuminated.

A CO_2 laser was selected as the heat source for the **SU-P2000** for several reasons:

- The nominal emission wavelength of the laser approximates the resonant frequency of the SiO_2 lattice in glass. Thus, quartz and other conventional glasses can be melted when the appropriate laser power is supplied.
- Laser heat is clean and leaves no metal residue on the pipette as do conventional heating filaments.
- Laser heat can be turned off instantly, leaving no residual filament heat.
- The user can program the amount and distribution of heat supplied to the glass.
- Laser heat source means there are no filaments to burn out or replace.

The **SU-P2000** can store up to 100 separate programs, with each program consisting of up to 8 command lines. Programmable parameters include: laser power level, scan width, trip velocity, delay/laser on time, and hard pull strength.

One important consideration for the use of the **SU-P2000** is the diameter of the glass used. The **SU-P2000** is designed to produce even heating on glass up to 1.2 mm in outside diameter. Larger diameter glass can be used with the **SU-P2000** (up to 1.5 mm quartz and 1.8 mm conventional glass), but the performance is best with glass that is 1.2 mm diameter or less.

SPECIFICATIONS

DIMENSIONS	30 x 14.25 x 13.25 in. (76 x 36 x 33.5 cm)
WEIGHT	90 lbs. (41 kg)
ELECTRICAL	115/230 V, 50/60 Hz
*Patent No.4,600,424	
CLASS 1 LASER PRODUCT	

ORDERING INFORMATION

SU-P2000 Micopipette Puller

References

Munoz, J.L. and Coles, J. Quartz micropipettes for intracellular voltage microelectrodes and ion selective microelectrodes. *Journal of Neuroscience Methods*: 22:57-64, 1987.

Rae, J.L. and Levis, R. A. A method for exceptionally low noise single channel recordings. *European Journal of Physiology* - Pflügers Archiv: 420:618-620, 1992.

Zuazaga, C. and Steinacker, A. Patch-clamp recording of ion channels: Interfering effects of patch pipette glass. *News in Physiological Science*: 5:155-159, 1990.

Levis, R.A. and Rae, J. L. The use of quartz patch pipettes for low noise single channel recording. *Biophysical Journal*: 65:1666-1677, 1993.

Next Generation Micropipette Puller

Flaming/Brown style puller with color touch screen control

Features

- Color touch-screen display
- Help topics and error detection
- Copy and paste functions for writing new programs
- Record of last two pull results
- Two symmetrical pipettes with each pull
- Self-contained air supply with filtration system and humidity control chamber
- Memory storage for up to 100 programs
- Two cooling modes: time and delay

Benefits

- Safe heat mode to protect and extend filament life
- Pre-heat mode improves stability
- Line repeat mode simplifies multi-line programming
- Pipette Cookbook program directory
- Glossary with micropipette and puller terminology
- Jaw temperature sensor helps define ideal pulling conditions
- Ramp test more easily accessed and can now be stored and referenced within each program. Helps to establish program heat settings and protect filament.

Applications

- Patch pipettes
- Sharp electrodes
- Pronuclear injection
- Zebrafish injection
- Insect egg injection
- Aspiration pipettes

The **SU-P1000** micropipette puller was developed through years of experience with the Flaming/Brown style micropipette pullers and infused with leading edge technology. The most obvious new feature is the color touchscreen display that provides an intuitive and full-featured interface.

The extensive library of programs found in the popular Sutter Cookbook has been incorporated into the puller and is available to the user via the touchscreen display. You need only specify the glass, filament, and type of pipette you require and a suitable program will be identified and available for installation. This takes the guesswork out of pipette pulling and simplifies programming.

The Pre-heat mode actively heats and controls the jaw temperature and assures that the jaws have reached a specific temperature before the glass is pulled. This can increase the stability of the program from pull to pull. Copy and paste functions assure that programs can be easily written and the line repeat mode simplifies multi-line programming. A safe heat mode is an additional feature that helps the user avoid using heat settings that might damage or burn out the filament. When the safe heat mode is turned on, the puller will "check" the installed heat and alert the user when a given heat value is too low or too high in relation to the ramp value. User notes can be added to each program for annotating important information.

New features

- Diagnostic testing of all puller components
- Built-in error detection of air pressure loss or filament burnout
- Easy access to ramp test
- Measurement of jaw temperature
- Access to previous pull results with the heat on times for each cycle of the program
- Help topics are pre-loaded to assist with on-site troubleshooting and the built-in glossary includes text, pictures, and diagrams explaining the terms used in micropipette fabrication
- Rotary dial is offered as an alternative to the keypad for numerical entry

SU-P1000 SPECIFICATIONS

DIMENSIONS	21 x 14 x 12" (53 x 36 x 30 cm)
WEIGHT	41 lb. (18.59 kg)
POWER	115/230 V, 50/60 Hz

ORDERING INFORMATION

SU-P1000	Pipette Puller

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

505094	2 mm Box Filament, 1.5 mm wide
505095	2 mm Box Filament, 2 mm wide
505096	2 mm Box Filament, 3 mm wide
505097	2.5 mm Box Filament, 4.5 mm wide
13834	2 mm Box Filament, 2.5 mm wide
505098	3 mm Box Filament, 1.5 mm wide
14074	3 mm Box Filament, 2 mm wide
506122	3 mm Box Filament, 3 mm wide
505099	Custom Filament
505101	3 mm Loop Filament, 1.5 mm wide
505103	3 mm Loop Filament, 2 mm wide
505105	3 mm Loop Filament, 2.5 mm wide
505106	Fire Polishing Spacer
505108	Trough Filament, 1.5 mm wide
13835	Trough Filament, 2 mm wide
13836	Trough Filament, 3 mm wide
505109	Trough Filament, 4.5 mm wide

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Flaming/Brown Pipette Puller

Create custom micropipettes, patch pipettes and microinjection needles

Features

- Environmental chamber for humidity control
- Programmable air pressure
- Memory storage for up to 100 programs
- Write protection and date stamp for each program
- Two symmetrical pipettes with each pull
- Two cooling modes: time and delay
- Vacuum fluorescent display

Benefits

- Preprogrammed sample programs for intracellular and patch pipettes. Special programming on request
- Ramp test — self test for establishing program heat settings when a new filament or glass is introduced
- Constant current power supply for filament and pull solenoid
- Looping pull cycle for fabrication of patch type micropipettes
- Self-contained air supply with filtration system and humidity control
- Consistent and reliable electrodes with tip diameters less than 0.1 µm
- Control over the time and pressure at which the air is delivered
- Optimized velocity sensing circuit for maximized sensitivity and reproducibility
- Quality control, SEM photograph of a tip pulled with each puller. Criterion is tip measurement less than 0.1 µm and typically is ~0.06 µm.

Applications

- Patch pipettes
- Sharp electrodes
- Pronuclear injection
- Zebrafish injection
- Insect egg injection
- Aspiration pipettes

The **SU-P97** Flaming/Brown type micropipette puller is ideal for fabricating micropipettes, patch pipettes and microinjection needles. While retaining many of the features of earlier models, the **SU-P97** offers improvements in mechanical, electronic and software design. The result is better control of the pulling process and a higher degree of reproducibility. The **SU-P97** combines a proven mechanical system with a sophisticated, programmable microprocessor controller. This programmable control of the pulling parameters allows the investigator to design application specific pipettes from a wide range of glass compositions and sizes.

A number of other features have been incorporated in the design of the **SU-P97**. Most apparent is the environmental chamber which surrounds the heating filament. This environmental chamber is designed to minimize the effect of changing humidity on the reproducibility of pulled pipettes. A 25% increase in power over the P-87 allows for the use of larger heating filaments, larger diameter glass and multi-barreled glass. The metal jaws that clamp the heating filament have also been redesigned to minimize heat retention. A gas delivery mode switch provides for extended cooling for large diameter and multi-barreled glass. A spring-loaded clamping mechanism has been added for easier loading of glass. A vacuum fluorescent display has been added that allows easy viewing.

Software improvements on the **SU-P97** include a display of the total heat-on time to assist in program development and troubleshooting. Up to 100 programs can now be written and stored in memory, which makes the **SU-P97** suitable for multiple users. These programs can now be write-protected, adding security to prevent programs from being changed or altered inadvertently. The display shows the last date and time the program was written or edited. In addition, the air pressure is included as a programmable parameter.

SU-P97 SPECIFICATIONS

DIMENSIONS	21 x 16 x 12 (53 x 40.6 x 30 cm)
WEIGHT	50 lb. (23 kg)
ELECTRICAL	115/230 V, 50/60 Hz

ORDERING INFORMATION

SU-P97	Pipette Puller

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

505094	2 mm Box Filament, 1.5 mm wide
505095	2 mm Box Filament, 2 mm wide
505096	2 mm Box Filament, 3 mm wide
505097	2.5 mm Box Filament, 4.5 mm wide
13834	2 mm Box Filament, 2.5 mm wide
505098	3 mm Box Filament, 1.5 mm wide
14074	3 mm Box Filament, 2 mm wide
506122	3 mm Box Filament, 3 mm wide
505099	Custom Filament
505101	3 mm Loop Filament, 1.5 mm wide
505103	3 mm Loop Filament, 2 mm wide
505105	3 mm Loop Filament, 2.5 mm wide
505106	Fire Polishing Spacer
505108	Trough Filament, 1.5 mm wide
13835	Trough Filament, 2 mm wide
13836	Trough Filament, 3 mm wide
505109	Trough Filament, 4.5 mm wide

Digital Microforge

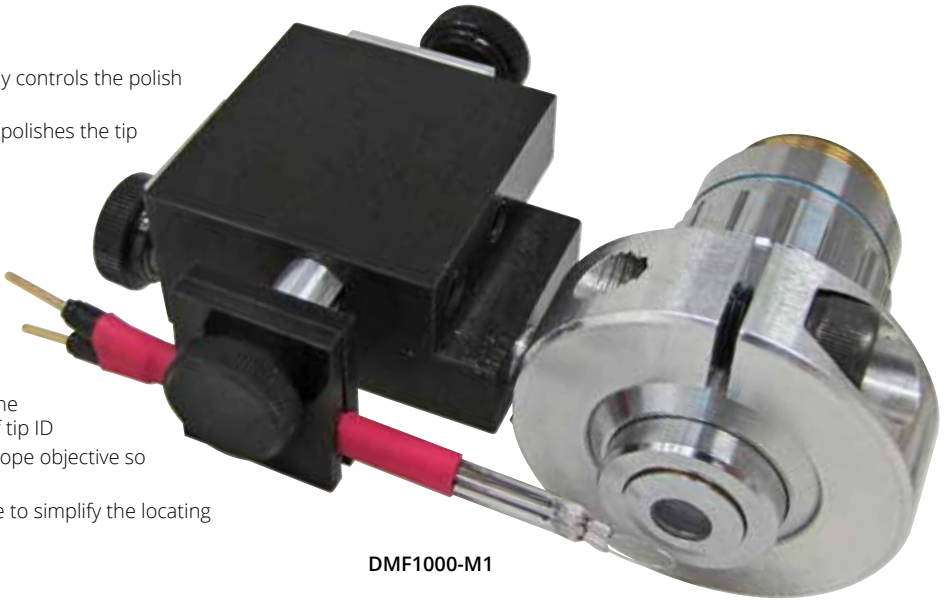
Microforging, Micropipette Calibration and Microinjection — in a single device!

Features

- Microprocessor-controlled microforge
- Digital signal processor technology precisely controls the polish heating time
- Unique digital pneumatic pressure feature polishes the tip without changing the size
- **W30S-LED** Microscope (Optional)

Benefits

- Digital Signal Processor (DSP) technology
- Complete system package available
- Kohler illuminator and Abbe condenser for less glare and sharper images.
- Pneumatic pressure polishing that allows the preparation of blunt tips without change of tip ID
- Heating filament is attached to the microscope objective so they move together
- Pipette holder sits on the microscope stage to simplify the locating and polishing of the pipette



DMF1000-M1

Filament Holder mounts directly to objective to provide precise control of heating element position.

Applications

- Polishing patch pipettes
- Microforging holding pipettes
- Microforging beveled injection pipettes
- Pipette tip calibration and microinjection

The **DMF1000** is a microprocessor-controlled microforge offering unmatched performance. Designed for fabrication of both small patch clamp glass pipettes and larger injection pipettes, the **DMF1000** should find many uses in the laboratory. The **DMF1000** is based on a design similar to that first used in WPI's extremely popular microforge model, the **MF200**. The extensive improvements incorporated into the **DMF1000** greatly increase its versatility and performance, making it one of the most powerful microforges on the market.

Digital Signal Processor (DSP) Technology

The **DMF1000** is powered by the latest digital signal processor (DSP) technology. A digital timer is used to precisely control the polish heating time. Ten memories can be used to store settings of the heating power and heating duration. All of the settings are controlled and displayed digitally for better accuracy and reproducibility. Two different operating modes are provided: Manual and Auto. In the Manual mode, the DSP will memorize the duration of the time that is used to achieve a desired polishing. In Auto mode, the heat will be applied for the duration of the timer setting.

Complete System Available

The **DMF1000** system includes a specially configured WPI model **W30S-LED** research grade compound microscope (optional) equipped with a high quality metallurgic 40x long-working distance objective and a pair of 10x eyepieces. The long working distance objective reduces the danger of damage to the objective lens during the heating process.

Kohler Illuminator and Abbe Condenser

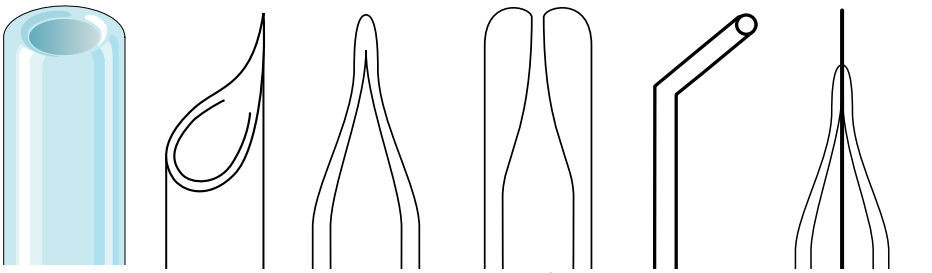
Other benefits of the **DMF1000** design include the use of a Kohler illuminator and Abbe condenser, which provide the reduced glare and sharper image contrast necessary when polishing pipettes as small as half a micron (0.5 µm) in diameter.

Pressure Polishing

The **DMF1000** incorporates a unique digital pneumatic pressure feature that enables pressurized air to be delivered through the pipette during fire polishing. In the fabrication of patch pipettes, the pressurized air can be used to blunt the taper at the pipette tip without changing the size of the tip opening. This reduces electrical resistance of the tip, leading to lower noise during patch-clamp recordings (Goodman & Lockery, 2000).

The Heating Filament

With a conventional microforge often the most difficult and time-consuming part of using a high magnification objective is being able to move both the heating filament and the pipette into the same viewing area. Finding and moving both the heating filament and the pipette without collision can be a challenge. However, this difficulty is eliminated with the **DMF1000** because the heating filament is directly attached to the



Fire Polishing | *Large Tip Sharpening (contact stretching)* | *Tip Sealing* | *Tip Reducing (holding pipettes)* | *Tip Bending* | *Carbon Fiber Sealing in Plastic Sensor*

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microscope's objective. Hence it can be easily adjusted to any position within the viewing area.

The low heat capacity and low thermal coefficient of linear expansion of the filaments are key design features. The low heat capacity of the filament allows it to reach fire-polishing temperatures without excessive heat. This permits you to bring the pipette tip close to the filament during polishing without fear of collapsing the pipette tip. Low heat capacity eliminates the need for an auxiliary air-cooling system. The low coefficient of expansion characteristic of the filament ensures minimal displacement of the filament during heating. This feature eliminates much of the guesswork out of tip placement in relation to the filament.

Two different heating filaments are provided to accommodate various applications. The **H5** *filament is large gauge and can be reformed into a "U" for fabrication of pipettes, air forming of patch pipettes and other applications. The* **H4** *is a smaller gauge filament and is ideal for polishing patch clamp pipettes.*

Pipette Holder Sits on the Microscope Stage

The pipette rests on a specially designed holder that sits on top of the microscope stage. The position of the pipette, relative to the heating filament, is controlled by the (X, Y, Z) adjustment of the stage. This unique design makes locating and polishing the pipette extremely easy. The stage of the microscope has a high quality rail that gives precise, smooth and stable control of the pipette's movement. This configuration also eliminates the need and expense of an additional micromanipulator to control pipette movement.

Typical applications of the DMF1000

Polishing the Patch Pipettes

Proper fire polishing of patch pipettes is the single most important factor for forming a stable giga-seal in patch clamp recording. This is even more important than the type of glass capillary used. Difficulties often arise in forming giga-seals because the polishing of patch pipettes using a conventional low magnification microforge is inadequate. However, the **DMF1000** uses a 40X long-working distance objective. Pipette polishing is much more accurately controlled. Both whole cell patch pipettes and single channel patch pipettes can be conveniently polished to the highest quality and reproducibility achievable with any microforge.

Microforging Holding Pipettes

A holding pipette with a large blunt tip and a small opening is used to hold a floating cell in place prior to microinjection by applying suction to the rear of the pipette. The procedure for making holding pipettes involves three steps: squaring off, large bore flame polishing and tip reducing. These steps are accomplished with a larger heating filament.

Microforging Beveled Injection Pipettes

Occasionally, a beveled large bore pipette is not sharp enough to penetrate a cell without damaging the area around the pipette. With the **DMF1000** and the large heating filament, a sharp point can be formed on the beveled tip to assist the penetration of the cell. This process is referred to as contact stretching.

Pipette Tip Calibration & Microinjection

The integrated digital pneumatic pressure system can be used to calibrate the precise diameter (I.D.) of a micropipette tip, based on a technique described previously (Hagag & Randolph 1990, Bowman & Ruknudin 1999). The pressure system can also be used separately as a simple but highly accurate controller for microinjection applications.

References

Wu, Z.-Z., Chen, S.-R., & Pan, H.-L. (n.d.). Differential Sensitivity of N-and P/Q-Type Ca^{2+} Channel Currents to a Opioid in Isolectin B 4 -Positive and -Negative Dorsal Root Ganglion Neurons. http://doi.org/10.1124/jpet.104.073429

SPECIFICATIONS

AC POWER MODULE	100-240 VAC 50/60 Hz
TIMER RANGE (for heater & timer)	0.01 to 360 sec
NUMBER OF MEMORYS	10
PRESSURE ADJUSTING RANGE	0.5 – 60 PSI (3.5 – 414 kPa)
PRESSURE RESOLUTION	0.1 PSI (0.7 kPa)
FILAMENTS: H4	Small filament for working with 40x long working distance objective.
FILAMENTS: H5	Large filament for working with 10x objective. Filament adjustment assembly provided for both objectives.
HEATER AND TIMER CONTROL	Auto or Manual via Pushbutton, TTL, or Optional Foot switch.
DIMENSIONS: Control Unit	4 x 7 x 17 in. (10.2 x 17.8 x 4.8 cm)
SHIPPING WEIGHT	4 lb. (1.8 kg)
MICROSCOPE	See W30S, page 187
MICROSCOPE: SHIPPING WEIGHT	16 lb. (7.3 kg)

ORDERING INFORMATION

DMF1000-1	Microforge, w W30S-LED Microscope (110 V)
DMF1000-2	Microforge, w W30S-LED Microscope (220 V)
DMF1000-M1	Microforge without microscope (110 V)
DMF1000-M2	Microforge without microscope (220 V)

**Above DMF1000 microforges include 40X long working distance objective*

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

500329	25x Long Working Distance Objective, 5 mm 0.5 NA
13142	Optional foot switch
800292	40x Long Working Distance Objective, 3mm 0.25 NA
503513	21 mm 10X Eyepiece with 100/10 reticle
DMF1000-H5	Replacement heating filament (large gauge)
MF200-H4	Replacement Heating filament (small gauge)
75050	Replacement Micropipette Slide
75040	Replacement Filament Cable

Analog Microforge

Sometimes the simplest designs work best

Features

- Simple, reliable and economically priced
- Analog temperature controller
- W30S-LED microscope (optional)

Benefits

- Includes 40x long-working distance objective and 10x eyepiece
- Kohler illuminator and Abbe condenser for less glare and sharper images.

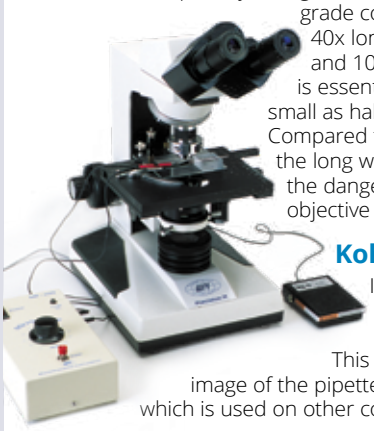
Applications

- Patch pipette tip polishing
- Micropipette tip size reduction
- Contact stretching in in vitro fertilization pipette production

The **MF200** Microforge is a versatile instrument designed specifically for the fabrication of glass micropipettes and other related tools. The system was developed in collaboration with Dr. Ming Li of the Department of Pharmacology, University of South Alabama. The **MF200** is simple, reliable and priced economically.

40x LWD Objective Included

The **MF200** system includes: An easy to use analog temperature controller, a specially configured WPI model **W30S-LED** research grade compound microscope (optional), 40x long-working distance objective and 10x eyepiece. 40x magnification is essential when polishing pipettes as small as half a micron (0.5 µm) in diameter. Compared to a conventional 40x objective, the long working distance objective reduces the danger of damage to the pipette and/or objective lens during the polishing process.



Kohler Illuminator

It is the only commercial microforge using the Kohler illuminator and Abbe condenser for illumination. This provides less glare and sharper image of the pipette than the frosted glass illuminator, which is used on other commercial microforges.

References

Guillou, L., Babataheri, A., Puech, P.-H., Barakat, A. I., & Husson, J. (2016). Dynamic monitoring of cell mechanical properties using profile microindentation. Scientific Reports, 6, 21529. http://doi.org/10.1038/srep21529

Vasauskas, A. A., Chen, H., Wu, S., & Cioffi, D. L. (2014). The serine-threonine phosphatase calcineurin is a regulator of endothelial store-operated calcium entry. Pulmonary Circulation, 4(1), 116–27. http://doi.org/10.1086/675641

SPECIFICATIONS

AC POWER MODULE	100-240 VAC 50/60 Hz
FILAMENTS (3)	H2, H3, H4
FILAMENT ON	Pushbutton Controlled or Optional Foot Switch Controlled
FILAMENT ADJUSTMENT ASSEMBLY	For 40x and 25x Long-Working, Distance Objectives: mounts on objective
FILAMENT ADJUSTMENT ASSEMBLY: OBJECTIVE	40x Long-Working Distance (3 mm)
FILAMENT ADJUSTMENT ASSEMBLY: OPTIONAL	25x Long-Working Distance (5 mm)
EYEPIECE	10x (pair)
EYEPIECE: RETICLE (10x eyepiece only) (OPTIONAL)	1.25 µm/division (at 40x), 0-90° Angle at 5°/division
EYEPIECE: OPTIONAL EYEPIECE	15x (pair)
GLASS HOLDER	Mounts on Microscope Stage
DIMENSIONS: Control Unit	4 x 7 x 1.875 in. (10.2 x 17.8 x 4.8 cm)
SHIPPING WEIGHT	3 lb. (1.4 kg)
MICROSCOPE: Note	See W30S-LED
MICROSCOPE: SHIPPING WEIGHT	16 lb. (7.3 kg)

FEATURE COMPARISON

	MF200	DMF1000
W30S-LED Microscope	✔	✔
40x Long Working Distance Objective	✔	✔
Analog Controller	✔	✔
Digital Controller		✔
Pressurized Air Control		✔
Microinjection Capability		✔
Optional Foot Switch	✔	✔
Memory		✔
Auto-sense of Filament Type		✔
Digital Temperature Control		✔

ORDERING INFORMATION

MF200-1	Microforge System w. W30S-LED Microscope (110 V)
MF200-2	Microforge System w W30S-LED Microscope (220 V)
MF200-M1	MF 200 without microscope (110 V)
MF200-M2	MF 200 without microscope (220 V)

**Above MF200 microforges include 40X long working distance objective*

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

500329	25× Long-Working Distance Objective (fits most microscopes with a 160 mm Focal Length)
13142	Optional foot switch
MF200-H3	Replacement heating filament (medium gauge)
MF200-H4	Replacement heating filament (small gauge)
75090	Filament Adjustment Assembly,22mm OD Objectives
75050	Replacement Micropipette Slide
75040	Replacement Filament Cable

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Micropressure System

Measure hydrostatic pressure in small vessels and oocytes

Features

- Utilizes a liquid filled micropipette (2–5 µm tip opening) for sensing pressure
- Pressure range from 1–100 mmHg (pressure range to 350 mmHg is available)
- Lower limit 1 mmHg (133 Pa)
- Includes calibration/test chamber
- Tubing and fittings for interconnecting system sub-components are provided
- Pressure in the pipette can be manually set to positive or negative relative to the outside
- Probe holder for mounting on micromanipulator is included
- 10 pre-pulled pipettes are included

Benefits

- Measures biological pressures in very small liquid (aqueous) filled spaces
- Pre-configured pipettes are available for convenience

Applications

- Pressure in kidney tubules
- Embryonic blood pressure
- Intracellular pressure
- Mouse intraocular pressure

The **900A** system is designed to measure liquid pressures dynamically in aqueous biological micro-environments, such as in kidney tubules or intracellular pressures. A liquid filled micropipette is used as a pressure probe, and pressure external to the pipette is measured at the tip. The outside diameter of the micropipette tip typically measures between 2–7 µm. Pressure measurement is achieved by monitoring the pipette's electrical resistance. The resistance changes according to changes in the pressure outside the pipette tip via displacement of an electrolyte concentration gradient. As the position of the concentration gradient changes, the resistance of the pipette changes. The resistance signal from the pipette is used as feedback to control a pressure source that applies pressure to the inside of the pipette to counterbalance pressure from the outside. The feedback loop forces the gradient to a neutral balance point, which is user-defined at atmospheric pressure beforehand. The internal pressure required to equally balance the external pressure to the neutral point is readily measured, and it is converted into an analog voltage available at the pressure output BNC and displayed numerically on the LED meter.

System requirements

The **900A** requires stable sources of both pressure and vacuum, which are essential for the system to rapidly counteract changing pressures encountered at the pipette tip. Pressure and vacuum sources are not provided with the **900A** instrument because some labs are already equipped with suitable sources of pressure and vacuum. For researchers who do not possess pressure or vacuum sources, a cylinder of compressed air or inert gas with a dual stage regulator serves very well as a pressure source. Vacuum must be very stable. It is often best supplied by a quality vacuum pump. WPI offers a very quiet continuous duty vacuum pump well suited for use with the system. In addition, a vacuum regulation kit is recommended to fine tune the vacuum source to the ideal level (**900A-VAC**).

A manometer or meter for independent pressure measurement is necessary to calibrate the pressure and vacuum sources, as well as for validation of the performance of the **900A** system prior to experimental use. A pressure measurement device capable of measuring within a range of +300 mmHg and –150 mmHg is recommended (**PM015D** or **PM015R**). For system performance validation at pressures well below 100 mmHg, the **PM01D** or **PM01R** is recommended, because it provides higher resolution at low pressure.

For transient response performance evaluation, a rapid burst of air or water pressure is required. WPI's **PV830** or **PV820** series PicoPumps provide this capability. Rapidly occurring transient pressure measurements are typically captured on a data acquisition system. For details about testing and measurement of rapidly occurring pressure phenomena, contact a WPI sales representative for additional information.

References

Inamoto, R., et. al. (2017). The difference in endolymphatic hydrostatic pressure elevation induced by isoproterenol between the ampulla and the cochlea. Auris Nasus Larynx, 44(3), 282–287. http://doi.org/10.1016/J.ANL.2016.07.018

Wei, J., et. al. (2017). Role of intratubular pressure during the ischemic phase in acute kidney injury. American Journal of Physiology - Renal Physiology, 312(6), F1158–F1165. http://doi.org/10.1152/ajprenal.00527.2016

Inamoto, R., et. al. (2017). The difference in endolymphatic hydrostatic pressure elevation induced by isoproterenol between the ampulla and the cochlea. Auris Nasus Larynx, 44(3), 282–287. http://doi.org/10.1016/j.anl.2016.07.018

Wei, J., et. al. (2017). Role of intratubular pressure during the ischemic phase in acute kidney injury. American Journal of Physiology-Renal Physiology, 312(6), F1158–F1165. http://doi.org/10.1152/ajprenal.00527.2016

Petrie, R. J., et. al. (2017). Activating the nuclear piston mechanism of 3D migration in tumor cells. The Journal of Cell Biology, 216(1), 93–100. http://doi.org/10.1083/jcb.201605097

Warmerdam, T., et. al. (n.d.). Perilymphatic and endolymphatic pressures during endolymphatic hydrops. European Archives of Oto-Rhino-Laryngology, 260(1), 9–11. http://doi.org/10.1007/s00405-002-0518-2

Petrie, R. J., & Koo, H. (2014). Direct measurement of intracellular pressure. Current Protocols in Cell Biology / Editorial Board, Juan S. Bonifacino ... [et al.], 63, 12.9.1–9. http://doi.org/10.1002/0471143030.cb1209s63

SPECIFICATIONS

PRESSURE RANGE	±0–100 mmHg (900APP100)
LINEARITY	< ±0.5% from a straight line
STABILITY	±0.1 mmHg up to 1 hour or more
ACCURACY	±0.5% of full scale
RISE TIME	>10 ms (10–90%), based on residual volume
OUTPUT ("Pressure Signal")	10 mV/mmHg
AMPLIFIER PROBE	Input Resistance $>10^{10}\Omega$, Voltage Gain 1.0
DIMENSIONS (MAIN FRAME)	43.2 x 13.3 x 25.4 cm (17 x 5.25 x 10 in.)
DIMENSIONS (PRESSURE POD)	9.4 x 2.5 x 5.7 cm (3.7 x 1 x 2.25 in.)
POWER	110 VAC/220 VAC

ORDERING INFORMATION

SYS-900A	Micropressure System

Specify line voltage. See training videos at www.wpiinc.com/sys-900a.

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

900AP	Replacement Probe
CAL900A	Pressure Calibration Chamber
3491	Probe Extension Cable
2933	Rack Mount Kit
5332	Replacement Liquid Trap
MEH6RF	Micropipette Holder (1.0, 1.2, 1.5 or 2.0 mm – Specify OD)
TIPTW900A	Pre-pulled Micropipette for 900A (1 mm thin-wall, 2 µTip) (pkg. of 10)
900APP100	Replacement Pressure Pod
SYS-PM015D	Pressure Manometer (15 psi)
SYS-PM01D	Pressure Manometer (1 psi)
801566	Vacuum Pump, 110V
801963	Vacuum Pump, 220V
900A-VAC	Vacuum Pump Regulation Klt

Pressure Manometer

For measuring hydrostatic pressures

Features

- Measure vacuum and pressure in gases
- Ranges available: ±1 PSI, ±15 PSI, ±100 PSI
- Measure in PSI or kPa on the 100 PSI unit or PSI and mmHg on the 15PSI unit
- Battery powered
- Includes tubing and mini-phone to BNC cable

Benefits

- Easy and accurate measurements

Applications

- Measure pressure of non-corrosive gases

Hand-held and battery operated, PM Series pressure manometers monitor vacuum and pressure in non-corrosive gases. 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 mmHg 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 ⅛-in. ID soft vinyl tubing. A mini-phone-to-BNC cable for the recorder output is also available (**CBL102**). Standard versions are equipped with a nine-volt alkaline battery.

PM100

CE

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 kΩ		
PNEUMATIC CONNECTORS	Barbed, for ⅛-inch or 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)		

ORDERING INFORMATION

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*

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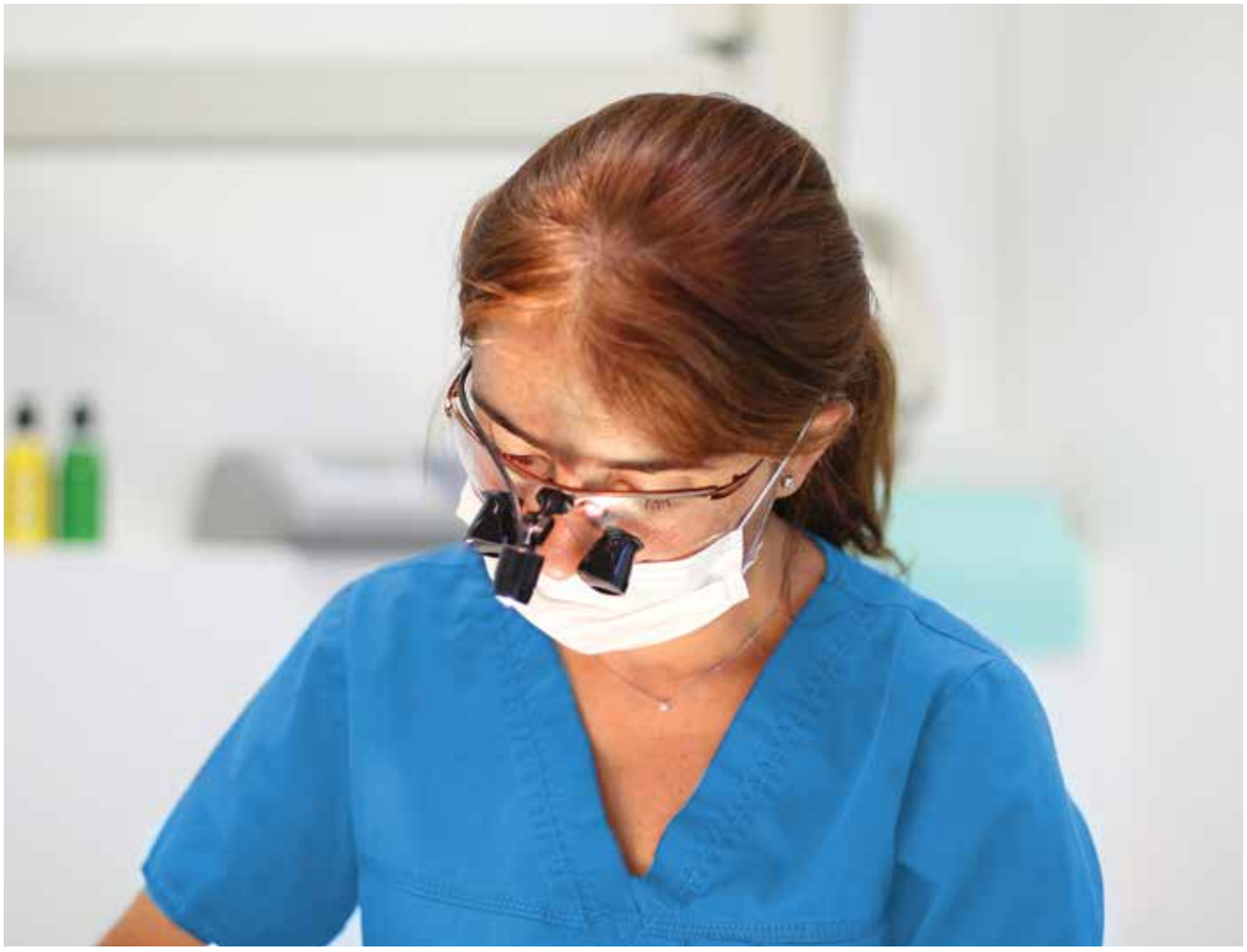
Animal Physiology

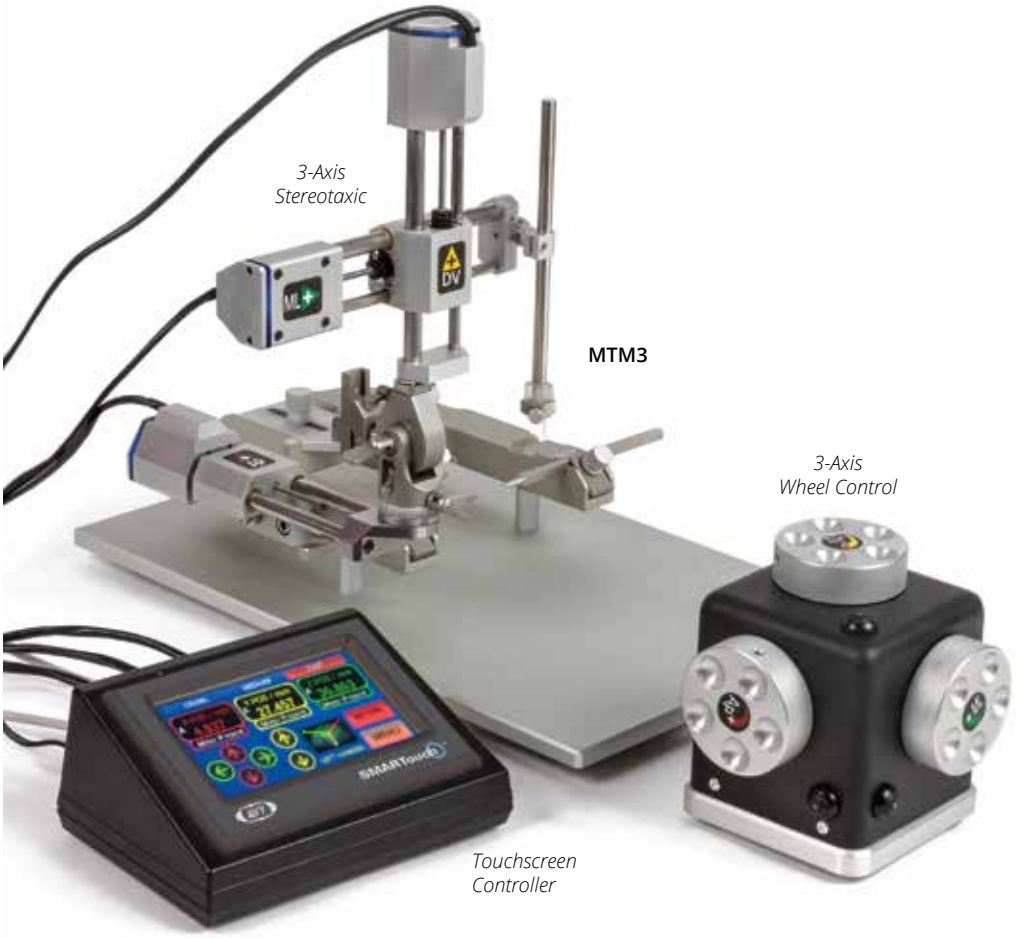


Specialized Equipment for Small Animal Research

WPI offers a broad range of instruments and laboratory supplies that are designed for small animal physiology. Let us help you get the laboratory equipment that's right for your research application.

Motorized Stereotaxic Frame

Automatically calculates coordinates and accurately places the probe



The **MTM-3** *is available in both left- and right-hand versions, or get the* **MTM-6**, *which includes both manipulator arms and dual controllers.*

Features

- Accurate microstepping motor drive for high resolution placement
- Digital controller
- No computer required
- Touch screen controller for easy, intuitive control with better than 10 µm precision
- Graphic controller display for instant operational feedback
- Hand controller for complete manual control

Benefits

- Reliable positioning reduces errors
- Increased precision and repeatabilty of motion
- Feature rich for your convenience of use
- Multiple modes of operation for precise probe positioning

Applications

- Stereotaxic surgery for small animal research

When precision and repeatability of motion are critical, the **MTM-3** Motorized Stereotaxic Frame and digital display outperforms manual models, and it greatly reduces human error when performing routine stereotaxic surgery. The motorized axis of the **MTM-3** provides precise, controlled, 3-dimensional placement of any probe or accessory within the working space of a stereotaxic frame.

No computer is required. The **MTM-3** 3-axis manipulator supplied with WPI stereotaxic frames is compatible with standard stereotaxic frames and may be adapted to existing frames of other manufacturers.

Single and dual manipulator arm motorized systems are available. This allows you to mount a stereotaxic drill and a probe simultaneously. Both 3-Axis Wheel Control and Touchscreen Controller are included.

Reliable positioning for reduced errors

The controller automatically calculates the brain map coordinates for precise probe placement during a stereotaxic surgery. This eliminates the errors resulting from reading Vernier scales.

Increased precision and repeatability of motion

The MTM-3 offers better than 10 µm accuracy with the microstepping motor drive for high resolution placement of your probe, drill or electrode. Coordinate distances are automatically calculated.

Convenient to use

Brain atlas coordinates may be entered into the controller, and no computer required. The simple to use touch screen controller offers ease of control. The graphic controller display provides instant operational feedback during a stereotaxic surgery. For example, the "final approach" speed may be set between 2 mm/sec and 0.02 mm/sec.

Multiple modes for positioning

The arms of the motorized stereotaxic frame may be positioned manually using the digital interface or hand controller. Use the Coordinates mode to control the arm positions based on specific mapped coordinates. Set your retracted position, and store up to three reference (origin) positions. Then, display the probe position with respect to any of your references or the absolute coordinates. If you prefer to write short scripts, computer control is also available which uses a simple, text based command set. For example, if your brain research requires that you routinely drill in the same location of the skull and implant a probe to the same prescribed depth, a script could dramatically improve your process.

SPECIFICATIONS	
TRAVEL	80 mm on each axis
PRECISION	10 µm

ORDERING INFORMATION	
MTM-3	3-Axis Stereotaxtic Frame (Left or Right)
MTM-6	6-Axis Stereotaxtic Frame (Left and Right)
MTM	3-Axis Stereotaxtic Arm/Controller only (Left), Upgrade
MTM-R	3-Axis Stereotaxtic Arm/Controller only (Right), Upgrade

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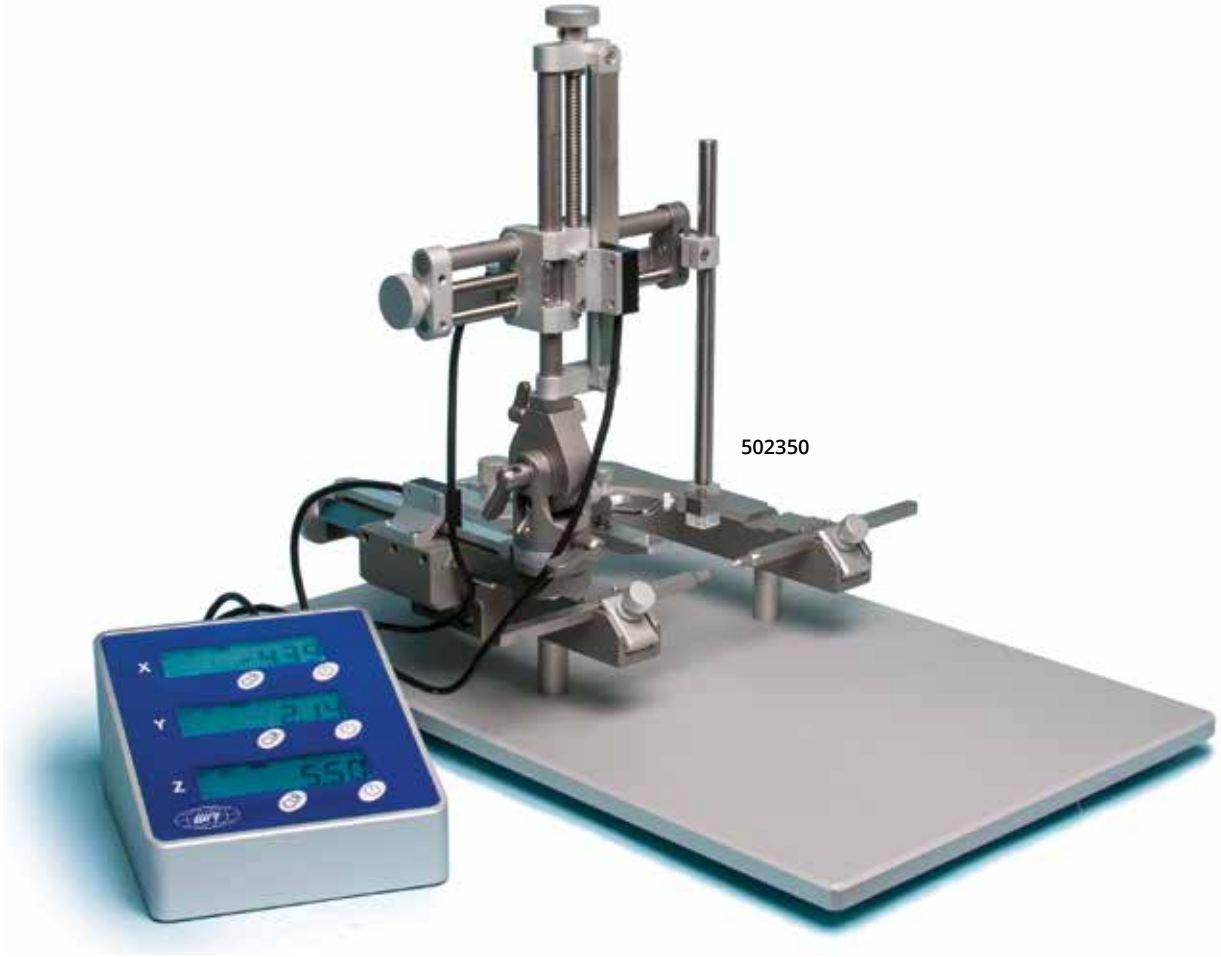
Digital Stereotaxic Frame with LCD Display

Battery powered, low noise for electrically quiet operation



Features

- Large LCD display from sealed sensors on each axis
- Adaptors available for use with rats, mice, birds, cats, guinea pigs and other species
- 80 mm of travel in three planes
- 180° rotation and lock at any vertical angle
- 360° rotation and lock at any level angle
- Syringe pump and drill can be attached directly
- Stable and accurate movement
- Targets specific coordinates by zeroing
- 10 µm precision in all directions
- Extended base plate (400 mm x 255 mm) suitable for various animals
- Vertical lock and fixing knob are separated to ensure accurate position at any angle

Benefits

- Quiet, battery-powered operation
- Battery-powered sensors, without electronic noise, are suitable for electrophysiology experiments

Applications

- Stereotaxic surgery for small animal research
- Electrophysiology applications

This new Digital Stereotaxic Frame features sealed electronic sensors and an easy-to-read LCD display with 10 µm resolution in all three axes. A zeroing function aids in targeting specific coordinates.

- The precisely designed rotary knob and U frame allow sufficient space for the anterior-posterior operation
- Laser engraved scales and a darkened rod for easy to read scales
- Curved design of nose clamp fixes the head of the animal more securely

ORDERING INFORMATION	
502300	Digital Stereotaxic Frame with 18°Ear Bars
502350	Digital Stereotaxic Frame with 45°Ear Bars
502303	Dual Manipulator Digital Stereotaxic Frame, 18°Ear Bars
502353	Dual Manipulator Digital Stereotaxic Frame, 45°Ear Bars
TAXIC-300	Digital Stereotaxic Frame with 18° Ear Bars & UMP3T-1
TAXIC-303	Dual Manipulator Digital Stereotaxic Frame with 18° Ear Bars with UMP3T-1 syringe pump
TAXIC-350	Digital Stereotaxic Frame with 45° Ear Bars & UMP3T-1
TAXIC-353	Dual Manipulator Digital Stereotaxic Frame with 45° Ear Bars with UMP3T-1 syringe pump

UPGRADE MANUAL STEREOTAXIC TO DIGITAL	
502360	Manipulator, 3 Axes, Right Hand, Digital Display
502361	Manipulator, 3 Axes, Left Hand, Digital Display

Precision Stereotaxic Instruments

For small animal research

Features

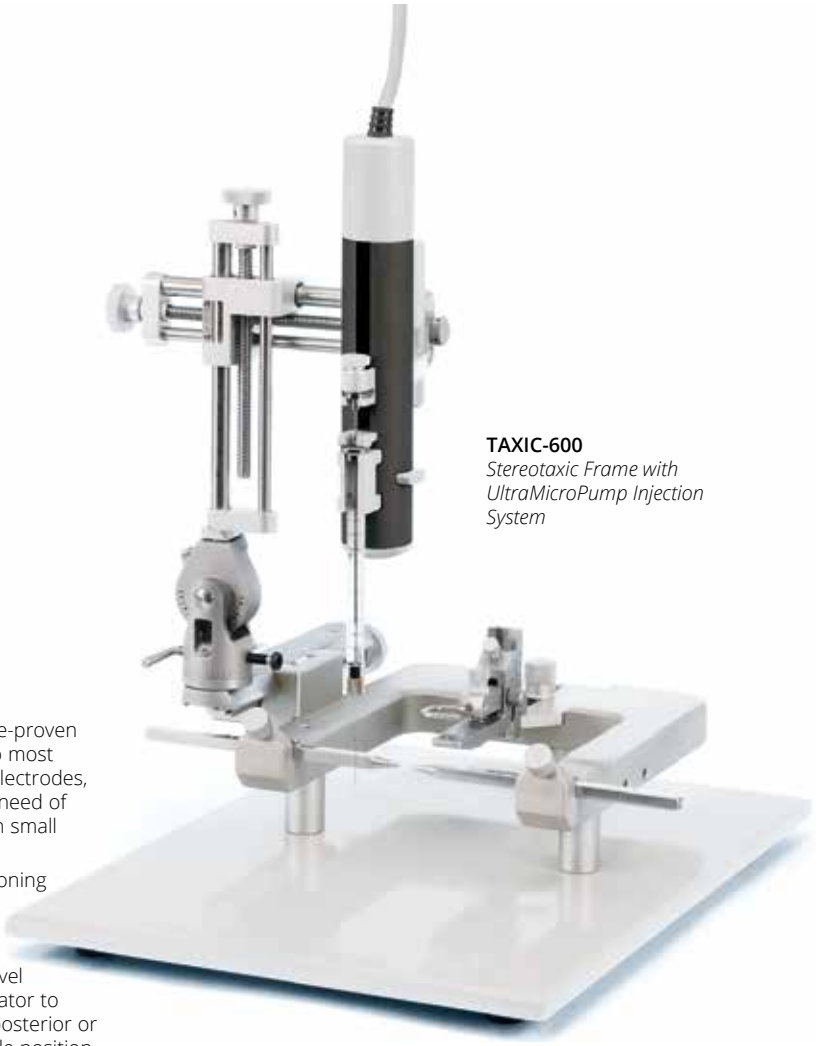
- 5 mm linear movement per revolution on each axis
- Absolute lock at 90° (vertical)
- Entire frame is electrically continuous, ideal for electrophysiology
- Accessories available for wide variety of small animals

Benefits

- Versatile positioning
- Easy to read scales
- Convenient for electrophysiology because the frame may be grounded

Applications

- Stereotaxic surgery for small animal research
- Electrophysiology research



TAXIC-600
Stereotaxic Frame with UltraMicroPump Injection System

WPI's Precision Stereotaxic Instrument is built around the time-proven U-frame design concept, providing stability and adaptability to most species. Precision alignment ensures accurate placement of electrodes, micropipettes and other devices. It is ideal for researchers in need of a versatile, reliable instrument for stereotaxic procedures with small animals.

The manipulator arm controls mediolateral and vertical positioning via lead screws with 80 mm of travel. This allows the fastest positioning possible, consistent with lining up the scales easily at a given coordinate. The anteroposterior movement is controlled via a dovetail slide movement, with 80 mm of travel possible in each direction. A universal joint allows the investigator to change the angle of the probe up to 90° in either the anteroposterior or mediolateral planes. The locking mechanism will hold any angle position without drift or creep. It also provides an absolute lock at 90° vertical.

All scales are oriented to be read easily from the open end of the "U." This is the position from which most scientists prefer to work. The numerals on the scales are clear and easy to read. Precise alignment with facing Vernier scales gives accurate resolution to 0.1 mm.

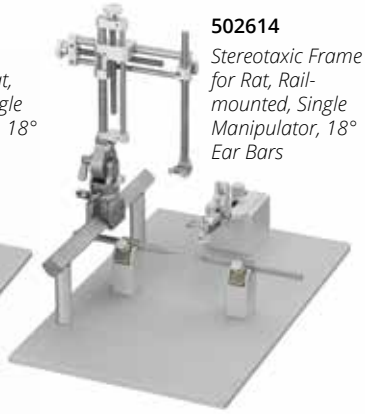
The entire stereotaxic frame, including the dovetails, manipulator arms and base are electrically continuous. Grounding of the entire frame including the base plate can be accomplished by connecting the provided grounding stud to earth. This is ideal for electrophysiological studies where the animal and surrounding structures need to be grounded to reduce electrical noise.

502600

502603

502612
Stereotaxic Frame for Rat, Portable, Single Manipulator, 18° Ear Bars

502614
Stereotaxic Frame for Rat, Rail-mounted, Single Manipulator, 18° Ear Bars



ORDERING INFORMATION

502600	Precision Stereotaxic Frame with 18°Ear Bars
502650	Precision Stereotaxic Frame with 45°Ear Bars
502603	Dual Manipulator Stereotaxic Frame with 18°Ear Bars
502653	Dual Manipulator Stereotaxic Frame with 45°Ear Bars
502612	Stereotaxic Frame, Single Manipulator, for Rat, 18° Ear Bars
502614	Stereotaxic Frame, Single Manipulator, Rail Mounted, for Rat, 18° Ear Bars
TAXIC-600	Stereotaxic Frame with 18°Ear Bars plus UMP3T-1
TAXIC-650	Stereotaxic Frame with 45°Ear Bars plus UMP3T-1
TAXIC-603	Dual Manipulator Stereotaxic Frame with 18°Ear Bars plus UMP3T-1 System
TAXIC-653	Dual Manipulator Stereotaxic Frame with 45°Ear Bars plus UMP3T-1 System

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Mice and Neonatal Rats

Specialized equipment for the smallest subjects

Features

- Base plate dimensions: 25.5 cm × 25.25 cm
- Unique and light ear bars composed of polyoxymethylene resin
- Ear bar and palate clip height regulation range is 20 mm (0 mm~+20 mm)

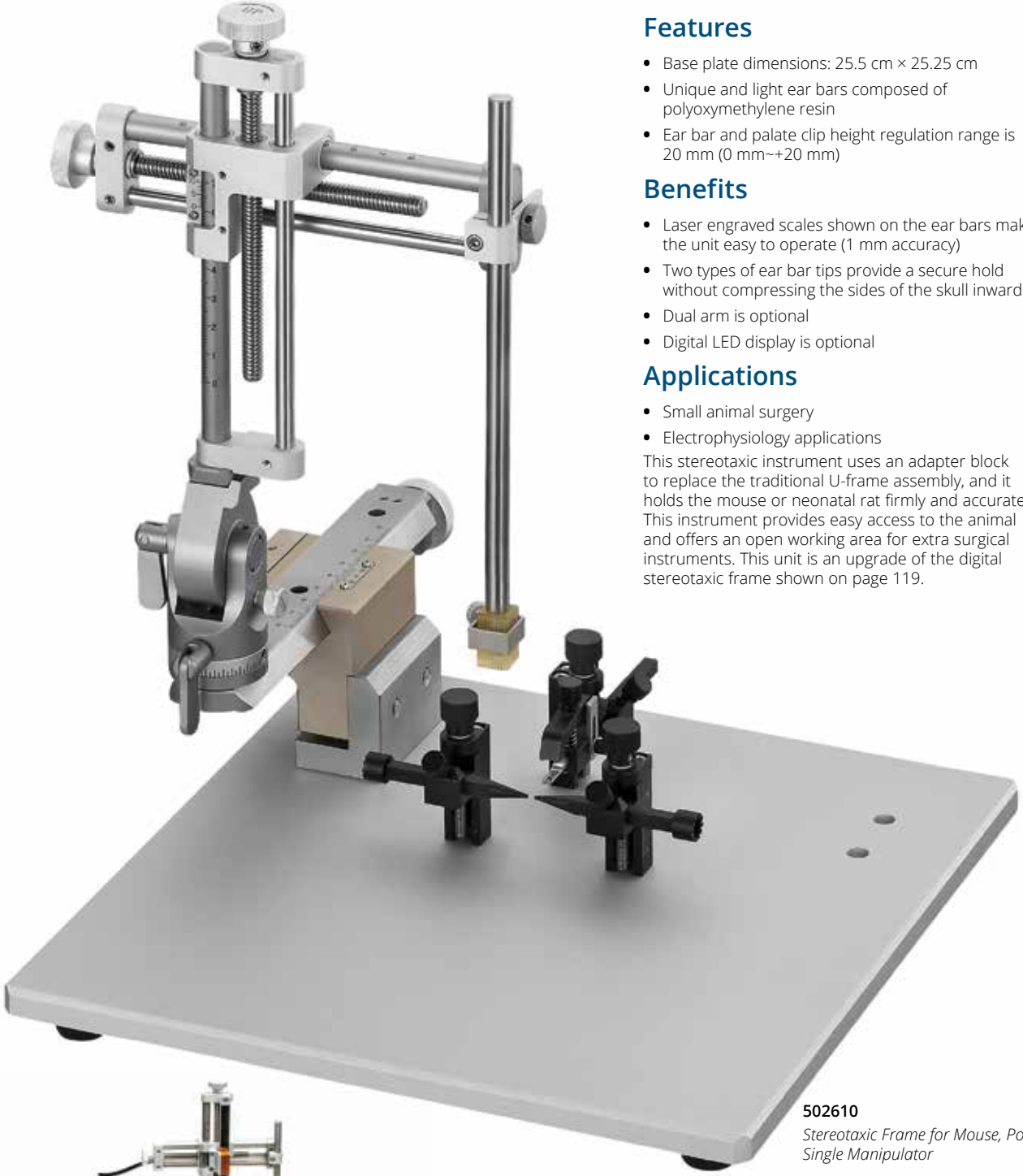
Benefits

- Laser engraved scales shown on the ear bars make the unit easy to operate (1 mm accuracy)
- Two types of ear bar tips provide a secure hold without compressing the sides of the skull inward
- Dual arm is optional
- Digital LED display is optional

Applications

- Small animal surgery
- Electrophysiology applications

This stereotaxic instrument uses an adapter block to replace the traditional U-frame assembly, and it holds the mouse or neonatal rat firmly and accurately. This instrument provides easy access to the animal and offers an open working area for extra surgical instruments. This unit is an upgrade of the digital stereotaxic frame shown on page 119.



502610
Stereotaxic Frame for Mouse, Portable, Single Manipulator

504926
Mouse/Neonatal frame with the optional digital controller

ORDERING INFORMATION	
502610	Stereotaxic Frame, Single Manipulator, for Mouse
504926	Digital Mouse Frame, Single
504927	Digital Mouse Frame, Dual

Parallel Rail Stereotaxic Instruments

For large animal research

502232

Features

- 5 mm linear movement per revolution on each axis
- Entire frame is electrically continuous, ideal for electrophysiology
- Includes the U-frame base plate, manipulator(s), cat/monkey adaptor, 18° ear bars and swivel mount

Benefits

- Versatile positioning
- Easy to read scales
- Convenient for electrophysiology because the frame may be grounded
- Ability to expand to accommodate a variety of large animals

Applications

- Stereotaxic surgery for large animals
- Electrophysiology applications

WPI's Parallel Rail Stereotaxic Frame systems are heavy-duty research instruments for large laboratory animals such as cats, monkeys and dogs. The solid, large frame and superior rigidity ensure the precise alignment of animals for stereotaxic surgery, injection and recording. The system can accommodate up to four manipulators with 100 µm resolution on each axis. Each manipulator can smoothly move to and lock at any location on both parallel rails in a range of 20 cm.

Parallel Rail Stereotaxic Frame system for large animals includes the Parallel Rail Frame, base plate, manipulator(s), cat/monkey or dog adaptor and swivel mount.

ORDERING INFORMATION	
502227	Stereotaxic Frame, 1 Manipulator for Cat/Monkey
502228	Stereotaxic Frame, 2 Manipulators for Cat/Monkey
502229	Stereotaxic Frame, 3 Manipulators for Cat/Monkey
502230	Stereotaxic Frame, 4 Manipulators for Cat/Monkey
502231	Stereotaxic Frame, 1 Manipulator for Dog
502232	Stereotaxic Frame, 2 Manipulators for Dog
502233	Stereotaxic Frame, 3 Manipulators for Dog
502234	Stereotaxic Frame, 4 Manipulators for Dog

502616

MRI Stereotaxic Instrument for Dogs and Monkeys

ORDERING INFORMATION	
502616	MRI Stereotaxic Frame, for Dogs and Monkeys

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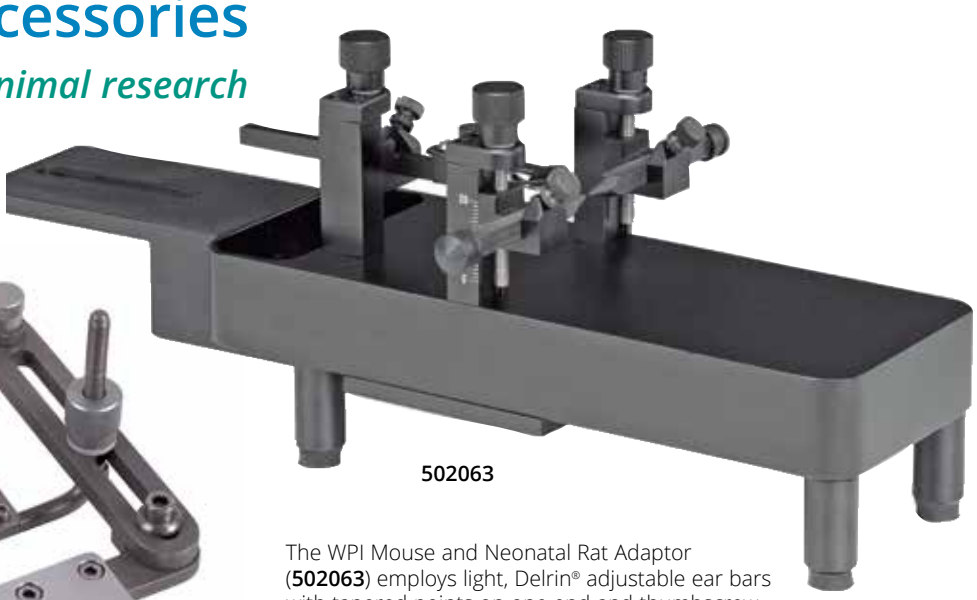
Stereotaxic Accessories

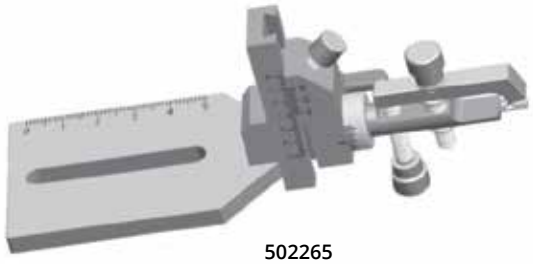
Instruments for small animal research



502063

502241

The WPI Mouse and Neonatal Rat Adaptor (**502063**) employs light, Delrin® adjustable ear bars with tapered points on one end and thumbscrew on the other to facilitate surgery on mice and rat pups. Adjustable ear bars may be independently adjusted in height to level the skull. Laser engraved scales show the vertical positions of the ear bars. A tooth bar and nose clamp secures the nose. A well in the thick aluminum body may be filled with dry ice and alcohol for hypothermic anesthesia of neonatal animals. The adaptor clamps securely on the right side of the "U" frame of the stereotaxic instrument. When gas anesthesia is needed, a gas mask assembly (**502213**) may be mounted on the adaptor.



502265

502259—*Rat Spinal Adaptor*

502266

ORDERING INFORMATION (ADAPTORS)	
502063	Mouse and Neonatal Rat Adaptor
502213	Platform, Gas Anesthesia, with Mouse Mask (use with 502063)
502265	Mouse Adaptor with Nose Clamp
502266	Rat Adaptor
502226	Cat/Monkey Adaptor for 502600 series
502259	Spinal Adaptor for Rat
502060	Guinea Pig Adaptor for 502600 series
502241	Dog/Monkey Adaptor for Parallel Rail Instruments, with Ear Bars, 18°
502259	Rat Spinal Adaptor, for Microscope Stage

502237

502245

502256

502070

Guide Cannula (See page 134)

502068

502244

ORDERING INFORMATION (PROBE HOLDERS)

502210	Probe Holder with Corner Clamp, 0.3-1.5 mm opening
502067	Probe Holder with Side Clamp, 0.3-3.5 mm opening
502070	Cannula Holder, Metal Tip, opens to 3.4 mm *(See cannulas, page 134)*
502256	Cannula Holder, plastic tip, opens to 3.4 mm *(See cannulas, page 134)*
502068	Large Probe Holder, 6–12 mm Opening
502237	Extra Large Holder for OmniDrill35 Microdrill
502236	Microdialysis Probe Holder, 1.5 mm Hole
502244	Micrometer Adjust Electrode Holder, 10 µm Resolution, 25 mm Travel, 0.3-1.5 mm Opening
502245	Manual Microsyringe Injection Holder, 10 µm Resolution, 25 mm Travel

502235 502056 502225 502242

502257
MRI Rat Adaptor

ORDERING INFORMATION (EAR BARS)

502055	Ear Bars, Rat, 18° (pair)
502056	Ear Bars, Rat, 45° (pair)
502224	Ear Bars, Cat, 18° (pair)
502225	Ear Bars, Cat, 45° (pair)
502235	Ear Bars, Mouse, 60°, Non-rupture (pair)
502242	Ear Bars, Rat, Hollow, 1.5 mm Hole for Auditory Stimulation
502249	Non-Rupture, Rubber Ear Bars for Mice
502250	Non-Rupture, Cuff Ear Bars for Mice

ORDERING INFORMATION (OTHER ACCESSORIES)

502257	MRI Rat Adaptor,36 x 12.5 x 9.6 cm
502201	V-Clamp, with 10/32 Screw for Mounting UMP3
504608	V-Clamp, with 10/32 Thumb Screw
502213	Platform, Gas Anesthesia with Mouse Mask (use with 502063)
502243	Adjustable Stage Platform for 502600 series (5 cm high)
503598	Micro-Drill, 35K rpm, with a set of bits, 110/220VAC
503599	Micro-Drill, 35K rpm, with a set of bits, 240VAC, UK plug
61840	Heating Plate for 502063, 4x15 cm (use with ATC2000)

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Stereotaxic Anesthesia Facemask

Ensures a snug fit for mice and rats with zero leakage and zero dead space

Features

- Facemask custom fitted to a toothbar that fits a Cunningham Stereotaxic Frame
- Ports swivel 360°
- Optically clear
- Includes OC-tubing and OC-adapter (requires **EZ-1130**)

Benefits

- Anatomically correct design for a tight fit for mice and rats
- Zero leakage
- Zero dead space
- Provides access to eyes and head of the rodent
- Mask provides stability of the animal for examinations and surgery
- Reduces animal stress by limiting handling
- Reduces technician's exposure to gas

Applications

- Small animal stereotaxic surgery

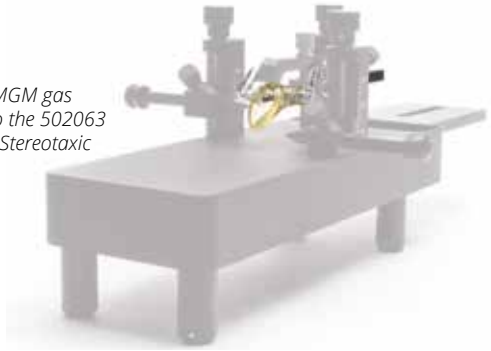
Our custom toothbar for the Cunningham adaptor is designed to accommodate the use of a soft gas mask. The included mask securely fits the toothbar to eliminate gas leakage.

Choose either small or medium size. The **502063-SGM** and **502063-MGM** are customized versions of our standard rodent gas masks.

The OC gas masks allow you access to the eyes and head of the rodent while sealing the nose and mouth. The gas masks provide stability of the animal for examinations and surgery, and they can be easily incorporated in existing examination procedures. The waste-line connects to gravity or vacuum filters, and swiveling ports allow for greater flexibility in positions. They are easily adapted for stereotaxic applications.

Thanks to the anatomical face mask design, you have head-to-tail access. The face mask reduces the technician's exposure to gas by sequestering and filtering waste, minimizing dead space and leakage.

You can reduce rodent stress by limiting handling required when using injectable anesthesia. By choosing these gas masks with isoflurane and thereby reducing the use of Schedule II drugs, you can simplify your lab management. Setting up and changing masks is simple, and the swivel adapters allow you to make adjustments quickly and even modify the mask for stereotaxic uses. Gas anesthesia reduces recovery time, making for a faster and more efficient lab.

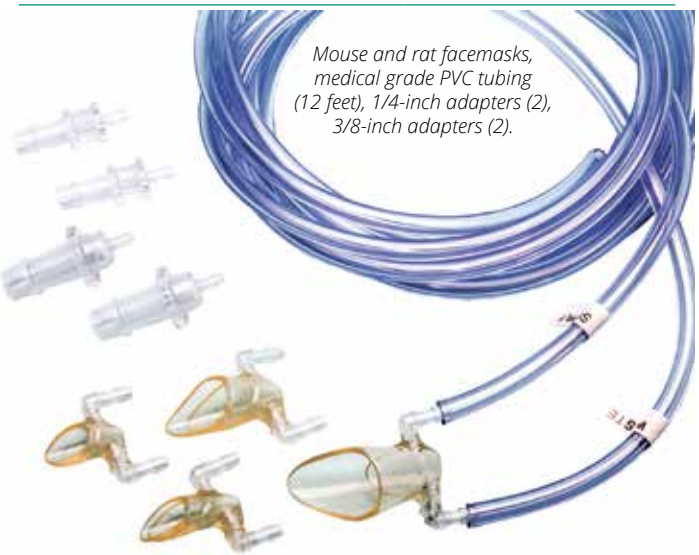


The 502063-MGM gas mask fits onto the 502063 Cunningham Stereotaxic Frame.

RODENT FACEMASKS

*Requires the use of OC-TUBING, OC-ADAPTER and EZ-1130.

OC-SFM	Small Mask	Small Mouse 0.5 – 2 months 8 mm Aperture x 25 mm overall length
OC-MFM	Medium Mask	Mouse 2+ months and Small Rat 10 mm Aperture x 30 mm overall length
OC-LFM	Large Mask	Adult Rat up to 250 g 13 mm Aperture x 35 mm overall length
OC-XLFM	Extra Large Mask	Adult Rat from 250 – 500 g 18 mm Aperture x 42 mm overall length
502063-SGM	Small Mask for Cunningham Stereotaxic Frame *Includes OC-TUBING and OC-ADAPTER	Small Mouse 0.5 – 2 months 8 mm Aperture x 25 mm overall length
502063-MGM	Medium Mask for Cunningham Stereotaxic Frame *Includes OC-TUBING and OC-ADAPTER	Mouse 2+ months and Small Rat 10 mm Aperture x 30 mm overall length



Mouse and rat facemasks, medical grade PVC tubing (12 feet), 1/4-inch adapters (2), 3/8-inch adapters (2).

OC-ALLFM-KIT

ORDERING INFORMATION

502063-SGM	Small Mask for Cunningham Stereotaxic Frame *Includes OC-TUBING and OC-ADAPTER*
502063-MGM	Medium Mask for Cunningham Stereotaxic Frame *Includes OC-TUBING and OC-ADAPTER*

***PLEASE NOTE:** This part is made to fit the WPI neonatal frame only. If you have a neonatal frame of another make, please contact WPI.*

Stereotaxic Frame Anesthesia Masks

Active and passive anesthesia masks for use with stereotaxic equipment

Two kinds of stereotaxic frame nosecone masks are available:

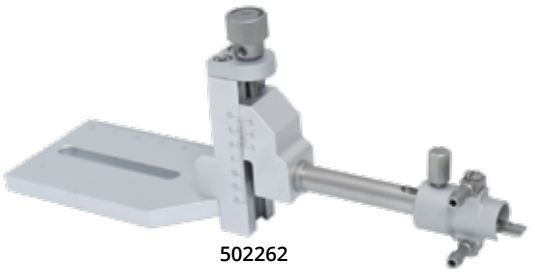
- Passive masks have collinear inlets and outlets.
- Active masks have separate (non-collinear) inlets and outlets on both sides

The passive mask is used with a charcoal canister only, and the active mask can be used with an evacuation apparatus.

Active Anesthesia

502046 (above) — 20 mm ID
502047 (not shown) — 22 mm ID

502042 (above) — 10 mm ID
502043 (not shown) — 11.5 mm ID



502262

ORDERING INFORMATION (ACTIVE SCAVENGING)	
502042	Stereotaxic Anesthesia/Evacuation Mask, Mice or Neonatal Rats, < 30 g
502043	Stereotaxic Anesthesia/Evacuation Mask, Mice or Neonatal Rats, 30-70 *g*
502046	Stereotaxic Anesthesia/Evacuation Mask, Rats ,< 300 g
502047	Stereotaxic Anesthesia/Evacuation Mask, Rats, > 300 g
502262	Mouse Gas Anesthesia Head Holder with Rubber Ear Bars

Passive Anesthesia

502213

502054

502053

ORDERING INFORMATION (PASSIVE SCAVENGING)	
502213	Platform, Gas Anesthesia, with Mouse Mask (use with 502063)
502053	Stereotaxic Mask, Gas Anesthesia, Mouse or Neonatal Rat (< 70g)
502054	Stereotaxic Mask, Gas Anesthesia, Rat (< 300 g)

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Animal Temperature Controller

Maintain optimal animal temperature during research procedures

Features

- Animal Temperature Controller with Adaptive mode–auto adjust PID regardless of animal size
- Plate's internal temperature sensor prevents localized hot spots under animal with maximum temperature stability
- Compatible with RTD (resistive temperature device) and thermocouple probes
- Extremely quiet DC heater to facilitate electrophysiological recordings
- Three temperature sensor inputs
- Auto shutdown if the plate reaches 45°C

ATC2000

Benefits

- Low noise temperature control system
- Adapts to different size animals automatically
- Accepts RTD and thermocouple probes

Applications

- Small animal surgery
- Stereotaxic surgery

The **ATC2000** Animal Temperature Controller is a low-noise heating system for maintaining animal body temperature during experimental procedures. The DC heater is extremely quiet in terms of electromagnetic radiation. This is essential in electrophysiological recordings which are very sensitive to electromagnetic interference.

The controller uses proportional, integral, derivative (PID) technology to provide precise and stable control of a subject's temperature. Compared with switched on/off type controllers, PID controllers provide a much more precise and stable control of temperature. The PID approach is also more immune to the variation of the experimental conditions such as change in animal size and unexpected disturbances. Our unique adaptive mode technology automatically senses and adjusts the PID values based on the size of the animal.

Multiple temperature sensing inputs

The **ATC2000** has three temperature sensing inputs.

- The resistive temperature device (RTD) probe input can be used to monitor an RTD rectal probe to control the animal temperature or to monitor ambient temperature, induction chamber temperature or any other temperature.
- When using a thermocouple probe, the thermocouple (TC) probe input can be used just like the RTD input. (A T type thermocouple must be used.)
- The heater plate also has an internal temperature sensor. The **ATC2000** monitors this sensor to prevent the localized hot spots under animal.

Operational modes

The controller has three operational modes:

- Normal mode uses the configured sensor (RTD or TC) or the plate sensor to drive the control loop.
- Adaptive mode uses the temperature of the heated plate and the temperature of the subject to control. This approach is less prone to overshoot, but somewhat slower than the normal mode, depending on the sampling rate used.
- Shutdown is a fail safe mode used if the plate temperature ever exceeds 45°C.

Required Accessories

The **ATC2000** is tuned at the factory. However, the PID parameters may also be set manually. The temperature resolution of the controller is 0.1°C. The rectal temperature probe has a 5-ft. ultra-flexible, shielded cable and an RTD sensor.

The metal heating plates (available separately) have built-in temperature sensors. The smaller heating plate (WPI# **61840**) is compatible with stereotaxic systems; the rigid, flat surface of the warming pad fits under the U-frame. Our homeothermic warming pads are washable with water and detergent.

A heating plate and a probe are required for use with this unit.

References

Nguyen Chi, V., Müller, C., Wolfenstetter, T., Yanovsky, Y., Draguhn, A., Tort, A. B. L., & Brankačk, J. (2016). Hippocampal Respiration-Driven Rhythm Distinct from Theta Oscillations in Awake Mice. *Journal of Neuroscience*, 36(1).

Okun, M., Lak, A., Carandini, M., Harris, K. D., Buzsaki, G., Stevenson, I., … Kaufman, M. (2016). Long Term Recordings with Immobile Silicon Probes in the Mouse Cortex. *PLOS ONE*, 11(3), e0151180. http://doi.org/10.1371/journal.pone.0151180

Gaylo, A., Overstreet, M. G., & Fowell, D. J. (2016). Imaging CD4 T Cell Interstitial Migration in the Inflamed Dermis. *Journal of Visualized Experiments*, (109), e53585–e53585. http://doi.org/10.3791/53585

***61840**—Small heating plate (15x4 cm) for use with stereotaxic frames.*

ORDERING INFORMATION

ATC2000	Animal Temperature Controller

RECOMMENDED ACCESSORIES (select one sensor and one plate)

61800	Heating Plate with Built-in RTD Sensor, 15 x 25 cm
61830	Heating Plate with Built-in RTD Sensor, 15 x 10 cm
61840	Heating Plate with Built-in RTD Sensor*, 15 x 4 cm

**for stereotaxic frame*

OPTIONAL ACCESSORIES/REPLACEMENTS

61824	RTD Rectal Temp Probe, 1.25 mm Shaft 2.5 mm Ball Tip
RET-2	TC Rat Rectal Temp Probe, 1 mm Shaft, 3.2 mm Ball Tip
RET-3	TC Mouse Rectal Temp Probe, 1 mm shaft, 1.6 mm Ball Tip
503573	Silicone Pad for ATC2000 (10 x 15 cm)
MT-29/1HT	29 ga 1 cm Needle Microprobe, 5-ft Cable
MT-23/3HT	23 ga 3 cm Needle Microprobe, 5-ft Cable
MT-D	Needle Microprobe, 5-ft Cable
IT-18	Flexible Implantable Probe, 0.025-inch Diam., 3-ft Cable
IT-23	Flexible Implantable Probe, 0.009-inch Diam., 3-ft Cable
IT-1E	Flexible Implantable Probe, 0.025-inch Diam., 3-ft Cable

Small Animal Anesthesia

Complete systems and all the accessories

EZ-B800 Basic System

Components may not be as pictured.

Features

- Safe for surgical personnel, 90% below OSHA isoflurane limit
- Time efficient and cost-effective
- Virtually stress free for the animals
- Speedy recovery time

Benefits

- Compact and portable
- Easy to set up and use, simplifying the training of new staff and reducing the risk of human error
- Turnkey (all-in-one) system or plug-and-play system

Applications

- Small animal surgery

EZ-Anesthesia is the system of choice for anesthetizing small animals, and it comes with a variety of choices. Animals to be anesthetized are placed in the acrylic induction chamber, and the system delivers a precisely blended mixture of oxygen and isoflurane. An activated charcoal air filter canister at the top of the chamber releases safe, filtered air back into the room. A water-heated cage warmer or warming plate (**ATC2000**) is used to retain the animal body temperature while in the induction chamber. After the initial anesthetizing, the animal may be moved to the heated surgical water bed and positioned properly in the snugly fitted nose cone. A highly sensitive valve regulated by the animal's breathing works with the nose cone to ensure non-rebreathing efficiency. It allows safe anesthesia for up to several hours.

The breathing device also includes an air filter that releases safe, filtered air back into the room.

Oxygen and liquid isoflurane are not supplied. These are required to operate the system. Each system comes with all necessary components and connections for immediate use, including:

- Oxygen regulator
- Vaporizer unit
- Induction chamber (standard **EZ-178**)
- Breathing device (standard **EZ-103**)
- Case of charcoal filters
- Connecting tubing

Other available options include:

- Heated water beds
- Additional breathing devices
- Chambers in a variety of sizes
- Key fill isoflurane vaporizer is available separately or may be substituted in a complete system (call for details)

EZ-FF9000 Fixed Flow System

The Fixed Flow System is our most advanced system and provides preset, fixed flow rates with no need for adjustment. The system offers five gas outlets, each with an individual ON/OFF switch. The system ensures consistent, precise gas flow when connected to any pressurized gas source higher than 7 psi.

- Induction chamber output is fixed at 1 LPM
- Four breathing circuit outputs are fixed at 0.5 LPM

This unit features an oxygen flush button that purges the induction chamber with pure oxygen, thereby protecting personnel from exposure to anesthesia gas when opening the chamber. A handle on the vaporizer makes the unit easy to safely transport.

EZ-7000 Classic System

The Classic System has a user-friendly flow meter. The system offers five gas outlets that can supply a single induction chamber and four breather circuits simultaneously.

The system also features an oxygen flush button that purges the induction chamber with pure oxygen, thereby protecting personnel from exposure to anesthesia gas when opening the chamber. A handle on the vaporizer makes the unit easy to safely transport.

EZ-B800 Basic System

The Basic System is designed for use with a single animal. It utilizes one output directly from the vaporizer into a Y-splitter which creates a dual feed that can be directed to the induction chamber or the breather circuit.

This unit incorporates an oxygen flush system that purges the induction chamber with pure oxygen, thereby eliminating personnel exposure to anesthesia gas when opening the chamber.

ORDERING INFORMATION	
EZ-FF9000	Fixed Flow System
EZ-7000	Classic System
EZ-B800	Basic System

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Anesthesia Accessories

Induction Chambers

These chambers incorporate a positive seal O-ring gasket for containment during use.

ORDERING INFORMATION	
EZ-177	Sure-Seal Mouse Chamber (5"L × 4.75"W × 4.38"H)
EZ-178	Sure Seal Mouse/Rat Chamber (9.75"L × 4.75"W × 4.38"H)
EZ-1785	Large Mouse/Rat Chamber (7"W × 11"D × 6"H inside)
EZ-179	Rabbit/Guinea Pig Chamber (18.75" × 12.75" × 12.75")

Ventilator Connection Kit

This kit is used to connect the **SAR-830** ventilators with EZ-Anesthesia systems. It includes all required components, pre-assembled for simple connection between the ventilator and the anesthesia system.

ORDERING INFORMATION	
EZ-830	Ventilator Connection Kit

Connection Kit

This kit is used for connecting additional components to the EZ-Anesthesia Systems. It includes 6 ft of clear PVC tubing with a quick-disconnect fitting.

ORDERING INFORMATION	
EZ-1130	Connection Kit

EZ Oxygen Regulators

Regulators are preset to 50 psi.

- **EZ-320** utilizes a CGA-540 connection for large "H" tanks.
- **EZ-330** utilizes a CGA-870 connection for small "E" tanks.

ORDERING INFORMATION	
EZ-320	Oxygen Regulator for large tanks
EZ-330	Oxygen Regulator for small tanks

Custom Hose Assemblies Available

Custom built hose assemblies for wall or ceiling outputs specific to facility needs: Chemetron, Ohmeda, Schrader or DISS.

Other Accessories

EZ-103

EZ-107

ORDERING INFORMATION	
EZ-104A	Versaflex Non-Rebreathing Unit
EZ-103A	Microflex Non-Rebreathing Unit
EZ-107A	Rat Stereotaxic Non-Rebreathing Unit
EZ-109	Multi-Animal Non-Rebreathing Unit
EZ-211	Mouse/Rat Thin-Line Heated Waterbed

Mobile Workstations

Two mobile workstations, constructed of heavy-duty stainless steel with locking casters, integrate all your EZ-Anesthesia components into one portable unit. Open side shelves accommodate 20 lb. cylinders, and convenient 2" port holes allow for easy rigging of gas and electrical lines. Below the work surface of each mobile workstation is an open shelf and a locking cabinet. **EZ-E25000** provides a 42"x24" work surface and holds up to four cylinders. **EZ-E27000** has a 22"x21" work surface and holds up to two cylinders. These systems are easy to set up and provide maximum flexibility and mobility.

ORDERING INFORMATION	
EZ-E25000	Mobile Workstation, 42" x 24" Top
EZ-E27000	Mobile Workstation, 22" x 21" Top

Euthanex Lids

EZ-20032

The Euthanex Lid system has become an industry standard. You no longer need to transfer animals. The lids are available in five sizes to accommodate virtually all plastic cage sizes designed for small lab animals. These heavy duty stainless steel lids have a stem fitting for connection to the quick-disconnect fitting on the hose from the gas source. A foam lid gasket ensures a good seal on the cage. Multiple lids may be used to treat several cages at once.

ORDERING INFORMATION	
EZ-20027	Small Lid (13" x 9") Fits old-style mouse cages
EZ-20028	Small Lid (16" x 10") Fits new-style mouse cages
EZ-20030	Square Lid (13" x 13") Fits Thorn cages
EZ-20032	Medium Lid (20.5" x 11") Fits rat cages
EZ-20034	Large Lid (23" x 16.5") Fits guinea pig cages
EZ-20029	Lid Storage Bracket (wall-mounted, holds up to four lids)
EZ-20027G	Small Lid Gasket (13" x 9")
EZ-20028G	Small Lid Gasket (16" x 9")
EZ-20030G	Square Lid Gasket (13" x 13")
EZ-20032G	Medium Lid Gasket (20.5" x 11")
EZ-20034G	Large Lid Gasket (23" x 16.5")

Vaporizer Pole Mount

The **EZ-E28000** is a mounting option for the EZ-Anesthesia system, combining system portability with a small footprint. Constructed of aluminum and stainless steel, it features a five-leg base for maximum stability and an oxygen "E" tank mounting bracket. Anesthesia system must be purchased separately.

ORDERING INFORMATION	
EZ-E28000	Vaporizer Pole Mount

EZ-E28000

Blood Pressure Monitor and Transducer

Audible monitor with variable pitch provides feedback

Features

- Variable amplification
- Displays systolic, diastolic or average blood pressure
- Audio monitor
- BNC output for data logging

Benefits

- **BLPR2** can be used for the direct arterial and venous pressure measurement in animal blood vessels

Applications

- Invasive monitoring of animal arterial or venous blood pressure

SYS-BP1

BP1 accepts WPI's **BLPR2** blood pressure transducer (below) as well as other blood pressure transducers. An audio monitor provides a signal with variable pitch and amplitude, allowing you to hear changes in blood pressure. Digital LCD display provides average or peak signal values from 0 to 1999 mV. With an optional pressure gauge (not provided — see **PM015D**, page 116), you may calibrate the display to read mmHg. Recorder output connector allows direct connection to a pen recorder, oscilloscope or computer via a data acquisition system.

Supplied sterile, **BLPR2** is accurate, linear and stable with temperature. May be sterilized cold with Rapicide OPA or a similar bactericide.

BLPR2 is equipped with a 12-ft cable and connector compatible with WPI's four-channel signal conditioning unit, **TBM4M** Transbridge, and the single-channel **BP1** blood pressure monitor. The cable has a moisture-resistant locking connector. A continuous, uniform lumen eliminates places for bubbles to form and lodge. The clear fluid path is easy to inspect. Easy to mount — slotted transducer body accepts Velcro strap.

To facilitate setup and operation, a four-way stopcock that allows easy filling, flushing and zeroing of the transducer is included. Typically, the stopcock is located between the transducer and the animal catheter where it can be used to quickly zero, flush or de-bubble the transducer.

Stopcock **14036** *included with* **BLPR2**

BP1 SPECIFICATIONS	
AMPLIFICATION	x1, x10, x100, variable (x5 to x1000)
OUTPUT VOLTAGE SWING	± 5 V
MAXIMUM OUTPUT CURRENT	2 mA
INPUT IMPEDANCE, EACH INPUT	100 kΩ || 0.01 µF
TRANSDUCER APPLIED VOLTS	10 V nominal, varies with load. 25 mA, maximum
POWER	95-135 V or 220-240 V, 50/60 Hz
DIMENSIONS	8.5 x 5.12 x 10 in. (21.6 x 13 x 25.44 cm)
SHIPPING WEIGHT	11 lb. (5 kg)

BLPR2 SPECIFICATIONS	
WORKING PRESSURE	–50 to +300 mm Hg
OVERPRESSURE	–400 to +4000 mm Hg
EXCITATION VOLTAGE	1-10 VDC or RMS to 5 kHz
SENSITIVITY	5 µV/V/mm Hg
DYNAMIC RESPONSE	100 Hz
EIGHT HOUR DRIFT	1 mm Hg after 5 minute warm-up
MAXIMUM ERROR	Total combined effects of Sensitivity, Linearity, Hysteresis (at 25°C and 5 µV/V/mm Hg) do not exceed ±2% or 1 mm Hg, whichever is greater.
SHIPPING WEIGHT	1 lb.

ORDERING INFORMATION

SYS-BP1	Pressure Monitor (transducer & cable not included)

Specify line voltage

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

BLPR2	Blood Pressure Transducer & Cable
BPCABLE2	Cable (12 ft) with DIN connector for BLPR2
503067	BLPR2 Transducer without cable
13024	Single Rack Mount Kit
13025	Dual Rack Mount Kit
3491	Extension Cable, 5 ft
500184	BNC-to-BNC Cable, 10 ft
14036-15	4-Way Luer Stopcock, Blue Tint (package of 15)
KZ1101	Micro Cannula, 3 inch

NOTE: BLPR2 is intended for animal research only and may not be used for human blood pressure measurement.

Micro Cannula KZ1101

- 0.4 mm O.D., 0.2 mm I.D. tubing
- Autoclavable
- Biocompatible perfluorocarbon tubing material

See description on page 221.

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Blood Pressure Measurement for Rodents

Unique environmental control system and single tail cuff allows tail movement, minimizing stress in the animal subjects

II-MRBP-M

Features

- Test up to 200 animals at a time
- Sensor is MRI compatible
- Quick and accurate blood pressure measurement at temperatures as low as 32˚C
- Highly sensitive photoelectric sensor for blood pressure detection
- Monitor, record, store or export real time systolic, diastolic, mean and heart rate

Benefits

- Automatic evaluation of data
- Touch screen or software control
- Data can be collected and stored on and displayed from a USB flash drive, which is included

Applications

- Non-invasive blood pressure monitoring of rodents

This revolutionary design brings non-invasive blood pressure testing to a new level — a true turn-key system for accurate, consistent blood pressure measurement on mice, rats or any other laboratory animal test subject.

It is a compact, simple yet versatile system that can test from one to 200 animals at a time with independent control of each channel. Simple daisy-chaining allows expansion of up to 200 independently controlled systems.

All components are built into one small unit — controls inflation of tail cuff, warming environment with whisper-quiet fans — providing an ideal system for teaching facilities and for the pharmaceutical industry when high throughput is a must.

Single animal systems are controlled from the touch screen, which allows keying in all necessary test setups. Touch screen control allows ease of operation, supplying automatic evaluation of test results — systolic, diastolic, mean and heart rate.

Data is collected, stored, displayed and can be transferred to the supplied memory stick. The USB interface allows for software control of multichannel systems. For single animal systems, built-in software lets you view and export data. Reports are in an Excel-style format and may be easily exported.

No computer is required. However, the analog output may be interfaced with your own data acquisition software.

System is easily cleaned. Removable trays are included with each system.

Tail Cuff Sensors have the ability to detect mouse blood pressure or rat blood pressure via the tail photoelectrically. The photoelectric sensor, light source and sensor are built into a unit which attaches to a restrainer with nylon hand screws. Sensors are nonmagnetic. The ambient temperature that a reading can be taken starts at 30°C. The maximum temperature needed for a test is usually 32°C for rats and 34°C for mice. The systolic readings are within five mmHg of Cannulation and Telemetry.

In addition to the standard one-year warranty on the system, tail cuff sensors have a lifetime warranty.

ORDERING INFORMATION

II-MRBP-M	Mouse Blood Pressure System
II-MRBP-R	Rat Blood Pressure System

Includes one tail cuff sensor and one restrainer (select when ordering). Call for pricing on multiple channels.

OPTIONAL ACCESSORIES

II-B64-1	Tail Cuff Sensor, 650-800 grams, ID 1 in.
II-B63-075	Tail Cuff Sensor, 500-650 grams, ID ¾ in.
II-B60-044	Tail Cuff Sensor, 150-380 grams, ID 7⁄16 in.
II-B60-038	Tail Cuff Sensor, 70-160 grams, ID ⅜ in.
II-B60-025	Tail Cuff Sensor, 20-80 grams, ID ¼ in.
II-78	Rodent Restrainer, 750 to 1000 grams, ID 4" (105 mm), 13" Long
II-79	Rodent Restrainer, 600 to 800 grams, ID 3½" (88 mm), 13" Long
II-80	Rodent Restrainer, 400 to 600 grams, ID 3" (75 mm), 12" Long
II-81	Rodent Restrainer, 250 to 400 grams, ID 2½" (63 mm), 9" Long
II-82	Rodent Restrainer, 180 to 270 grams, ID 2" (50 mm), 8" Long
II-83	Rodent Restrainer, 70 to 170 grams, ID 1½" (38 mm), 6" Long
II-84	Rodent Restrainer, adult mice and neonate rats, 20 to 45 grams, ID 1" (25 mm), 4" Long
II-84XL	Rodent Restrainer, 45 to 70 grams, ID 1¼" (30 mm), 5" Long

Microprobe Thermometers

Instrument of choice for biological and laboratory use

BAT-12

Stand sold separately

BAT-10

Features

- Super accuracy
- Fast response
- Analog output signal
- Multiple inputs
- Differential temperature measurement

Benefits

- Portable
- A variety of probes available

Applications

- Temperature monitoring
- Cryogenic measure for blood banking
- Skin temperature measurement in exercise experiments

A Microprobe Thermometer is the instrument of choice for biological and laboratory temperature measurements. These thermometers are very versatile, providing fast response, high accuracy and stability with digital display and analog signal for connection to a computer or recorder. With the wide selection of probes, the instruments can be used in almost any application.

BAT-12: This thermometer has a sealed construction making it water, dust and fume resistant. The **BAT-12** has a single microprobe input and a single range with the same high accuracy as the **BAT-10**. Comes complete with carrying case.

The thermometers can be used with any "Type T" thermocouple. Select a temperature microprobe on the following page for your specific application.

BAT-10: This is the most versatile thermometer available. The instrument has a wide temperature range and fast response with most microprobes. The **BAT-10** accuracy is NIST traceable and in each of the two temperature ranges, the accuracy is the same as the resolution. There are three microprobe inputs, 1 and 2 can be selected as separate inputs while 2 and 3 will read the differential temperature measurement between the two. The instrument has automatic warnings for low battery or faulty probes on the digital display. The linearized analog output (LOP) signal allows ease of connection to a data acquisition system or recorder.

MICROPROBE THERMOMETER SPECIFICATIONS

	BAT-10	BAT-12
TEMPERATURE RANGE & RESOLUTION	-200°C to +400°C, 1°C resolution -100°C to +199.9°C, 0.1°C resolution	-100°C to +199.9°C, 0.1°C resolution
DIFFERENTIAL TEMP. RANGE	-19.99°C to +19.99°C Linearization centered at 40°C 0.01°C resolution	N/A
ACCURACY 1° Range 0.1° Range Diff. Range	 1°C ±1 least significant digit 0.1°C ± 1 least significant digit 0.01°C ± 1 least significant digit	 0.1°C ± 1 digit between 0-50°C 0.1% ± 1 digit over full range
REPEATABILITY	± 1 least significant digit	
CALIBRATION CONFORMITY	Conforms to NIST tables	Follows NIST thermocouple tables within 1 digit
DISPLAY	3½ Digit LCD	3½ Digit LCD
INPUT SOCKET	Miniature, quick disconnect, copper-constantan	Miniature, quick disconnect, copper-constantan
ANALOG OUTPUT	Non-linearized set at 1.6 V, corresponding to temperature of 401°C	≈ 10 mV per degree C
POWER SUPPLY/BATTERIES	BAT-10: 4 alkaline "C" cells (life: 1000 hr) BAT-10R: 4 Ni-Cad "C" cells (rechargeable unit)	BAT-12: 9V cell BAT-12R: 9V Ni-Cad with charger
SENSORS	Three Type T thermocouple inputs	One Type T thermocouple input
AMBIENT OPERATING RANGE	15-45°C	Auto-compensated to 0.1°C from 0°C to 50°C
DIMENSIONS	21.6 x 22.9 x 8.9 cm (8.5 x 9 x 3.5 in.)	12.7 x 6.4 x 15.2 cm (5 x 2.5 x 6 in.)
WEIGHT	1.6 kg (3.5 lb), including carrying case	1 kg (2 lb), including carrying case

ORDERING INFORMATION

BAT-10R/LOP	Multiple Input Type T Thermocouple Thermometer, rechargeable NiCad batteries and 110 VAC adapter (microprobes ordered separately)
BAT-10R/LOP220	Multiple Input Type T Thermocouple Thermometer, rechargeable NiCad batteries and 220 VAC adapter (microprobes ordered separately)
BAT-12R	Single Input Type T Thermocouple Thermometer, rechargeable NiCad batteries and 110 VAC adapter (microprobes ordered separately)
BAT-12R-220	Single Input Type T Thermocouple Thermometer, rechargeable NiCad batteries and 220 VAC adapter (microprobes ordered separately)

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

EXT-6	Probe Extension Lead, 180 cm long
501608	Tripod Stand for BAT-12

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Temperature Probes

A variety of probes for any application

Features

- Flexible Teflon microprobes are used for implantation in tissue, in spectrophotometer cuvettes, rectally in neonatal mice, in water baths, PCR thermal cyclers, etc.
- Monitors animal rectal temperatures during surgical procedures and pyrogen testing

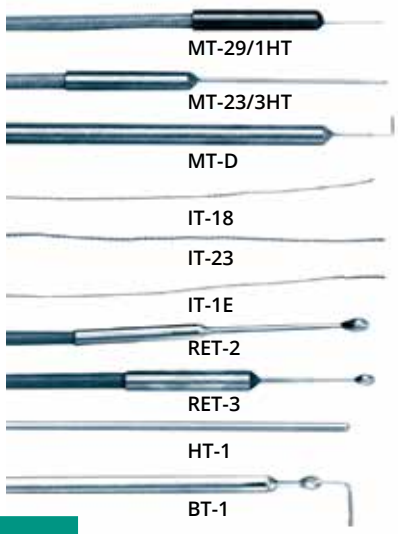
Benefits

- Thermocouple wire used meets NIST standards (certification is available for an additional cost)

Applications

- Rectal temperature monitoring
- Instant read in tissue, semi-solids, small specimen and other materials

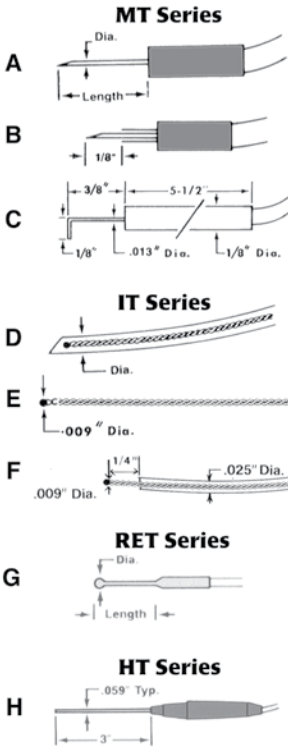
When precise temperature measurements are required, WPI can provide you with a very accurate monitor and thermocouple microprobes. WPI monitors have both resolution and accuracy of 0.1°C in the 0-50°C range and are traceable to NIST standards, whereas, other competitive electronic thermometers have an accuracy that is usually to 0.5°C or worse. Furthermore, all our type T clinical probes are guaranteed accurate to 0.1°C, due to our stringent wire standards. These are five times more accurate than competitive probes made with regular "Special Limits" wire.



NEEDLE MICROPROBES ORDERING INFORMATION

Fast-response needle probes for instant readings in tissue, semi-solids, liquids, very small specimens, powders and materials.
Needle tip is sealed to ensure only stainless steel contacts specimen. Maximum autoclavable temperature is 135°C.

Probe Type	Size	Style	Time Constant	Isolated	Max. Temp.	Lead Length	Description
MT-29/1HT	29 ga / 1 cm	A	0.125 sec	No	200°c	5 ft	29 gauge approximately 0.013 in.
MT-29/2HT	29 ga / 2 cm	A	0.125 sec	No	200°c	5 ft	-
MT-29/3HT	29 ga / 3 cm	A	0.125 sec	No	200°c	5 ft	-
MT-29/5HT	29 ga / 5 cm	A	0.125 sec	No	200°c	5 ft	-
MT-26/2HT	26 ga / 2 cm	A	0.1 sec	No	200°c	5 ft	26 gauge approximately 0.018 in.
MT-26/4HT	26 ga / 4 cm	A	0.1 sec	No	200°c	5 ft	-
MT-26/6HT	26 ga / 6 cm	A	0.1 sec	No	200°c	5 ft	-
MT-23/3HT	23 ga / 3 cm	A	0.15 sec	No	200°c	5 ft	23 gauge approximately 0.125 in.
MT-23/5HT	23 ga / 5 cm	A	0.15 sec	No	200°c	5 ft	-
MT-23/8HT	23 ga / 8 cm	A	0.15 sec	No	200°c	5 ft	-
MT-4	29 ga / 1 cm	A	0.025 sec	No	200°c	5 ft	Similar to MT-29/1 but has a blunt tip. Good for instant skin and surface temperatures, liquids
MT-D	—	C	0.025 sec	No	200°c	5 ft	Fast response surface probe (stainless steel for locating inflammation, arteries, etc. Also for dental use.



FLEXIBLE IMPLANTABLE PROBES ORDERING INFORMATION

Designed for high accuracy on extremely small specimens such as insects, seeds, etc. Maximum insertion depth 1/8". Totally sheathed in chemical resistant Teflon.

Probe Type	Sensor Lead Diameter	Style	Time Constant	Isolated	Max. Temp.	Lead Length	Description
IT-14	0.050" dia	D	0.3 sec	Yes	150°c	3 ft	-
IT-18	0.025" dia	D	0.1 sec	Yes	150°c	3 ft	-
IT-18EXLONG	0.025" dia.	D	-	Yes	150°c	5 ft	-
IT-21	0.016" dia	D	0.08 sec	Yes	150°c	1 ft	-
IT-23	0.009" dia	E	0.005 sec	Yes	150°c	3 ft	For ultra fast measurements and for use on micro-size specimens. Tissue implantable with 23ga. Needle (supplied). Rather fragile. Teflon coated.
IT-1E	0.025" dia	F	0.005 sec	Yes	150°c	3 ft	As IT-18 sensor except bead exposed. Combines ultra-fast reponse of IT-23 with sheath strength of IT-18.

RECTAL PROBES ORDERING INFORMATION

Probe Type	Sensor Lead Diameter	Style	Time Constant	Isolated	Max. Temp.	Lead Length	Description
RET-2	-	G	0.8 sec	No	125°c	5 ft	Rectal probe for rats typically for fast intermittent measurements. Smooth ball tip (0.125 in. dia.) with 1" long (0.59 in. dia) stainless steel shaft.
RET-3	-	G	0.5 sec	No	125°c	5 ft	Rectal probe for mice similar to RET-2 except tip diam. 1.6mm (0.063") and shaft ¾" long (0.028" diam.)

GENERAL PURPOSE ORDERING INFORMATION

Probe Type	Sensor Lead Diameter	Style	Time Constant	Isolated	Max. Temp.	Lead Length	Description
HT-1		H	0.5 sec	No	400°c	5 ft	"Workhorse" probe for liquids, gases, semi-solids. Plastic handle with straight stainless steel shaft. Not good for surface temperatures.
HT-2		H	0.5 sec	No	400°c	5 ft	Like HT-1 except shaft length is 9 in.

Due to the fragility of these probes, warranty is limited:
Defective probes may be returned within 14 days of receipt.

These probes may also be used with **ATC2000** *Animal Temperature Contoller.*

See page 127.

Neuroscience Cannulas

For in vivo *investigation of rodents*

Features

- Exceptional quality
- Best prices
- Rapid order response

Cannula assembly: fixing screw, internal cannula with attached tubing, and guide cannula.

Benefits

- Beveled inside and out and polished to remove burrs and ensure that the inside diameter is perfectly cylindrical. This limits trauma to tissue and ensures smooth operation.
- Exceptional quality at the best prices

Internal cannula secured with fixing screw.

Applications

- Drug administration
- Optogenetics

These cannulas for neuroscience study and pre-clinical research include an entire range of cannula options, including the Guide Cannula, the Internal Cannula and the Dummy Cannula (cap).

Guide Cannulas

Gauge	OD	ID
22	0.64	0.46
24	0.56	0.40
26	0.48	0.32

The Guide Cannula is a surgical grade, stainless steel tube that is implanted into a rodent's skull and cemented into place using dental cement and screws. It guides the Internal Cannula to the specific injection site.

Internal Cannula

Gauge	OD	ID
22	0.41	0.26
24	0.36	0.21
26	0.30	0.16

Insert the Internal Cannula into the Guide Cannula to sample or inject fluid.

Dummy Cannula

The Dummy Cannula has a stainless steel wire core, and it is placed in the Guide Cannula when the Internal Cannula is removed. It seals the opening and prevents tissue from entering the bottom of the Guide Cannula. The Dummy Cannula is threaded to securely tighten it so that the animal will not unscrew it while grooming. Note that the DUM26 cap is used for the 24 ga cannulas also.

Ordering

Order the Guide Cannulas based on the gauge and length from the base and the Internal or Dummy Cannulas based on the length of the Guide Cannula and the projection from the Guide Cannula tip.

Understanding Part Numbers

Cannula Type
GC–Guide Cannula
INC–Internal Cannula
DUMC–Dummy Cannula

GC22-37
Cannula Type
Gauge of Guide Cannula
Length of Cannula or Projection

Gauge–Choose the gauge of the Guide Cannula to be used, even if you are ordering an Internal or Dummy Cannula. Choices include 22, 24 and 26 gauge.

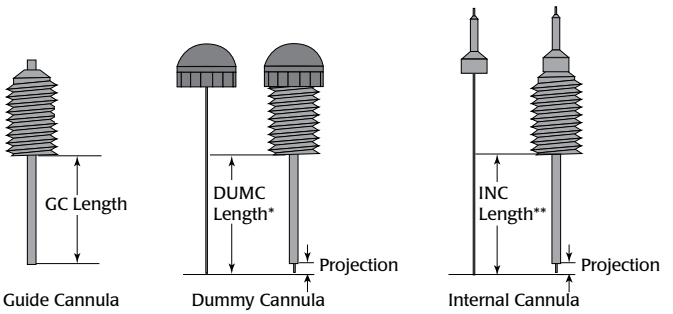
Length–Guide Cannulas can be ordered in lengths from 1.0–9.9 mm. Length can be specified to 0.1 mm, with a tolerance of ±0.07mm. For example, a **GC24-60** is a 24 gauge cannula that is 6.0 mm long.

For other cannulas, the length is determined by the desired projection length and the guide cannula length. The projection can extend beyond the tip of the Guide Cannula up to 1.0 mm.

DUMC Length = GC Length + Projection

INC Length = GC Length + Projection

For example, for a Dummy Cannula flush with the end of a 26 ga Guide Cannula that is 6.0 mm long, order a **DUMC26-60**. For an internal cannula that projects 0.5 mm beyond the 6.0 mm Guide Cannula (6.5 mm), order an **INC26-65**.



** DUMC Length=GC Lenth + Projection. If the cap is screwed on too tightly, the projection will be longer than expected.*
*** INC Length=GC Lenth + Projection. Internal cannula mounts flush and does not screw into place.*

ORDERING INFORMATION

Cannulas

GC22-X*	Guide Cannula, 22 ga, X.0 mm
INC22-X*	Internal Cannula, 22 ga, X.0 mm
DUMC22-X*	Dummy Cannula, 22 ga, X.0 mm
GC24-X*	Guide Cannula, 24 ga, X.0 mm
INC24-X*	Internal Cannula, 24 ga, X.0 mm
GC26-X*	Guide Cannula, 26 ga, X.0 mm
INC26-X*	Internal Cannula, 26 ga, X.0 mm
DUMC26-X*	Dummy Cannula, 26 ga, X.0 mm

** X indicates the length of the cannula or projection. See Understanding Part Numbers.*

Flexible PE Tubing

504278	0.25 mm ID, 0.5 mm OD, 1 m long
504279	0.42 mm ID, 0.85 mm OD, 1 m long
504280	0.6 mm ID, 1.1 mm OD, 1 m long

Miscellaneous Accessories

504281	Fixing Screw-connect INC & GC

Flexible PE tubing is recommended to connect to Internal Cannula (INC) only, NOT Guide Cannula (GC) or Dummy Cap (DUMC).

504278 matches **INC26-XX**

504279 matches **INC24-XX**

504280 matches **INC22-XX**

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Electronic von Frey Anesthesiometer

Assessing mechanical allodynia with 15 SuperTips

Features

- LCD readout (floating or last maximum/minimum)
- Rigid tips up to 800 g
- Supertips™ up to 65 g
- 1,000 g probe available
- Optional analog output cable for chart recorder
- Pipette tips can be customized to any specification
- Microprocessor electronics 0.1 g plug-in probes

II-2391

Benefits

- Plug up to three probes into a single unit
- Independent from temperature

Applications

- Small animal analgesia testing

To assess mechanical allodynia, which is a painful response to a light touch or pressure from a stimulus that is not normally painful, the Electronic von Frey Anesthesiometer was developed. The Electronic von Frey meter uses one of 15 different flexible von Frey hairs called "SuperTips™" (or rigid tips up to 800 grams). Each hair, regardless of model chosen, is exactly 0.8 mm in diameter. This uniformity of design eliminates false readings and allows for comparison of test results. The Electronic von Frey can be used with chart recorders and analog/digital converters, and it never needs calibration. This system includes either a 90, 800 or 1,000 gram probe. Mesh stands are available in a variety of sizes for large group studies.

ORDERING INFORMATION	
II-2390	Electronic von Frey Anesthesiometer, Rigid Tips, 90 g Range
II-2391	Electronic von Frey Anesthesiometer, Rigid Tips, 800 g Range
II-2392	Electronic von Frey Anesthesiometer, Rigid & 15 Supertips, 90 g Range
II-2393	Electronic von Frey Anesthesiometer, Rigid & 15 Supertips, 800 g Range
II-23931	Electronic von Frey Anesthesiometer, Custom Rigid Tips, 1000 g Range
II-2394	von Frey Probe, 90 g Range
II-2395	von Frey Probe, 800 g Range
II-2396	von Frey Probe, 1000 g Range
II-2397	MRI Probe Option *(add to price of probe above)*
II-2400	Analog Output Cable

Quattro

Four test systems

II-2889

This special package offers four tests, including Electronic von Frey, Plethysmometer, Randall Selitto and the Grip Strength Meter. You get all four test modules and the electronic controller that is interchangeable with all four systems. The electronic controller has up to three inputs, so you can perform up to four unique tests with only one electronic system. If you prefer, you may build your system as you grow. Because of the modular design of these four systems, you need to order only one complete system. Then, the modules for the other three tests, which integrate into the system, can be purchased separately, as needed. The stand and sling for the Randall Selitto test are sold separately.

ORDERING INFORMATION	
II-2889	Quattro 4-in-1 System

Trio

Three test systems

II-2888

Get three test systems in one package with the Trio, featuring the Electronic von Frey, Plethysmometer and Randall Selitto Meters. Just like the Quattro package, the modular design allows these three test systems to communicate with the same electronic controller. The stand and sling for the Randall Selitto test are sold separately.

ORDERING INFORMATION	
II-2888	Trio 3-in-1 System

Plethysmometer (Paw Volume Meter)

Test effectiveness of anti-inflammatory agents

Features

- No wetting solution needed
- One calibration/year
- Battery-operated or line powered controller
- One-year warranty

Benefits

- A sensor in the water notes a pressure change when the paw is immersed
- Pressure is calibrated in 0.1 milliliters and displays on the battery-powered monitor

Applications

- Measure the effectiveness of anti-inflammatory agents and agents to reduce edemic conditions

II-520 mR

Test the effectiveness of anti-inflammatory agents and agents to reduce edemic conditions with the Plethysmometer. Simply insert the rat or mouse paw into water. The acrylic stand offers full visibility of the subject throughout the testing.

ORDERING INFORMATION	
II-520MR	Paw Volume Meter for Mouse & Rat

Randall Selitto Paw Pressure Meter

Get instantaneous, live readings

Features

- Visible force limit indicator
- Portable electronic display
- Battery-operated or line powered controller
- No calibration required

Benefits

- Hands-free operation with foot switch
- 3-oz. hand held probe with accuracy of 0.5%

Applications

- Analgesic drug studies

The Randall Selitto Paw Pressure Meter for analgesia testing is digitally controlled. Use the handheld instrument to apply force to an animal's extremity and get instantaneous, live readings. You can even view the last maximum force applied during the test. The new limit indicator lets you select the maximum force limit, and then indicates with a warning light when the system reaches that limit. This unit comes with an acrylic stand to allow for easy viewing of the display. Stand and sling are sold separately.

II-2500

800 g pressure applicator

ORDERING INFORMATION	
II-2500	Randall Selitto Paw Pressure Meter

Grip Strength Meter

Measure muscle hyperalgesia in rodents

Features

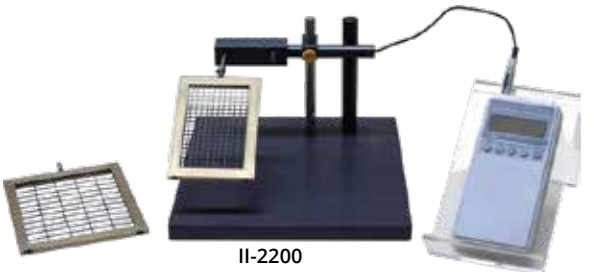
- Mouse and rat wire mesh grid plates included
- Maximum force range is 2,000 g (10% over range allowed). Higher ranges are available by special order.
- 1 gram increment readings
- Suction feet on the heavy, anodized base plate resist even large pulling forces

Benefits

- Battery-operated or line powered controller
- One-year warranty

Applications

- Measure muscle hyperalgesia in rats and mice



II-2200

Measure muscle hyperalgesia in rats and mice with the Grip Strength Meter, which gauges the forelimb grip force using a digital force transducer. Simply hold the animal by the tail and gently dangle it over the wire mesh plate until the animal grasps the plate with its forepaws. The force transducer, connected with the wire mesh plate, measures the strength of the animal at the time of the test. The battery-operated, electronic control device calculates the average of three measurements, and it holds the last maximum force in a "peak and hold" type readout until you reset it.

ORDERING INFORMATION	
II-2200	Grip Strength Meter for Mouse & Rat

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Incremental Hot Cold Plate Analgesia Meter

Latency and threshold-based nocicetption

Features

- Heat or cool, from 0-70˚C
- Ramping temperatures for threshold & latency results
- Rapid increase or decrease in temperature
- Printout of data
- Includes clear animal enclosure
- Plate size 4" x 8"
- Two-year warranty

Benefits

- Precise programmable digital control
- Temperature stability is 0.1˚C

Applications

- Analgesia research
- Latency and threshold-based nocicetption

II-PE34

This safe, humane device for rats and mice is used for latency and threshold-based nocicetption, ramping temperatures for 0-70˚C. Because this hot cold plate is incremental, it measures latencies of much more than just the strong narcotic agents, broadening dramatically the range of analgesia research with devices of this type. Microprocessor-controlled, the Incremental Hot Cold Plate can heat or cool in increments of 0.1˚C, at a rate of 1-10˚C per minute. With uniform heating and cooling and upper/lower cut-off limits, this device is predictable and safe. It can also function as a constant temperature plate with great stability (0.1˚C). As soon as a reaction is observed from the chosen paw, the unit reverses to the standby temperature.

ORDERING INFORMATION

II-PE34	Incremental Hot Cold Plate Analgesia Meter

Incapacitance Meter for Mouse & Rat

Test pain and inflammation in small animal hind limbs

Features

- Precise programmable digital control
- Start, stop and reset test from controller's front panel
- 180-270 gram holder included (other sizes available)
- Reaction detected automatically
- Manual override of all timer functions
- Alphanumeric readout
- 5 to 999 seconds test period
- Alphanumeric readout
- All functions and parameters entered via keypad
- Two-year warranty

Benefits

- Overcomes the drawback of placing unnecessary stress on the animals

Applications

- Test pain and inflammation in the hind limbs of mice, rats or birds

II-600 mR

The Incapacitance Meter uses a technique called dual channel weight averaging, which tests both hind limbs. This gives you a clean, stress-free correlation of the paw pressure test. Conduct control and testing of the animal at the same time. Place the animal in the holder with its hind limbs resting on the two weight-averaging platform pads. The controller records the average weight (grams) over the test period as the animal shifts its weight from each pad.

ORDERING INFORMATION

II-600MR	Incapacitance Meter for Mouse & Rat

Hot Plate Analgesia Meter

Latency testing in rodents

Features

- Includes both mouse and rat enclosure
- Temperature indicated in 0.1˚C increments
- Holding accuracy is ±0.1˚C
- Digitally controlled
- Two-year warranty

Benefits

- Plate has consistent temperature throughout a procedure, ensuring accurate testing

Applications

- Latency testing in rats and mice

II-39

To use the Hot Plate Analgesia meters, simply place the animals on the black anodized aluminum plate (11" x 10.5" x 0.75", 275 x 263 x 15 mm) and set the plate's surface temperature to the desired set point (up to 75˚C). The plate maintains a consistent temperature throughout the test.

ORDERING INFORMATION	
II-39	Hot Plate Analgesia Meter for Mouse & Rat

Plantar Test Apparatus/Tail Flick Test Analgesia

Meter to test narcotics and strong non-narcotic drugs

Features

- Includes three acrylic animal enclosures that each hold two rats or four mice
- Precise programmable digital control
- User-defined humane cutoff feature
- Adjustable beam intensity in 1% increments up to 250˚C
- Reaction is detected automatically
- Alphanumeric readout
- Manual override of all timer functions
- All functions and parameters entered via keypad
- Heated glass option
- Tail temperature monitor option (for use with the Tail Flick Meter)

II-336TG

Benefits

- Plantar test and tail flick test applications are combined in one platform
- Stimulate other body parts by adjusting the height of the glass

Applications

- Test the properties of narcotics on unrestrained mice/rats in Plantar mode

This unit, which is designed for testing narcotics and strong non-narcotic drugs, offers both Plantar (Hargreaves Method) and Tail Flick testing with a single unit. Either testing system is also available individually. In plantar mode, the visible light/heat source is directed at the paw or other desired body part, and in tail flick mode it is directed at the subjects' tails. Test up to 12 mice or 6 rats simultaneously. If desired, other animals like cats and rabbits may also be used. Tests are simple to setup. The focused, radiant heat/light source creates a 4 x 6 mm intense spot. Because the light is visible, you know when the test starts and ends. The equipment is silent (no whining or clicking sounds) to avoid triggering an automatic response in conditioned animals. You can set a humane cutoff timer that automatically shuts off the heat if no response is observed during the designated time frame.

When an animal is placed on cold glass, its reaction time may be slower. This unique system offers a heated glass option that prevents the glass enclosure from acting as a heat sink, giving a more accurate reading. An optional tail temperature monitor can also be selected for use with the Tail Flick Meter. This option actually preheats the tail before experimentation. Once the preset tail temperature is reached, the test and timer automatically begin. A glass stand is also available in two sizes for large group studies.

ORDERING INFORMATION	
II-336T	Combination Plantar/Tail Flick Meter *(non-heated glass and tail temperature for mouse and rat)*
II-336TG	Combination Plantar/Tail Flick Meter *(tail temperature and heated glass for mouse and rat)*
II-390	Plantar Test Analgesia Meter *(non-heated glass for mouse and rat)*
II-390G	Plantar Test Analgesia Meter *(heated glass for mouse and rat)*

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Adhesives

ADHESIVES APPLICATION GUIDE

WPI Part #	Description	Curing Time	Useful Applications and Characteristics
Epoxies	**Form strong bonding. Used in wire bonding applications.**		
4898	Silver Filled Conductive Epoxy	12 hr @ 50° C – 5 min @ 150° C	Connecting conductors that can't be soldered. Constructing or connecting Ag/AgCl pellets.
7335	Carbon Filled Conductive Epoxy	48 hr @ 25° C – 5 min @ 150° C	Constructing carbon electrodes
4886	High Performance Structural Epoxy	12 hr @ 25° C	Forms a strong and slightly flexible bond on plastic, metal, & glass. Bonds some low surface.
Hot melt (EVA)	**Easy to use for bonding, needs large gap filling**		
13316	Mini Glue Gun with glue sticks	As soon as it cools down	Bonds wood, glass, metals, and many plastics
Silicone Adhesives/Sealants/Primers		**Good moisture resistant and elastic. Low toxic.**	
1571	Room Temperature Vulcanizing (RTV) adhesive. Acyloxy/moisture cure system. Acetic acid is cure by-product.	24 hr @ 25° C	Has the best adhesion property in this silicone family. Will bond to many materials.
7128	RTV sealant. Alkoxy/moisture cure system. Methanol is cure by-product.	72 hr @ 25° C	Good for bonding or sealing electronics circuits (metal)
SYLG184	Sylgard. Two-part vinyl/platinum cure sealant. Hydrogen is cure by-product. Very low toxicity.	24 hr @ 25° C – 15 min @ 150° C	Coating patch clamp electrodes, cell culture dish, making dissection pads
KWIK-SIL	Two-part adhesive. Vinyl/platinum system. Hydrogen is cure by-product. Very low toxicity.	< 5 min @ 25° C	Live tissue and nerve studies. Medium strength adhesion.
KWIK-CAST	Two-part sealant. Vinyl/platinum cure system. Hydrogen is cure by-product. Very low toxicity.	< 5 min @ 25° C	Sealant for live tissues. Embedding peripheral nerves with electrodes.
6820	Primer for silicone	N/A	Enhances adhesion of silicone adhesives for difficult to bond plastic surfaces
Cyanoacrylate	**Forms an instantaneous bonding.**		
7341	Ethyl cyanoacrylate, low viscosity 90-120 cps	<10 seconds	Mounting rat/mouse brain slices. Ideal for relatively small gaps and smooth surfaces. Bonds plastic, metals and rubber. Package of 10 vials, each approximately 1.5 mL.
7342	Ethyl cyanoacrylate, high viscosity 1100-1600 cps	<30 seconds	Use in brain slice experiments. Ideal for larger gaps, allows slightly longer bonding time. Bonds plastic, metals and rubber. Package of 10 vials, each approximately 1.5 mL.
VETBOND	Butyl cyanoacrylate, low toxicity	<10 seconds	Bonds tissues, alternative to suture, helps small wound healing. Antimicrobial effect. Used in forensic science.
503763	Octyl cyanoacrylate, low toxicity	<15 seconds	Suitable for surface wound bonding, protection, holding a sensor or other device on the tissue.

Kwik-Gard™

Kwik-Gard™ is specially packaged **Sylgard 184** silicone for quicker and easier application, eliminating the messy procedure of preparing the mixture before application. Its special cartridge controls the precise mixing ratio to ensure proper curing. The disposable tip mixes resin and hardener as they are dispensed. Since no air is introduced during mixing, the resin does not need degassing for most applications. The mixed silicone is applied directly to the site, reducing preparation time and material waste.

Each Kwik-Gard cartridge contains 37 mL of resin and hardener. The dispensing tip has a dead volume of 0.75 mL.

ORDERING INFORMATION

KWIKGARD	Kwik-Gard™ Start-up Kit *(incl. dispenser, 1 cartridge, 5 tips)*
KWIKGLUE	Kwik-Gard™ Refill *(2 cartridges, 10 dispensing tips)*
KWIKMIX	Dispensing Tips *(pack of 10)*
KWIKGUN	Kwik-Gard™ Dispenser

Scotch-Weld 2216 Structural Epoxy

4886

Scotch-Weld 2216 remains the best epoxy for bonding plastic, often used as the benchmark for testing the binding strength of other adhesives. The slightly rubbery texture also makes it less easy to break off. *It is the only epoxy known that can bond PEEK.*

Color: gray
Cures at room temperature.
Shipping weight: 1 lb. (0.5 kg)

ORDERING INFORMATION

4886	Scotch-Weld 2216 (2 oz.)

Low Toxicity Adhesive

Ideal for neuroscience applications, nerve studies and more

Features

- Bio-compatible adhesive for live tissue and nerve studies
- Pre-mixing tips simplify use
- Medium strength adhesion
- Low toxicity
- Rapid curing silicone adhesive, cure on contact
- Cures without producing heat
- Includes 10 mixing tips
- Volume discounts - save up to 15%!

KWIK-SIL

Benefits

- Low toxicity
- Rapid cure time

Applications

- Neuroscience and nerve studies
- Biomedical applications

600022

Kwik-Sil and **Kwik-Cast** silicones have very low toxicity before, during and after curing. The by-product of curing is a small amount of hydrogen gas, which is much less toxic to cells than acetic acid or alcohol from traditional RTV silicone sytems.

Kwik-Sil and **Kwik-Cast** curing speed is hundreds of times faster than traditional RTV silicones. A curing time of a few minutes at room temperature is especially useful for encapsulation of live tissue or implanting into a live animal.

Unlike many vinyl-based silicones in which the platinum complex catalysts are easily poisoned by contamination from amines and animal tissue, **Kwik-Sil** and **Kwik-Cast** are not sensitive to contamination from animal tissue.

Kwik-Sil™ is a translucent, medium-viscosity silicone adhesive, developed for chronic peripheral nerve studies such as anterograde tracing with fluorescent indicators or electrode recording. Good adhesion and mechanical properties (tear strength and elongation) allow days of study without breaking of the bonding. Curing speed is very reproducible.

Kwik-Cast™ is a very low viscosity silicone sealant developed to embed peripheral nerves with electrodes for acute multi-fiber recordings. It flows easily, filling the small spaces around the nerve and leaving no channels through which peritoneal fluid can travel and thus short the nerve/electrode contact. Equally important is the ability of the material to flow into itself and create one continuous mass from underneath the nerve all the way to the top of the nerve/electrode contact to ensure long-term recording stability. **Kwik-Cast** is color-coded to make the mixing foolproof. The catalyst is yellow and the base is blue. When uniformly mixed, it is green. **Kwik-Cast** can be applied and cured underneath mineral oil. After recording, electrodes are easily recovered due to the low tear strength.

KWIK-CAST

References

Maura Casciola, Shu Xiao & Andrei G. Pakhomov. Damage-free peripheral nerve stimulation by 12-ns pulsed electric field. *Scientific Reports 7*, Article number: 10453. https://www.nature.com/articles/s41598-017-10282-5

Tiran, E., Ferrier, J., Deffieux, T., Gennisson, J.-L., Pezet, S., Lenkei, Z., & Tanter, M. (2017). Transcranial Functional Ultrasound Imaging in Freely Moving Awake Mice and Anesthetized Young Rats without Contrast Agent. *Ultrasound in Medicine & Biology*, 43(8), 1679–1689. http://doi.org/10.1016/j.ultrasmedbio.2017.03.011

Lee, D., & Lee, A. K. (2017). Efficient Method for Whole-Cell Recording in Freely Moving Rodents Using Ultraviolet-Cured Collar-Based Pipette Stabilization. *Cold Spring Harbor Protocols*, 2017(4), pdb.prot095810. http://doi.org/10.1101/pdb.prot095810

Welle, T., Hoekstra, A. T., Daemen, I. A. J. J. M., Berkers, C. R., & Costa, M. O. (2017). Metabolic response of porcine colon explants to in vitro infection by Brachyspira hyodysenteriae: a leap into disease pathophysiology. *Metabolomics*, 13(7), 83. http://doi.org/10.1007/s11306-017-1219-6

Lee, D., & Lee, A. K. (2017). In Vivo Patch-Clamp Recording in Awake Head-Fixed Rodents. *Cold Spring Harbor Protocols*, 2017(4), pdb.prot095802. http://doi.org/10.1101/pdb.prot095802

Suwabe, T., Fukami, H., & Bradley, R. M. (n.d.). Synaptic Responses of Neurons Controlling the Parotid and von Ebner Salivary Glands in Rats to Stimulation of the Solitary Nucleus and Tract. http://doi.org/10.1152/jn.01115.2007

KWIK-CAST & KWIK-SIL SPECIFICATIONS

	Kwik-Sil	Kwik-Cast
MIX RATIO	1 to 1	1 to 1
WORKING TIME	< 5 minutes*	4 minutes
SETTING TIME (ROOM TEMP., 1:1 RATIO)	5–10 minutes**	<10 minutes
CURE TIME	~15 minutes	
VISCOSITY, CPS	15,000	10,000
GUARANTEED SHELF LIFE AT 23 °C	6 months	6 months
VOLUME	5 mL	5 mL
NUMBER OF MIXING TIP	10	10
DEAD VOLUME OF THE MIXING TIP	<0.12 mL	<0.12 mL
AFTER CURING 24 HOURS:		
TEAR STRENGTH, PPI	90	44
ELONGATION %	650	60
DUROMETER (SHORE A-2)	30	36
COLOR	translucent	green
VOLUME RESISTIVITY, W/CM	$1x10^{15}$	$1x10^{15}$

** 3 minutes average with about 90 seconds of liquidity*

*** no longer mixable at this point*

ORDERING INFORMATION

KWIK-SIL	Silicone Adhesive Compound (two 5-mL syringes)
KWIK-CAST	Silicone Casting Compound (two 5-mL syringes)
600022	Replacement KWIK Mixing Tips (pack of 10)

Quantity discounts available

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"Super" Adhesives for Life Science Research

Four times stronger than butyl cyanoacrylate and less toxic

Cyanoacrylate adhesives have been on the market since 1958. Most industrial or household grade cyanoacrylate is made of shorter alkyl chain derivatives such as methyl or ethyl cyanoacrylate (WPI's **7341** and **7342**). They are very useful for temporarily holding tissues such as mounting specimens for microtome sectioning. However, they are not suitable for bonding wounds on live animals. The difficulties of using cyanoacrylate for bonding live animals are: (**1**) a strong, irritating odor; (**2**) quick loss of bonding strength due to breakdown of the bonding by hydration; (**3**) the breakdown products, cyanoacetate and formaldehyde, are toxic and can cause inflammatory reactions; and (**4**) they have low flexibility and tend to be brittle.

VETBOND

To overcome these problems, several longer alkyl chain cyanoacrylates have been developed especially for veterinary and human use. The first longer alkyl chain product is butyl cyanoacrylate. This product has been used for animal and human applications outside the USA since 1970. It is much less toxic and has a lower odor than the methyl or ethyl cyanoacrylate. The butyl cyanoacrylate offered by WPI is **Vetbond™**.

A family of adhesives containing octyl cyanoacrylate, a plasticizer and stabilizer, was developed In the 1990's (one of them approved by FDA for human use). When bonding to tissue, these new adhesives are four times stronger and less toxic than butyl cyanoacrylate. Compared with the traditional suture, the new super adhesive has several advantages. On average, it takes only one-tenth of the time to close an incision. The bonding strength is equal to 5-0 monofilament suture. It also has a mysterious antimicrobial effect that can decrease infection rates in contaminated wounds. Bonding will slough off naturally in 5 to 7 days. Cosmetic appearance of the healed incision is also better.

Gluture Topical Tissue Adhesive **503763** forms a strong and flexible film and is thus more suitable for surface wound bonding, protection, and holding a sensor or other device on the tissue. Setting time is about 10 seconds, which gives ample time for application. It can also be used for temporarily holding a live tissue. For example, there is a report of using it to hold nematodes on a glass slide for patch-clamp neurons recording.

All of the products offered by WPI are veterinary grade (not suitable for human application). Though very similar to the grade for human use, they are not sterile and do not have FDA approval.

ORDERING INFORMATION	
503763	Gluture Topical Tissue Adhesive (10 tips), 1.5 mL
7341	Cyanoacrylate Adhesive, low viscosity—90-120 cps (pack of 10 vials, each approx. 1.5 mL)
7342	Cyanoacrylate Adhesive, high viscosity—1100-1600 cps (pack of 10 vials, each approx. 1.5 mL)
VETBOND	3M Vetbond™ Adhesive (3 mL)

Sylgard

SYLG184

A two-part silicone elastomer, ideal for potting and encapsulating applications. Very low dielectric constant sealing compound used in patch clamping and many other lab applications. After cure, will withstand -55° to 200 °C.

ORDERING INFORMATION	
SYLG184	Sylgard, 0.5 kg (1.1 lb)

Silicone Dissecting Pad Kit

Make your own silicone dissecting pads easily and quickly. Mix the 2-part silicone right in the plastic Petri dishes and allow to cure 24 hours at room temperature. Kit includes enough two-part Sylgard silicone elastomer to prepare 20 dishes; pins; and 20 plastic Petri dishes with lids, 65 mm.

ORDERING INFORMATION	
501986	Silicone Dissecting Pad Kit

Electrically Conductive Silver Epoxy

Two-component silver-filled epoxy for electrical connections which cannot be soldered, such as Ag/AgCl pellets. This widely used silver-filled epoxy features low viscosity and smooth flowing character. Pure silver is dispersed in both resin and hardener. Cures in 15 minutes at 120 °C. Mix ratio 1:1. May be premixed and frozen for later use.

ORDERING INFORMATION	
4898	Silver Epoxy, 28 g (1 oz)

Electrically Conductive Carbon Epoxy

Two-component carbon-epoxy, curable at room and elevated temperatures. Ideal for electrostatic discharge protection and EMI/RFI shielding. 1:1 mix ratio. May be premixed and frozen for later use.

ORDERING INFORMATION	
7335	Carbon Epoxy, 56 g (2 oz)

Silicone RTV Adhesive (non-acidic)

Because it is non-corrosive, this material is ideal for use on metal, for encapsulating small circuits on connectors. After cure, will withstand -55° to 200 °C. No mixing required.

ORDERING INFORMATION	
7128	RTV Coating, 90 mL (3 fl oz)

Silicone RTV Adhesive

Clear silicone sealant provides good bonding to plastic. After cure, will withstand -55 to 200 °C. No mixing required. A handy, general purpose laboratory sealant. (Releases acetic acid during curing.)

ORDERING INFORMATION	
1571	RTV Sealant, 139 mL (4.7 fl oz)

RTV Prime Coat

Enhances adhesion of silicone adhesives to many difficult-to-bond plastic surfaces.

ORDERING INFORMATION	
6820	RTV Prime Coat, 400 mL (13.5 fl oz)

Mini Glue Gun

Comes with three sticks of special formula hot melt glue. UL approved. 110V 60 Hz only.

ORDERING INFORMATION	
13316	Mini Glue Gun

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Biosensing

Selection includes high selectivity and low detection limit sensors

WPI's biosensors are unique, because they offer a high selectivity and low detection limit (down to nM concentration) with a broad dynamic range; covering physiological concentration of species with different sizes from nM to mM. The majority of our sensors are the only commercially available sensors in the world. Scientists across a variety of disciplines have relied on our sensors for over 25 years. These scientists use WPI's sensors for research performed in universities, hospitals, biomedical research labs, pharmaceutical companies, food/ nutrition research labs, environmental monitoring centers and military labs. Our popular biosensors are listed in thousands of publications.

Leading Scientist Heads WPI Biosensing Division

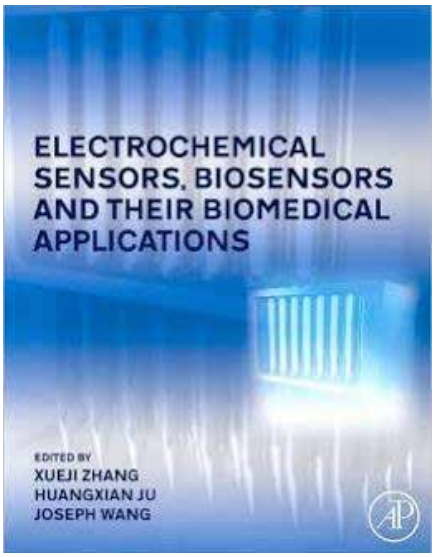
About Dr. Xueji Zhang

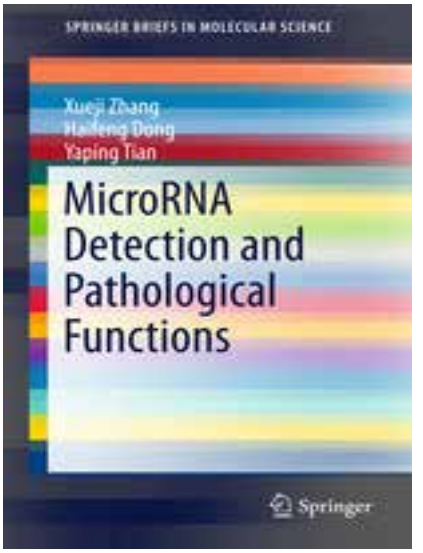
The notable expert in the area of electrochemical sensors, Xueji Zhang, PhD, Sr. Vice President and Chief Scientist at WPI, is leading the development for microsensors (including the **ISO-H2S-100-Cxx**) for many applications. His research includes bio-analysis, electrochemical sensors and biosensors, microelectrodes, ultramicroelectrodes and nanoelectrodes, nanosensors, free radical sensors, nitric oxide sensors, cancer diagnostics, design and application of biomedical instrumentation.

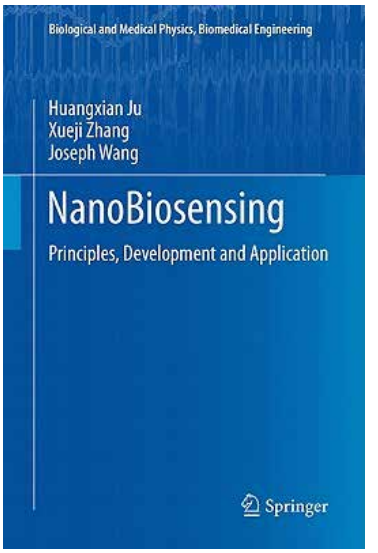
Dr. Zhang has written hundreds of published research papers. Listed below is a select list of Dr. Zhang's papers covering the detection of Hydrogen Sulfide. We are very proud to share the research findings with you. Please email wpi@wpiinc.com for a copy of the paper(s).

- **Zhang XJ, *et al.*,** Electrochemical Sensors Biosensors and their Applications, Elsevier 2008.
- **Zhang XJ, *et al.***, Electrochemical hydrogen sulfide biosensors. *Analyst*. 2016;141:1185-95.
- **Zhang XJ, *et al.***, A novel enzymatic method for determination of homocysteine using electrochemical hydrogen sulfide sensor, *Frontiers in Bioscience*, 2007, 12, 3774

Dr. Zhang is a national chair professor and director at the University of Science & Technology, Beijing, China. He is also an adjunct professor of University of Tokyo, University of South Florida, Chinese Academy of Sciences, PLA 301 hospital. He is president of the Chinese Alliance of Biodetection & Biomonitoring. He is the honorary president of MITBJ. He has published over 400 papers in peer-reviewed journals, authored 8 books and 80 patents. He has developed numerous biomedical sensors, instruments and devices for commercialization. Dr. Zhang also serves as the editor-in-chief of *Frontiers in Bioscience* (www.bioscience.org) and *The American Journal of Biomedical Sciences* (www.nwpii.com/ajbms) and has been a member of the advisory editor board of 19 other international journals. He has received numerous awards and honors, including academician of Russian Academy of Engineering (2013), Fellow of American Institute for Medical & Bioengineering (2016), Fellow of Royal Chemistry Society (2014), Fellow of Chinese Chemical Society (2014), Scientist of the Year in China (2015), Engineer of the Year in China (2016), National Innovation Award (2017) and W. Simon Fellow of ICSC-World lab, United Nations (1996).







Biosensors Designed for Selective Detection

Selecting microsensors for your application

Choosing the right sensor for your application is critical for successful research. The manufacturer's specifications provide valuable information for selecting your sensor. Consider the following five performance factors in reference to your application:

Response–Electrochemical electrodes produce changes in current in response to changes in concentration. "Response" is most often specified in terms of the amount of current per concentration unit: nA/µM or pA/nM, *etc*. The larger the current per concentration the higher the sensitivity of the sensor.

Detection Limit–Detection limit is the minimum change in concentration that can be reliably seen. This specification is directly related to the noise of the sensor. A sensor with a 100nA/µM response but a 3 µM detection limit is not as good as a 10nA/µM response sensor with a 1 µM detection limit.

Free Radical Detection–The best sensors have low detection limits and high sensitivity. A sensor can have a low detection limit and a good response, however, to be useful in long term studies it must be stable when temperature and concentration are constant. A drifting baseline, if monotonic, can be corrected, but wandering baselines limit the utility of sensors to short experiments.

Selectivity–It is a rare instance that the ion species of interest is the only ion in the medium to be measured. In a perfect world your sensor would respond ONLY to the ion of interest. In reality there is always some contribution from competing species. The lower the contribution the better.

Linearity–For an electrode to be useful and easy to calibrate the response must be "linear" with changes in concentration over the range of interest. Non-linear behavior requires special curve fit software to calibrate the sensors. This approach is more time consuming and can be unreliable. "Good" linearity is expressed by a R^2 of 0.980 or higher. (1.00 is perfect.) All of the electrochemical sensors made by WPI are 0.98 or better.

The table below presents the specifications of WPI's macro sensors (2 mm sensor) and microsensors.

MACRO SENSORS

SPECIES	Carbon Monoxide	Nitric Oxide	Hydrogen Peroxide	Oxygen	Hydrogen Sulfide
Order Number	**ISO-COP-2**	**ISO-NOP**	**ISO-HPO-2**	**ISO-OXY-2**	**ISO-H2S-2**
Available Diameters	2 mm	2 mm	2 mm	2 mm	2 mm
Response Time	< 10 sec	< 5 sec	< 5 sec	< 10 sec	< 5 sec
Detection Limit/Range	10 nM to 10 µM	1 nM to 40 µM*	< 100 nM to 100 µM	0.1%-100%	< 5 nM to 100 µM
Sensitivity	~0.5 pA/nM	≤ 2 pA/nM	8 pA/µM	0.3-0.6nA/%	2 pA/nM
Drift	< 1 pA/min	< 1 pA/min	< 1 pA/min	≥ 1%/min	< 1 pA/min
Temperature Dependent	Yes	Yes	Yes	Yes	Yes
Physiological Interference	nitric oxide	$NaNO_2$ (10^{-6} or better)	None	None	None
Replacement Sleeves (pkg. of 4)	**95620**	**5436**	**600012**	**5378**	**600016**
Filling Solution	**95611**	**7325**	**100042**	**7326**	**100084**
Start-up Kit	**95699**	**5435**	**600011**	**5377**	**600015**

**Higher detection limit available on request — call for custom pricing.*

MICRO SENSORS

Species	ISO-NOPF200	ISO-NOPF200-Lxx[3]	ISO-NOPF100	ISO-NOPF100-Lxx[3]	ISO-NOPF500-Cxx	ISO-NOP3005	ISO-NOP3020	ISO-NOP007	ISO-NOPNM	ISO-HPO-100	ISO-HPO-100-L	ISO-H2S-100-Cxx
	Nitric Oxide									H_2O_2		H_2S
Package Quantity	*(pkg. of 2)*	*(pkg. of 2)*	*(pkg. of 2)*	*(pkg. of 2)*	*(pkg. of 2)*	*(pkg. of 3)*	*(pkg. of 3)*	*(pkg. of 3)*	*(pkg. of 3)*	*(pkg. of 3)*	*(pkg. of 2)*	*(pkg. of 2)*
Fiber Diameter (µm)	200	200	100	100	500	30	30	7	7 Conical tip: 100nm	100	100	100
Tip Length[2] (mm)	1-5[1]	1-10[1]	1-5[1]	1-5[1]	5–10	0.5	2	2	2	1–5[1]	1–5[1]	2-5[1]
Response Time (sec.)	< 5	< 5	< 5	< 5	< 10	< 3	< 3	< 3	< 3	< 5	< 5	< 5
Lowest Detection Limit/Range (nM)	0.2	0.2	0.2	0.2	0.2	1	1	0.5	0.5	1	1	< 5
Nominal Sensitivity-New Sensor[2] (pA/nM)	≥ 10	≥ 20	≥ 6	≥ 20	≥ 20	≥ 0.2	≥ 1	≥ 0.5	≥ 0.5	≥ 1	≥1	1-4
Baseline Drift (pA/min.)	none	none	none	none	none	none	none	none	none	< 2.0	< 2.0	< 2

[1]Sensor available in 1 mm length increments (for example, 1 mm, 2mm, 3mm...)

[2]Sensor sensitivity varies with length and diameter.

Any 100 µm sensor can be purchased with a hypodermic sheath. Add ***-H*** *to the end of the part number (for example,* ***ISO-HPO-100-H****).*

[3]L-shaped sensor for use with a tissue bath.

Some nitric oxide sensors are available in custom lengths. When ordering custom lengths, use the part numbers **ISO-NOPF100-C*xx*** or **ISO-NOPF200-C*xx*** and replace the ***xx*** with the desired length. For example, for a 1 mm flexible sensor tip, the part number should be **ISO-NOPF200-C01**. Sensors can be ordered in the following custom lengths: 1 mm, 2mm, 3mm, 4mm or 5 mm (**ISO-H2S-100**: 2-5mm only).

Nitric Oxide Sensors

For routine detection of NO at ultra low concentrations

Features

- Excellent selectivity to NO
- Rapid response time
- Highly sensitive

Benefits

- NO sensors in different sizes from 100 nm to a few mm can be used for many NO detection applications, such as single cell measurement, *in vivo* measurement in tissues (even in animals), and NO release from drugs

Applications

- Cell culture, cell suspensions
- Measurements at the cellular level
- Arteries, microvessels, *in vivo* applications
- Tissue bath applications

WPI offers the most extensive range of nitric oxide (NO) sensors available. Developed over a decade of extensive research in the field of nitric oxide, the result is a superior range of NO sensors that enable routine detection of nitric oxide at ultra low concentrations.

The ideal NO sensor should be insensitive to other reactive species likely to be present within the measurement environment. The conventional Nafion coated carbon fiber NO micro sensor exhibits a large response to such species. WPI's unique NO sensor technology utilizes a novel surface membrane which amplifies the response to NO while eliminating responses to a vast range of reactive species, including nitrite, ascorbic acid, hydrogen peroxide, catecolamines, and much more.

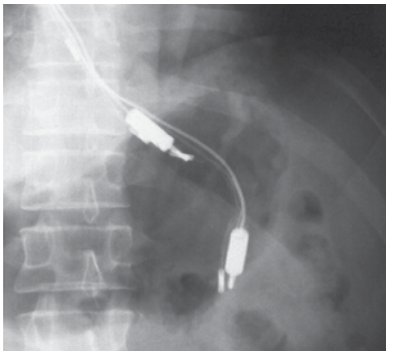
ISO-NOP

The original nitric oxide probe – ideal for cell cultures, cell suspensions and many other applications

ISO-NOP

The **ISO-NOP** is a popular, robust and high performance sensor encased within a 2 mm diameter disposable stainless steel protective sleeve. The tip of the sleeve is covered with a NO-selective membrane. Replacement membrane sleeves can be purchased separately (5436) and require an internal electrolyte (7325).

A simple change in experimental protocol enables the **ISO-NOP** to be conveniently used for indirect rapid accurate determination of nitrite (NO_2^-) and nitrate (NO_3^-) concentration in samples. Using this method a detection limit for NO_2^- or NO_3^- as low as 1 nM is routinely possible.



*Abdominal X-ray showing the appratus consisting of two customized ISO-NOP nitric oxide probes, 4-channel pH catheter, and Teflon nasogastric tube. (Courtesy Prof. K.E.L. McColl, University Department of Medicine and Therapeutics, Western Infirmary, Glasgow, Scotland.) Iijima, K., et al. Gastroenterology 2002: **122**: 1248-1257.*

References

Zhang X.J. Real time and *in vivo* monitoring of nitric oxide by electrochemical sensors—From dream to reality, *Frontiers in Bioscience*, 9,3434-3446(2004)

Zhang X.J., Ju H.X., Wang J. Electrochemical Sensors, *Biosensors and Their Biomedical Applications*, Elsevier, 2008

Zhang X.J., et al. Nanometer size Electro for nitric oxide and s-nitrosothiols measurement, *Electrochem. Commun.* 4, 11-16 (2002)

Zhang X.J. Construction and Characterization of a new *in vivo* nitric oxide microsensor, *Electroanal*. 9, 640-643, (2004)

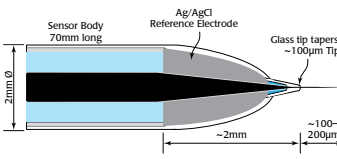
Zhang X.J. An integrated nitric oxide sensor based on carbon fiber electrode coated with selective membranes, 12. 1113-1117(2000)

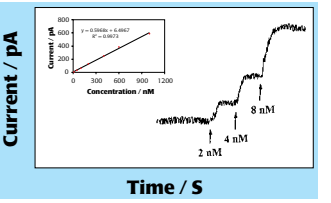
ISO-NOPNM

The world's smallest nitric oxide NanoSensor, designed for measurement of NO at the cellular level.

The **ISO-NOPNM** NanoSensor has a tip diameter of just 100 nm (0.1 µm) and a detection limit for NO of less than 0.5 nM — making it indisputably the smallest and most sensitive NO sensor in the world!

The **ISO-NOPNM** is based on a novel design in which an electrochemically "activated" composite graphite nanofiber is used as the NO-sensing element. The surface of the NanoSensor is then modified using a unique multi-layered NO-selective membrane. Figure at right illustrates the response of the **ISO-NOPNM** following successive additions of nanomolar concentrations of NO. The ultra-low noise of the **ISO-NOPNM** (0.5 pA) enables a detection limit of just 0.5 nM NO. The response time of **ISO-NOPNM** is less than 3 s.



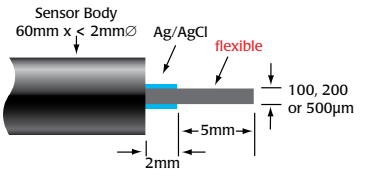


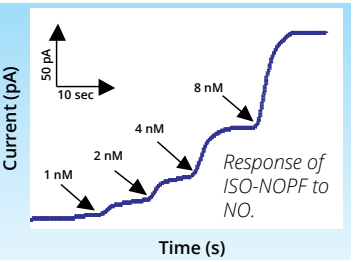
Amperometric response of the NO nanosensor (ISO-NOPNM) to the successive additions of 2 nM, 4 nM, 8 nM NO into 0.1 M $CuCl_2$.

ISO-NOPF

Unique flexible NO sensor! Designed for arteries, microvessels,* in vivo *applications and similar applications.

ISO-NOPF electrodes are available in 100 µm and 200 µm diameters. Utilizing the latest advances in nano-technology and material science, scientists at WPI's Sensor Laboratory have created these completely flexible and virtually unbreakable NO sensors. The new sensors are based on a composite graphite NO-sensing element combined with a reference electrode. The surface of the sensor is then coated with a unique multi-layered NO-selective membrane.





Response of ISO-NOPF to NO.

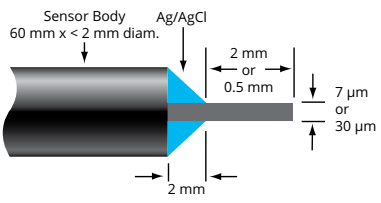
NITIRC OXIDE SENSOR SPECIFICATIONS

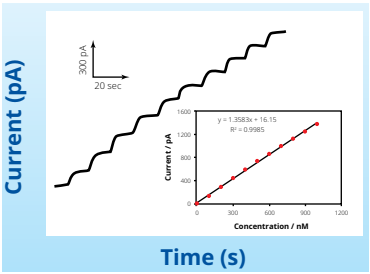
	ISO-NOPF	ISO-NOP	ISO-NOPF100-L10	ISO-NOPF200-L10	ISO-NOP30	ISO-NOP007	ISO-NOPNM
APPLICATION	In Vivo	Cell Cultures, NO_2^-, NO_3^-	Tissue Bath	Tissue Bath	Microvessels	Microvessels	Single Cell
SENSOR DIAMETER	100, 200, or 500 µm	2 mm	30 µm	70 µm	30 µm	7 µm	100 nm
RESPONSE TIME	< 5 sec	< 5 sec	< 3 sec	< 3 sec	< 3 sec	< 3 sec	< 3 sec
LOWEST DETECTION LIMIT	0.2 nM	1 nM	1 nM	1 nM	1 nM	0.5 nM	0.5 nM
TEMPERATURE SENSITIVITY	yes	yes	yes	yes	yes	yes	yes
DRIFT	none	none	none	none	none	none	none
SENSITIVITY	8 pA/nM	1–2 pA/nM	≥1 pA/nM	≥1 pA/nM	1.4 pA/nM	0.5 pA/nM	0.5 pA/nM
PHYSIOLOGICAL INTERFERENCE	none	none	none	none	none	none	none

All WPI NO sensors are 100% compatible with the TBR4100 and TBR1025 Free Radical Analyzers. They are also compatible with the discontinued ISO-NO Mark II (NOMK2), APOLLO 4000 and APOLLO 1000.

ISO-NOP007, ISO-NOP30xx

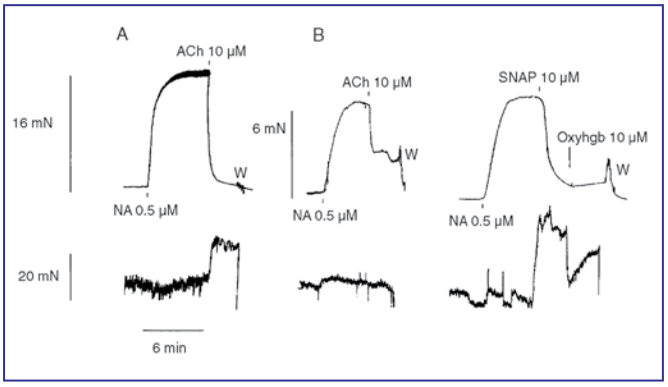
7 and 30 micron sensors with exceptional performance — ideal for tissues and microvessels





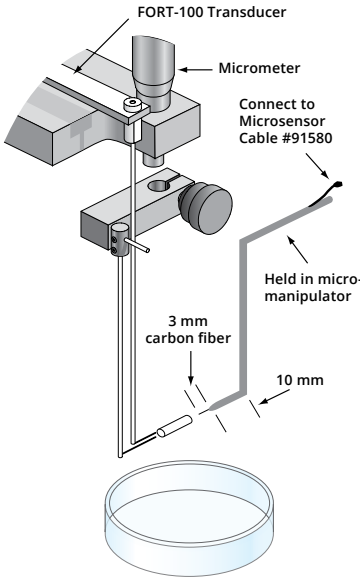
The response of a 7 µm NO sensor (ISO-NOP007) to successive additions of NO (100 nM). Inset shows the linearity of the resulting calibration plot.

The **ISO-NOP007** has a tip diameter of just 7 microns and a length of 2 mm. The **ISO-NOP30** has a tip diameter of 30 microns and is available in two different tip lengths (i.e., **ISO-NOP3020** has tip length of 2 mm, **ISO-NOP3005** has tip length of 0.5 mm). The response of the **ISO-NOP007** and **ISO-NOP30** is linear over a wide dynamic concentration range of NO. The design of both electrodes is based on a single carbon fiber coated with WPI's NO-selective membrane. A detection limit of approximately 1 nM NO makes these electrodes ideal for use in tissues and microvessels.



Simultaneous measurement of force (top trace) and changes of NO concentration (lower trace) in (A) the rat superior mesenteric artery relaxed with ACh and (B) a small human artery relaxed with ACh and SNAP using and ISO-NOP30. In this artery oxyhaemoglobin(oxyHb) partly reversed the increase in NO concentration, with only a small change in force. [U. Simonsen, et al., J. Physiol., *1999,* ***516****: 271-282.]*

ISO-NOPF100-L10, ISO-NOPF200-L10, ISO-HPO-100-L



L-shaped sensors for tissue bath & cell culture studies

These unique L-shaped nitric oxide sensors are designed specifically for use in tissue bath studies and similar applications. The shape of the sensor has been engineered to facilitate placement of the electrode within the lumen of the tissue vessel under study. The **ISO-NOPF200-L10** is designed specifically for cell culture studies.

ORDERING INFORMATION

ISO-NOP	Replacement 2 mm shielded sensor and cable
ISO-NOPNM*	100 nm NanoSensor, pkg. of 3 (requires cable 91580)
ISO-NOPF100*	100 µm Flexible NO Sensor, pkg. of 2
ISO-NOPF200*	200 µm Flexible NO Sensor, pkg. of 2
ISO-NOPF500*	500 µm Flexible NO Sensor, pkg. of 2
ISO-NOP007*	7 µm Nitric Oxide Sensor (pkg. of 3)
ISO-NOP3020*	30 µm Sensor Tips (2 mm length), pkg. of 3 (requires 91580)
ISO-NOP3005*	30 µm Sensor Tips (0.5 mm fiber), pkg. of 3 (requires 91580)
ISO-NOPF100-L10*	NO Sensor, 100 µm Flexible L-shaped (pkg. of 2)
ISO-NOPF200-L10*	NO Sensor, 200 µm Flexible L-shaped (pkg. of 2)
ISO-HPO-100-L*	HPO Sensor, L-Shaped 100 µm (pkg. of 2)
5435	ISONOP Startup Kit *(recommended with first purchase)*
5436	Replacement Sleeve Kit for 2mm sensor, pkg. of 4
7325	ISO-NO Electrolyte (10 mL)
7521	ISO-NO Electrolyte, CO2-insensitive (10 mL)
5399	T-Adapter Kit (pkg. of 3) for ISO-NOP
7357	Nitrite Standard Solution, 1 gram/liter (100 mL)
91580	Microsensor Adapter Cable
SNAP50	SNAP, 50 mg vial

**Tip diameters given do not include the coatings. Tips are bare wire.*

Hydrogen Sulfide Sensors

Low detection limit sensors to record in vitro

Features

- High selectivity and sensitivity to H_2S with fast response time
- Broad linearity

Benefits

- A dry sensor that works like a 2 mm wet sensor
- Use like an **ISO-H2S-2** without sleeves and filling solution

Applications

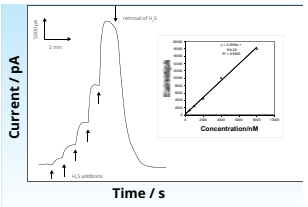
- Measure biological H_2S *in vivo* or *in vitro* in tissues or biological media
- Measure H_2S released from drugs
- Cell culture, cell suspensions, arteries, *in vivo* applications

Although hydrogen sulfide (H_2S) is generally thought of as a poisonous gas, it is endogenously produced in many mammalian tissues. It has been detected in micromolar amounts in blood and brain tissue. Hydrogen sulfide is reported as having a broad range of biological functions and although its potential to participate in cell signaling is clear, this biological role is not well understood. H_2S is strongly analogous to nitric oxide (NO) because they share several physical and metabolic properties.

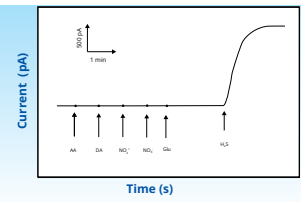
Like NO, H_2S is a potent vascular signal that can mediate vasoconstriction or vasorelaxation depending on the O_2 level and tissue. In the rat aorta, H_2S concentrations that mediate rapid constriction at one O_2 level will cause rapid relaxation at lower O_2 levels.

The **ISO-H2S** sensor is a low detection limit sensor to record H_2S *in vitro*. This is the only sensor available that measures H_2S. The **ISO-H2S-100** is a hydrogen sulfide sensor with a 100 µm diameter tip. It is designed like the dry microsensors, however, it works like a traditional 2 mm sensor. The sensor can be ordered in a variety of lengths from 2–5 mm. It incorporates WPI's proprietary combination electrode technology in which the hydrogen sulfide-sensing element and separate reference electrode are encased within a single shielded sensor design. The **ISO-H2S-100** offers several advantages:

- Requires no sleeves or filling solutions like 2mm macrosensors
- Durable for long-term use, because of its platinum wire construction
- Rapid response time
- Broad linear range (Range is based on the length of the sensor tip)



Stepped response to increasing concentrations of H_2S are linear (R=.9963).



The sensor is insensitive to competing species such as ascorbic acid, dopamine, nitrate, nitrite and glutathiols.

ORDERING INFORMATION

ISO-H2S-100-Cxx	Hydrogen Sulfide Micro Sensor (pkg. of 2)
ISO-H2S-2	2 mm Shielded Hydrogen Sulfide Macro Sensor

Hydrogen Peroxide Sensors

Direct quantitative measurements in biological samples

ISO-HPO-2

ISO-HPO-100

ISO-HPO-100 H

Features

- Gas permeable polymer membrane sleeve blocks liquids, ions and particulate matter
- Incorporated reference electrode

Benefits

- Non breakable integrated hydrogen peroxide sensor with tip dimension of 100 µm, detection limit down to nM range. Tip size can be custom made as small as a few micrometers.

Applications

- Cell culture, cell suspensions
- Cell tissue measurements

Despite the recognized importance of this oxidant in biology, real-time measurements at low concentration have been difficult. The hydrogen peroxide sensors developed by WPI are designed to compliment existing high sensitivity fluorescent approaches with direct quantitative measurement in biological samples in the low nM range.

The **ISO-HPO-2** is a 2.0 mm stainless steel sensor, with replaceable membrane sleeves (600012) and an internal refillable electrolyte (100042). It is designed for use in cell cultures and similar applications.

The **ISO-HPO-100** is a 100 µm tip diameter hydrogen peroxide micro sensor designed for use in tissues and similar applications. The design is based on a platinum wire sensing electrode coated with a proprietary membrane to enhance H_2O_2 detection.

These sensors incorporate WPI's proprietary combination electrode technology whereby the hydrogen peroxide sensing element and separate reference electrode are encased within a single Faraday-shielded probe design. This design has been shown to enhance performance during measurements and minimizes overall sensor size.

Our hydrogen peroxide (H_2O_2) sensors work with the **TBR4100** and **TBR1025** free radical analyzers.

H_2O_2 SENSOR SPECIFICATIONS

	ISO-HPO-2	ISO-HPO-100	ISO-HPO-100 H	ISO-HPO-100-L
APPLICATION	Cell Cultures, Cell Suspensions	Tissue/Microvessels	Hypodermic Sheath	Tissue Bath
SENSOR DIAMETER	2.0 mm	100 µm	100 µm	100 µm
RESPONSE TIME	< 5 SEC (90%)	< 5 SEC (90%)	< 5 SEC (90%)	< 5 SEC (90%)
DETECTION LIMIT	< 100 nM to 100 µM	1 nM to 1 mM	< 10 nM to 1 mM	1 nM to 100 µM
DRIFT	< 0.2 pA/min	< 2.0 pA/min	< 2.0 pA/min	< 2.0 pA/min
SENSITIVITY	8 pA/µM	1 pA/nM	1 pA/nM	1 pA/nM
PHYSIOLOGICAL INTERFERENCE	none	Contact WPI	Contact WPI	Contact WPI

ORDERING INFORMATION

600011	ISO-HPO Startup Kit (recommended with first purchase)
ISO-HPO-2	2 mm Shielded HPO Sensor & Cable
ISO-HPO-100	100 µm HPO Sensor*, pkg. of 3
ISO-HPO-100-L	100 µm HPO Sensor, L-shaped*, pkg. of 2
ISO-HPO-100H	100 µm HPO Sensor in hypodermic sheath*, pkg. of 3
600012	Replacement Sleeve Kit for ISO-HPO-2, pkg. of 4
100042	ISO-HPO-2 Electrolyte (10 mL)
91580	Microsensor Adapter Cable

∗ Requires 91580 Microsensor Adapter Cable

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Oxygen Sensors

Make direct quantitative measurements in biological samples

ISO-OXY-2

Features

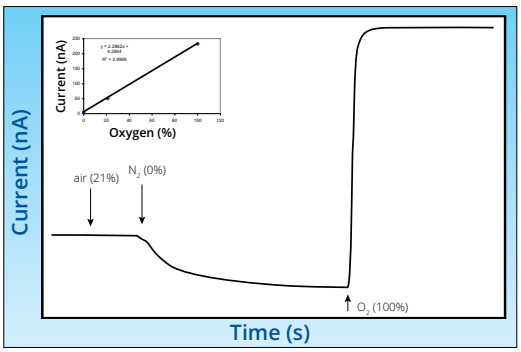
- Gas permeable polymer membrane sleeve blocks liquids, ions and particulate matter
- Incorporated reference electrode

Benefits

- Clark type of oxygen sensor with tip size of 2 mm, can be used for very small volume O_2 measurement

Applications

- Cell culture, cell suspensions
- Cell tissue measurements



This sensor incorporates WPI's proprietary combination electrode technology whereby the oxygen-sensing element and separate reference electrode are encased within a single shielded sensor design. A gas-permeable polymer membrane is fitted over the end of the sleeve, which allows oxygen to pass while blocking liquids, ions and particulate matter.

Oxygen diffuses through the membrane. The voltage applied to the sensor is held at -0.7V when the monitoring device is on and the sensor is properly connected. The magnitude of the generated electrical current is determined by the rate of diffusion through the membrane. The rate is proportional to the partial pressure of oxygen outside the membrane. The current serves as a measure of the partial pressure of O_2.

The **ISO-OXY-2** is a 2.0 mm stainless steel sensor, with replaceable membrane sleeves (5378) and an internal refillable electrolyte (**7326**).

O_2 SENSOR SPECIFICATIONS	
APPLICATION	Cell cultures, cell suspensions.
SENSOR DIAMETER	2.0 mm
RESPONSE TIME	<10 SEC (90%)
DETECTION LIMIT	0.1 % to 100%
DRIFT	<1%/min
SENSITIVITY	N/A
PHYSIOLOGICAL INTERFERENCE	None

ORDERING INFORMATION	
ISO-OXY-2	2 mm Shielded Oxygen Sensor & Cable
5377	ISO-OXY Startup Kit (recommended with first purchase)
5378	Replacement Electrode Sleeve Kit, pkg. of 4
7326	ISO2 Filling Solution (electrolyte)

Implantable Glucose Sensor

Measure glucose in vivo *or* in vitro *over long term*

Features

- Implantable sensor for long term studies
- Incorporated reference electrode

Benefits

- Implantable microsensor,
- Biocompatible
- Long term monitoring

IGS100

Applications

- *In vivo* long term measurement of glucose in animals or tissues

Measuring glucose *in vivo* over the long term is challenging and difficult. Previous measurement systems were limited to acute studies or a few days at best. WPI introduces a new kind of implantable glucose sensor based on a patented technology. This sensor provides a tool for researchers to directly detect glucose in chronic studies *in vitro* or *in vivo*. The sensor is fully compatible with WPI's TBR systems.

GLUCOSE SENSOR SPECIFICATIONS	
IN VITRO PRECISION	Coefficient of Variation (CV) ≤5%
GLUCOSE RANGE	36–450 mg/dl (or 2-25 mM/L)
RESPONSE TIME (SEC)	100–300 s
IN VIVO CALIBRATION	*In vivo* calibration
INTERFERENCE SPECIES	Acetaminophen, ascorbic acid, uric acid
LENGTH	5 cm
SENSOR SIZE	0.6 × 0.7 mm
REFERENCE ELECTRODE	Ag/AgCl
POLARIZATION VOLTAGE (V)	0.65 -0.7 V vs. Ag/AgCl
SENSOR LIFE	3-4 months in solutions at room temperature under continuous polarization; 15-30 days *in vivo*
SHELF LIFE	6 months
OPERATION CONDITIONS	20° to 40° C (68° to 104° F)
STORAGE CONDITIONS	10° to 25° C (50° to 77° F)

ORDERING INFORMATION	
IGS100	Implantable Glucose Sensor (pkg. of 2)
91580	Microsensor Adapter Cable

Four-Channel Free Radical Analyzer

Fast, reliable, real-time detection— Measure redox-reactive species

TBR4100

Features

- Real-time detection using electrochemical sensors
- Integrated system includes one temperature sensor, your choice of two additional sensors and a start-up kit
- Current measurement range from 300 fA to 10 µA (four ranges) permits wide dynamic range for detection
- Wide bandwidth allows recording of fast events
- Measure carbon monoxide from 10 nM to 10 µM
- Measure nitric oxide from < 0.3 nM to 100 µM
- Measure hydrogen peroxide < 10 nM to 100 mM
- Measure hydrogen sulfide
- Measure glucose
- Measure oxygen from 0.1% to 100%
- Isolated architecture allows Lab-Trax interface to simultaneously measure free radical and independent analog data (for example, ECG, BP, *etc*.) on any channel

Benefits

- Measure up to four different species and temperature in the same preparation or simultaneous measurement in four different preparations
- Lab-Trax data acquisition system is flexible

Applications

- Free radical detection (NO, H_2O_2, H_2S, CO, O_2 and glucose)

Real-time detection and measurement of a variety of redox-reactive species is fast and easy using the electrochemical (amperometric) detection principle employed in the **TBR4100**. This optically isolated four-channel free radical analyzer has ultra low noise and independently operated channels.

Measure four species simultaneously

For use with WPI's wide range of nitric oxide, hydrogen peroxide, hydrogen sulfide and oxygen sensors, the **TBR4100** can measure four different species simultaneously in the same preparation. Simply plug a sensor into any one of the input channels on the front panel and select the current range. Poise voltage can be selected from a range of values tuned for optimal response from WPI sensors. An independent output for real-time monitoring of temperature is also included.

Lab-Trax data acquisition system is flexible

The **TBR4100** analyzer utilizes PC-based data acquisition via our **Lab-Trax** interface. Data traces are displayed and recorded in real-time. The LabScribe software comes pre-configured for single or multiple electrode recording; filters, gains and smoothing are all set for optimal results. Data can be viewed making adjustments to smoothing and filter settings without affecting the original stored raw data. Electrode calibration from multiple concentration readings can be input into the software's Multipoint Calibration utility quickly, providing a plot and slope calculation for electrode sensitivity determination. Alternately, the **Lab-Trax** data interface can be used for providing simultaneous acquisition of Free Radical data along with other physiological data (ECG, HR, BP, *etc*.) as each of the four input channels has its own independent input, filters and 24-bit converter.

See www.wpiinc.com/TBR4100 for more information on Lab-Trax data acquisition.

References

Zhang X.J. Real time and *in vivo* monitoring of nitric oxide by electrochemical sensors—From dream to reality, *Frontiers in Bioscience*, 9,3434-3446(2004)

Zhang XJ. Ju HX. Wang J. Electrochemical Sensors, *Biosensors and Their Biomedical Applications*, Elsevier, 2008

Murine strain differences in inflammatory angiogenesis of internal wound in diabetes. (2017). *Biomedicine & Pharmacotherapy*, 86, 715–724. https://doi.org/10.1016/J.BIOPHA.2016.11.146

Xie, L., Feng, H., Li, S., Meng, G., Liu, S., Tang, X., ... Ji, Y. (2016). SIRT3 Mediates the Antioxidant Effect of Hydrogen Sulfide in Endothelial Cells. *Antioxidants & Redox Signaling*, 24(6), 329–343. http://doi.org/10.1089/ars.2015.6331

Nguyen, T.-K., Selvanayagam, R., Ho, K. K. K., Chen, R., Kutty, S. K., Rice, S. A., ... Boyer, C. (2016). Co-delivery of nitric oxide and antibiotic using polymeric nanoparticles. *Chem. Sci.*, 7(2), 1016–1027. http://doi.org/10.1039/C5SC02769A

Chen, G., Yang, L., Zhong, L., Kutty, S., Wang, Y., Cui, K., ... Bin, J. (2016). Delivery of Hydrogen Sulfide by Ultrasound Targeted Microbubble Destruction Attenuates Myocardial Ischemia-reperfusion Injury. *Scientific Reports,* 6, 30643. http://doi.org/10.1038/srep30643

Xu, T., Scafa, N., Xu, L.-P., Zhou, S., Abdullah Al-Ghanem, K., Mahboob, S., ... Zhang, X. (2016). Electrochemical hydrogen sulfide biosensors. *The Analyst*, 141(4), 1185–1195. http://doi.org/10.1039/C5AN02208H

Zong, Y., Huang, Y., Chen, S., Zhu, M., Chen, Q., Feng, S., ... Jin, H. (2015). Downregulation of Endogenous Hydrogen Sulfide Pathway Is Involved in Mitochondrion-Related Endothelial Cell Apoptosis Induced by High Salt. *Oxidative Medicine and Cellular Longevity*, 2015, 1–11. http://doi.org/10.1155/2015/754670

Cho, Y., Park, Y. M., Barate, A. K., Park, S.-Y., Park, H. J., Lee, M. R., ... Holden, D. (2015). The role of rpoS , hmp , and ssrAB in Salmonella enterica Gallinarum and evaluation of a triple-deletion mutant as a live vaccine candidate in Lohmann layer chickens. *Journal of Veterinary Science,* 16(2), 187. http://doi.org/10.4142/jvs.2015.16.2.187

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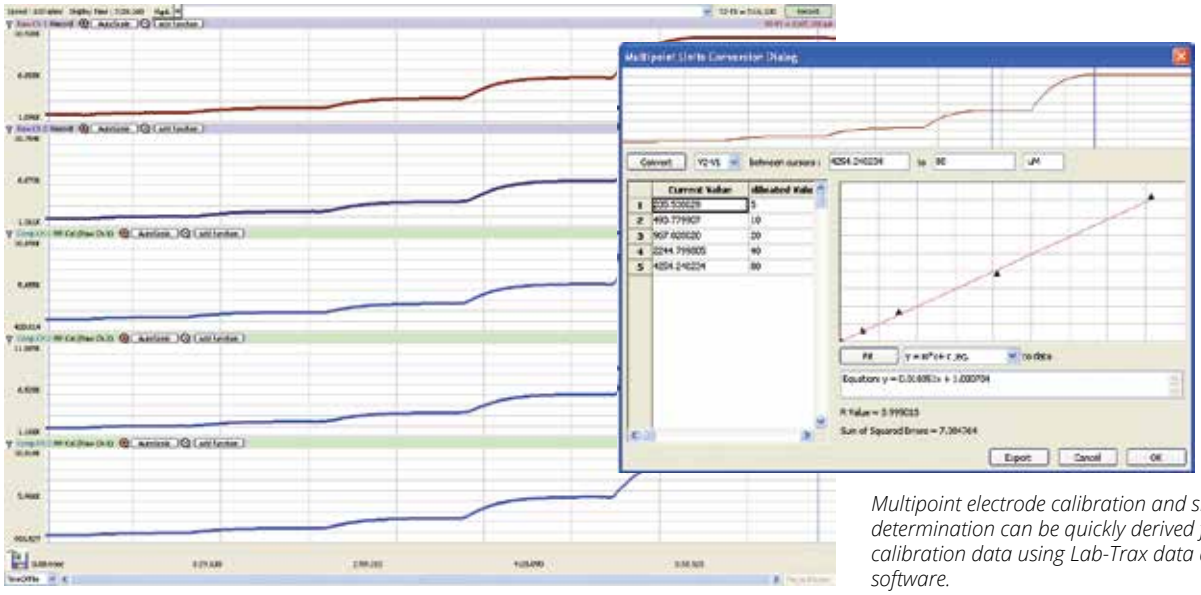


Multipoint electrode calibration and slope determination can be quickly derived from recorded calibration data using Lab-Trax data acquisition software.

TBR4100 SPECIFICATIONS

POWER	100 ~ 240 VAC, 50-60 Hz, <15 W
OPERATING TEMPERATURE (ambient)	0–50°C (32–122°F)
OPERATING HUMIDITY (ambient)	15 – 70% RH non-condensing
WARM UP TIME	<5 minutes
DIMENSIONS	135 X 419 X 217 mm (5.25" X 16.5" X 8.16")
WEIGHT	1.35 kg (3 lb.)
DISPLAY FUNCTIONS	18 mm (0.7") LCD readout, 4.5 digit Polarization Voltage (mV) Current input (nA, µA)
CONTROLS	Power (on/off) Current Input Range Polarization Voltage
ANALOG OUTPUT RANGE	±10 V (continuous)
ANALOG OUTPUT IMPEDANCE	10 KΩ
CHANNEL TO CHANNEL ISOLATION	>10 GΩ
CHANNEL TO OUTPUT ISOLATION	>10 GΩ
POWER SUPPLY TO AC LINE ISOLATION	>100 MΩ
ANALOG OUTPUT DRIFT	<10 pA/h
TEMPERATURE INPUT	
NUMBER OF CHANNELS	1
SENSING ELEMENT	Platinum RTD, 1000 Ω
RANGE	0–100°C
ACCURACY	± 1°C
RESOLUTION	0.1°C
ANALOG OUTPUT	31.25 mV/°C (continuous)
AMPEROMETRIC INPUT	
NUMBER OF AMPEROMETRIC CHANNELS	4
SIGNAL BANDWIDTH	0-3 Hz
POLARIZATION VOLTAGE (SELECTABLE VIA ROTARY SWITCH)	
Nitric Oxide	865 mV
Hydrogen Sulfide	150 mV
Hydrogen Peroxide	450 mV
Glucose	600 mV
Oxygen	700 mV
ADJ (user adjustable)	± 2500 mV
POLARIZATION VOLTAGE ACCURACY	± 5 mV
POLARIZATION VOLTAGE DISPLAY RESOLUTION	±1 mV

CURRENT MEASUREMENT PERFORMANCE

Range	Analog Output	Noise @ 3Hz	Noise @ 0.3 Hz *
± 10 nA	1 mV / 1 pA	< 1 pA	< 0.3 pA
± 100 nA	1 mV / 10pA	< 7 pA	< 3 pA
± 1 µA	1 mV / 100pA	< 70 pA	< 30 pA
± 10 µA	1 mV / 1 µA	< 700 pA	< 300 pA

**Instrument performance is measured as the (max-min) over 20-second period with open input. Typical values are given at 3 Hz and 0.3 Hz bandwidth.*

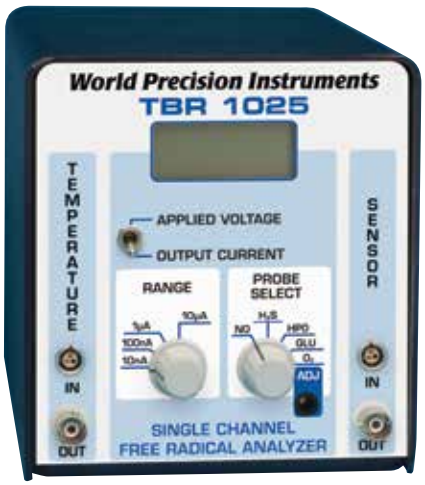
Typical sensor performance with TBR4100: ISO-NOPF100 NOISE . . . . . 0.2 nM NO (<2 pA)**

***Sensor noise is measured as the (max-min) over a 20-second period with the sensor immersed in 0.1 M $CuCl_2$ solution.*

Temperature Sensor

The temperature sensor (**ISO-TEMP-2**) is based on a 2.0 mm tip diameter high quality miniature platinum RTD (Resistance Temperature Detector) electrode. This design has been shown to provide greater accuracy, stability and interchangeability during temperature measurements than traditional thermistor and thermocouple sensors. The ISO-TEMP-2 is included with the purchase of a system.

TBR1025



Don't need four channels? *The single-channel TBR1025 packs the power of the full-size 4-channel unit in a small, economical package.*

ORDERING INFORMATION

TBR4100-416 Four-Channel Free Radical Analyzer with Lab-Trax 4/16 Data Acquisition System
Includes TBR4100 analyzer & power cord, Lab-Trax-4/16 data acquisition system & USB cable, 4 BNC cables, 1 electrode adapter cable, 1 temperature probe, 2 sensors of your choice, and sensor start-up kit(s), if applicable.

TBR1025 Single-Channel Free Radical Analyzer
Includes 1 sensor of your choice & 1 start-up kit

RECOMMENDED ACCESSORIES / REPLACEMENT PARTS

SNAP50	SNAP S-Nitroso-N-acetyl-D-penicillamine, 50 mg vial
ISO-TEMP-2	2 mm Platinum RTD Temperature Sensor (requires 91580)
91580	Microsensor Adapter Cable

Optical Oxygen Sensor

Oxygen detection in small samples

Features

- Oxygen detection using the phase shift between a reference signal and measured signal
- Common sterilization procedure via gamma radiation, ethanol, para-acetic acid, ethylene oxide
- Easy cleaning procedure with 3% H_2O_2, ethanol or common soap solution
- Compatibility with ethanol, methanol and isopropanol
- No cross-sensitivity in static aqueous solutions with pH 1-14, CO_2, H_2S, SO_2 or any other ionic species
- Cross-sensitivity for organic solvents such as acetone, toluene, chloroform or methylene chloride and any chlorine gas
- Available with SMA or ST connector
- Small sensor tip diameter ≤ 50 µm

Benefits

- Designed for use in gaseous and aqueous solutions
- Easy calibration via a two-point calibration with an oxygen-free environment (nitrogen, sodium sulfite) and an air-saturated environment
- Fast response time t_{90} ≤ 3 seconds (in gas phase)
- Retractable up to 10 mm
- No oxygen consumption during measurements

Applications

- Oxygen measurement in small samples
- Bioprocess control

BioOxy is a new and innovative technology for measuring oxygen in gaseous and aqueous phase. **BioOxy** is an optical oxygen sensor with important advantages over using common Clark type electrodes.

- **BioOxy** does not consume oxygen while making measurements.
- Similar performance overall at a lower cost. This helps lower research or operational expenses compared to competitive consumable sensors.
- **BioOxy** may be gamma sterilized. Sensors can be irradiated, as well as ETOH and PAA, which may be ideal for biological applications.
- Very good resistance to long term photobleaching allows for extended use, a periodic re-calibration is recommended for optimal results.
- Sensor-to-sensor repeatability because of the very small unit-to-unit variation allows much more confident data from test to test using different sensors.

The **BioOxy** is ideally adapted for examination of small sample volumes thanks to its miniature sensor tip diameter of less than 50 µm. The **BioOxy** is well suited for long-term measurements and biotechnological applications. The signal does not depend on the flow rate of the sample and the measurement principle requires no contact.

The physical principle is based on quenching of luminescence, which is caused by the collision between molecular oxygen and a luminescent dye molecule in the excited state. There is a direct relationship between the measured phase angle and oxygen concentration. The phase angle decreases when oxygen is present in your sample. The transfer of the emitted light signal is done optically using high quality fused silica fibers, ensuring a constant performance from lot-to-lot.

BIOOXY SPECIFICATIONS

OXYGEN MEASUREMENT	Gaseous & Dissolved O_2
PROBE SIZE	240 µm with active area ~50 µm Retractable 10 mm
MEASUREMENT RANGE	0 – 100 % O_2 0 – 1000 hPa
LIMIT OF DETECTION	0.05 % Oxygen
RESOLUTION	± 0.09 % O_2 or better
ACCURACY @ 20 °C	± 0.4 % O_2 @ 20.9 % O_2 ± 0.05 % O_2 @ 0.2 % O_2
MEASUREMENT TEMPERATURE RANGE	0 to + 80 °C
RESPONSE TIME (T_{90})	< 3 sec. (in gas phase)

ORDERING INFORMATION

O2-T0050L250-12012	BioOxy Sensor, 50 µm Tip, ST Connector, pack of 2
O2-T0050L250-12022	BioOxy Sensor, 50 µm Tip, SMA Connector, pack of 2

COMPATIBLE WITH:

OXY-MICRO-AOT	Fiber Optic Oxygen Meter with ST Connection
FLOX-PROBE	In Situ Oxygen Monitoring Kit with SMA Connection

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Oxygen Monitoring Kit

Detect O_2 for real-time analysis

Features

- Fluorescence-sensing detector for optical sensors, a viable alternative to traditional chemical sensing devices
- Measure fluorescence lifetime, phase and intensity
- LED based photometry makes this unit affordable–Half the cost of comparable phase measurement systems
- Excellent stability, extremely low drift and phase noise
- Simple calibration, setup and control

Benefits

- Self-contained, benchtop system–invariant to fiber bending or stray light
- Easy setup and control, combined with its stability and sensitivity make this unit perfect for long term studies
- Three coatings for probes and patches give you many options.

Applications

- Oxygen sensing applications requiring stability and sensitivity to drift which must be undisturbed for lengths of time
- Monitor O_2 partial pressure in gas and aqueous solutions and in non-aqueous vapors and solutions
- Monitor traces of oxygen in gas and liquids

FLOX-PROBE

FLOX is a device for measuring fluorescence lifetime, phase and intensity. It uses LED excitation and photodiode detection with filter-based wavelength selection for easy experimental set-up and control.

Self contained unit

The compact, self-contained unit makes it invariant to fiber bending and stray light. It also has a wide dynamic range of optical intensity, as well as low optical and electronic crosstalk, and low drift and phase noise.

FLOX is especially useful for oxygen sensing applications where stability and sensitivity to drift is important and where sample set-ups must be left undisturbed for long periods of time.

Easy setup, great for long term studies

The new oxygen sensing system measures fluorescence lifetime, phase and intensity, using LED excitation and photodiode detection with filter-based wavelength selection. The system is simple to set-up and control. When stability and sensitivity to drift are important in your oxygen sensing experiment, this unit is ideal. It is perfect for applications where sample set-ups must be left undisturbed for long periods of time.

Three coatings available for probes and patches

The optical sensors consist of transducer materials, applied to the tips of optical fibers or to substrates such as patches or cuvettes, which change optical properties in response to specific analytes in their immediate environment.

OXY–The standard oxygen sensor designed for monitoring oxygen partial pressure in gas and aqueous solutions is a fiber optic fluorescence probe with a proprietary oxygen sensing coated tip.

HIOXY–Designed for monitoring oxygen partial pressure in non-aqueous vapors and solutions. The sensor coating chemistry is compatible with oils, alcohols, and hydrocarbon-based vapors and liquids.

FOSPOR–A new generation of highly sensitive sensor coating can be used for monitoring traces of oxygen in gas and liquids.

The oxygen sensor probes are low-power and offer high sensitivity, reversibility and stability, ideal for remote monitoring. The thin coating on the probe tips consumes no oxygen, allowing for continuous contact with the sample. They are ideal for viscous samples and are immune to interference caused by pH, ionic strength or salinity fluctuations or biofouling.

OR125 g and **OR125 gT**
These probes are 1/8" OD optical fiber probes used as direct replacement for 1/8" OD O2 electrodes. • 1000 µm optical fiber, stainless steel ferrule; 3.175 mm OD, 63.5 mm length

R Sensor Probe
1000 µm fiber in a stainless steel 1/16" ferrule; 1.587 mm OD, 152.4 mm length

AL300
A 500 µm OD (300 µm core diameter) aluminum-jacketed optical fiber probe for applications that require fine spatial resolution. • 300 µm alµminµm-jacketed fiber assembly; 500 µm OD, 1 m length

OR125
The OR125 is a 1/8" OD optical fiber probe used as a direct replacement for 1/8" OD O2 electrodes. • 100 µm optical fiber, stainless steel ferrule; 3.175 mm OD, 63.5 mm length

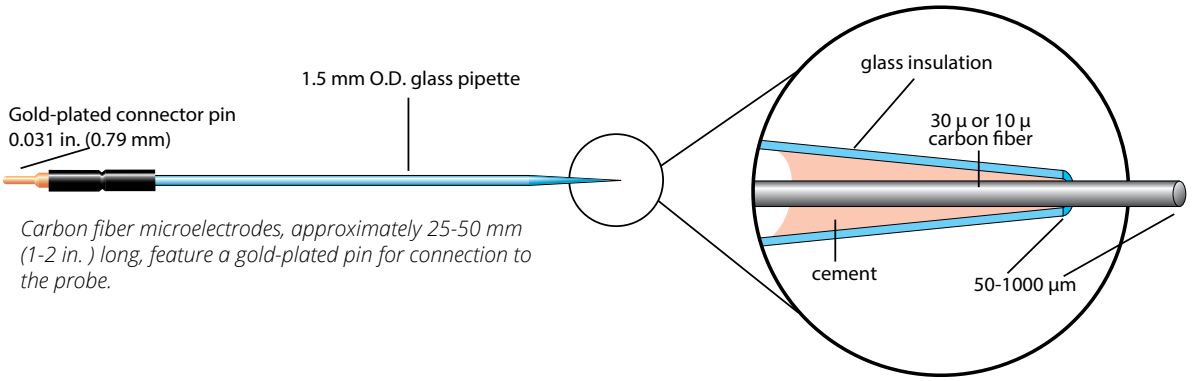
P1600
The PI600 is a silicone-jacketed, polyimide-coated optical fiber probe used in environments where a non-metallic probe is required. • 200 or 600 µm optical fiber with silicone jacketing; 710 µm OD, 2 m length

ORDERING INFORMATION

FLOX-PATCH	Non-Invasive Oxygen Monitoring Kit, including phase measurement system, temperature probe; select sensor patches when ordering
FLOX-PROBE	In Situ Oxygen Monitoring Kit, including phase measurement system, temperature probe; select sensor when ordering

Carbon Fiber Microelectrodes

Electrochemical detection of oxidizable compounds



Carbon fiber microelectrodes, approximately 25-50 mm (1-2 in.) long, feature a gold-plated pin for connection to the probe.

Features

- Sensitive, renewable/durable and economical carbon fiber electrodes for electrochemical detection of oxidizable compounds
- Excellent linearity to the oxidizable compounds

Benefits

- Precision tip size and length of the CF electrodes
- Renewable

Applications

- Detection of neurotransmitters and oxidizable compounds *in vivo* or *in vitro*

Carbon fiber microelectrodes have been used in both the detection of oxidizable compounds (Gonon, *et al.*, 1978; Cahill and Wightman, 1995) and extracellular single-unit recording (Armstrong-James and Millar, 1979). WPI's ultra-sensitive and low-noise carbon fiber (**CF**) electrodes can be applied, with our Micro-C Potentiostat or similar instruments, in the electrochemical detection of catecholamines (epinephrine, norepinephrine and dopamine), indolamines (serotonin, 5-HT or melatonin), ascorbic acid, Fe (II) and other oxidizable compounds.

CF electrodes (diameter of 10 or 30 µm) respond with an excellent linearity to the oxidizable compounds (see figure below) and can detect the compounds as low as 0.2 nM. While the shorter (25-100 µm) CF electrodes are suitable for *in vivo* amperometric and voltammetric measurements, the longer CF electrodes provide higher sensitivity and are especially useful for the *in vitro* studies (amperometric or differential pulse voltammetry). When used with the Micro-C Potentiostat, these CF electrodes can be activated and renewed in sensitivity for multiple use. The selective detection of catecholamines can be achieved with our Nafion-coated CF electrodes. For selective detection of 5-HT and ascorbic acid, please contact WPI for more information.

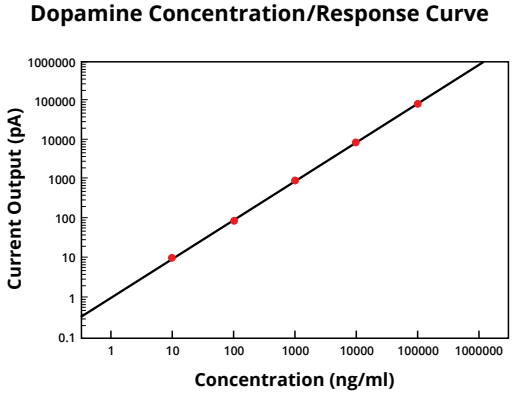


Fig. 1 — Excellent linearity in the response of carbon fiber electrode (CF30-500) to dopamine recorded on Micro-C. Courtesy: Drs. D. Yeomans and X.-T. Wang, University of Illinois at Chicago.

References

P. S. Cahill, **R. M. Whightman**, *Anal. Chem.*, **67**, 2599-2605 (1995).
F. Gonon, *et al.,* Hebd Seances Acad. Sci. Ser. **286**, 1203 (1978).
M. Armstrong-James, J. Millar, *J. Neurosci. Methods,* **1**, 279 (1979).

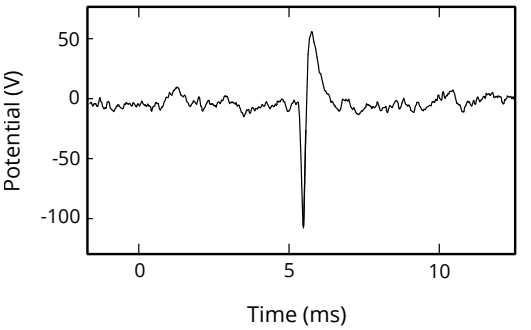


Fig. 2 — Extracellular recording using a carbon electrode in CA1 region of the hippocampus in an anesthetized rat shows ultra-low noise (<5 µV). Courtesy: Dr. Carolyn Harley of Memorial University, Newfoundland, Canada.

ORDERING INFORMATION

CARBON FIBER MICROELECTRODES, UNCOATED

	Diameter	Length	(pack of 5)
CF10-100	10 µm	100 µm	
CF10-250	10 µm	250 µm	
CF10-500 *	10 µm	500 µm	
CF30-50 *	30 µm	50 µm	
CF30-100	30 µm	100 µm	
CF30-500 *	30 µm	500 µm	
CF30-1000 *	30 µm	1000 µm	

CARBON FIBER MICROELECTRODES, NAFION-COATED

	Diameter	Length	(pack of 5)
CFN10-50 *	10 µm	50 µm	
CFN10-100 *	10 µm	100 µm	
CFN10-250 *	10 µm	250 µm	
CFN30-50 *	30 µm	50 µm	
CFN30-100 *	30 µm	100 µm	
CFN30-250 *	30 µm	250 µm	
CFN30-1000 *	30 µm	1000 µm	

** Built to order — allow up to 4 weeks manufacturing time.*

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Fiber Optic Oxygen Meter and Sensors

A generation of sensors based on luminescence lifetime

Features

OXY-MICRO-AOT

- Oxygen is not consumed during the experiment
- Immune to electrical and magnetic interference
- Excellent long-term stability
- No lengthy polarization necessary (like Clark-type O_2 electrodes)
- Fast response time < 0.5 s for MicroTip sensors
- Probe size of MicroTip sensors as small as 50 µm
- Measurement is feasible in dry gas
- Optical isolation of sensor tip available for fluorescent or photosynthetically active samples

Benefits

- Unaffected by light source stability and intensity fluctuations, because it is based on luminescence lifetime detections.
- Compact, portable meters may be used inside or outside

Applications

- Process control like bottling plant in breweries and quality control of packages (OxyMini)
- Biotechnology like control of cell culture media and non-invasive control of bioreactors (OxyMini)
- Implantation of oxygen sensors into soil and trees (OxyMini)
- Oxygen profiles of marine sediment, soils, or tissue (OxyMicro)
- Implantation in living tissue like heart or muscle tissue (OxyMicro)
- Control of cell culture media in Biotechnology (OxyMicro)

The measurement principle of the sensor system is based on the detection of oxygen concentration as a function of luminescence lifetime, either in dissolved or gaseous phase environments.

Unaffected by light source stability/intensity

Conventional fiberoptic oxygen sensor systems based on intensity measurements are limited in their accuracy by light source stability and ambient light fluctuations. Using a luminescence lifetime detection, measurements are not affected by light source stability, intensity fluctuations caused by fiber bending or changes of the optical properties of the sample (turbidity, refractive index, coloration, etc.).

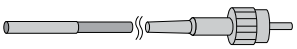
Calibration: The sensors can be calibrated by a simple two point calibration, 100% air-saturation and 0% air saturation.

Compact, portable meters, inside and outside

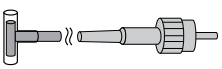
The **OxyMini** and **OxyMicro** fiber optic oxygen meters are compact and easy to transport. Designed for in/outdoor use, they can be connected to a PC via a RS232 interface. Data can be visualized, analyzed and stored with supplied software. A full range of sensors are available.

OxyMini systems

The OxyMini is a one channel fiber optic O_2 meter for fiber optic O_2 minisensors. These sensors are based on 2 mm polymer optical fibers and have a length of 2.5 m.



MiniTip – This dipping probe (501641) has a tip diameter of 4 mm and consists of a polymer optical fiber with an O_2 sensitive coating. Its range is 0–100%. It has a response time (t_{90}) of ~ 40 s.

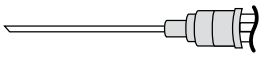


MiniFlow – The MiniFlow probe (501642) is a miniaturized fiber optic chemical sensor integrated in a standard T-shape flow through cell which can be easily connected via Luer-Lock adapters to external tubings. Liquids can be pumped through the cell. It has a response time (t_{90}) of approximately 40 s and an excellent long-term stability.

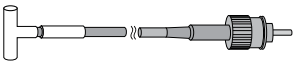
MiniFoil – Sensor material on a 1 cm^2 support disk made of polyester can be glued inside glass vials. Measure oxygen concentration non-invasively and non-destructively from outside through the wall of the vial. Illuminate the sensor foil with a plastic fiber optic cable (501644, 01645). The wall of the flask must be transparent/non-fluorescent (response time (t_{90}) of ~50s). The material can be implanted into animal tissues or custom-made housings.

OxyMicro systems

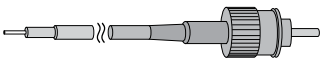
OxyMicro is a one channel O_2 meter for fiber optic O_2 microsensors.



MicroTip – The MicroTip (501656) is a needle-type (27 ga.) oxygen micro sensor designed for applications where a small tip size (50 µm) and fast response time (t_{90}) of 1 s are required. The oxygen sensitive sensor tip consists of 140 µm fiber tapered to a 50 µm tip. Housed inside a stainless steel needle 22 mm long and 0.4 mm diameter, it can penetrate a septum rubber or similar material. They are ideal for oxygen profiling in sediments and biofilms.



MicroFlow – The MicroFlow oxygen sensor (501657) is a miniaturized fiber optic chemical sensor optimized for fast response time (t_{90} <1 sec in gases, <5 sec in liquids). The tiny probe has a tip size of 50 µm and is integrated in a T-shape flow cell for easy connection via Luer-Lock adapters to external tubings. Liquids (like water, blood, etc.) can be pumped through the cell.



MicroImplant – The MicroImplant oxygen sensor (501658) is an implantable probe (IMP) with a probe tip size 50 µm, an exposed fiber length of 5 mm and a jacket diameter of 900 µm. It has been successfully implanted in crabs, fishes and soil.

SPECIFICATIONS

	MiniTip	MiniFlow	MiniSpot	MicroTip	MicroFlow	MicroImplant
MEASURE RANGE DISSOLVED/ GASEOUS	0-45 ppm, 0-100% 0-760 mmHg	0-45 ppm, 0-100% 0-760 mmHg	0-45 ppm, 0-100% 0-760 mmHg	0-45 ppm, 0-100% 0-760 mmHg	0-45 ppm, 0-100% 0-760 mmHg	0-45 ppm, 0-100% 0-760 mmHg
RESPONSE TIME [T_{90}] DISSOLVED/ GASEOUS	40 s 10 s	40 s 10 s	40 s 10 s	< 2 s < 0.5 s	< 2 s < 0.5 s	< 2 s < 0.5 s
STERILIZATION ETOH, H_2O_2 AUTOCLAVABLE*	Y N	Y Y	Y Y	Y N	Y Y	Y Y
DRIFT**	< 0.1%	< 0.1%	< 0.1%	< 0.3%	< 0.3%	< 0.3%
ACCURACY***	0.2%					
RESOLUTION***	2.75 ±0.01 ppm, 9.00 ±0.05 ppm, 220 ±0.15 ppm, 45.0 ±0.25 mmHg, 150 ±0.75 mmHg, 375 ±2.6 mmHg					
TEMP RANGE	-10°C to 50°C					
PROBE ASSY LENGTH	2.5 m					

**130°C, 1.5 atm **100,000 data points, 20°C ***20°C*

ORDERING INFORMATION

MINISENSOR SYSTEM

OXY-MINI-AOT	Fiber-optic Oxygen Meter for Minisensors *

MINISENSORS ***(not interchangeable with Microsensors)***

501641	MiniTip, fiber-optic oxygen sensor
501642	MiniFlow, flow-through cell with integrated planar oxygen sensor
503090	MiniSpot, planar oxygen-sensitive spot, 5 mm diam. (includes 10) Requires ***501644***
501644	Polymer optical fiber with 1 SMA connector

MICROSENSOR SYSTEM

OXY-MICRO-AOT	Fiber-optic Oxygen Meter for Microsensors *

MICROSENSORS ***(not interchangeable with Microsensors)***

501656	MicroTip, needle-type housing fiber-optic oxygen sensor, 50 µm tip
501656-C	MicroTip, needle-type housing, 50 µm tip, optical isolation
501656-F	MicroTip, needle-type housing, 140 µm flat tip
501657	MicroFlow, flow-through housed oxygen microsensor
501658	MicroImplant, implantable oxygen microsensor, 50 µm tip
501658-F	MicroImplant, 140 µm flat tip

**Meter contains two analog outputs and one trigger input*

4-Channel Data Acquisition System with Software

Low noise, high resolution system with 8 analog input and 3 analog output channels

Features

- Powerful low-noise (<1 mV RMS) and high-resolution (16 bits) data acquisition system for sampling up-to 8 analog input channels and 3 analog output channels simultaneously, using standard BNC connections
- MDAC software provides easy to use interface controlling, with extensible standard and customized Data Processing and Analysis Tools

Benefits

- Online Channel Math operations, general purpose Fast Fourier analysis (FFT) and digital filtering of Analog In channels
- Numerous basic signal forms can be combined to design experimental protocols, for most physiological applications
  - Factory designed standard or customized protocols
  - Semi-automated data analysis toolbox
- Protocol repeat function to avoid time consuming protocol programming of extended experiments

Applications

- Muscle physiology (Can be used with **SI-MTM** Muscle Testing Platform, **SI-CTS200** Cell Tester System, **SI-HTB2** Horizontal Tissue Bath and **SI-BF-100** Biofluorometer)
- Stand alone general data recorder for Spectroscopy, Neuroscience and Electrophysiology (Can be used with **TBR4100** Free Radical Analyzer, Extracellular Bioamplifiers like **SYS-DAM50, SYS-DAM80, SYS-900A, ISO-80**, **EVOM2™** Volt Ohm Meter, **ATC2000** Animal Temperature Controller, **BP-1** Blood Pressure Monitor or the **BAT-12** Microprobe Thermometer)
- Instrument control for software triggered devices like **A365**/**A385**/**A395** Constant Current Stimulators, **MPS-2** Perfusion System, **SYS-PV820**/**SYS-PV830** Pneumatic PicoPumps, **Duo 773** Intracellular amplifiers and the **SYS-TBM4M** Transbridge Transducer Amplifier (e.g. for FORT force transducers)

Knowledge of the physiological characteristics of muscle tissue can be useful to quantify beneficial or adverse effects of drug supply on muscle function in pre-clinical and toxicological studies, evaluating muscle dystrophies, training effects in sports and rehabilitation (disuse vs. overuse) and advanced physiology and biomedical research.

This is usually achieved by quantifying the contractile and/or the elastic properties of muscle tissue. This needs the programming of different and specific experimental protocols (isometric, concentric and eccentric, isokinetic or isotonic), so that the physiological structure of interest can be quantified. **LabTrax-MDAC** data acquisition software was designed for use with WPI's Muscle Physiology line to test physiological characteristics of muscle tissues in various conditions, using factory designed standard or customized protocols. The semi-automated Data Analysis Toolbox of standard protocols gives quick access to user-friendly, readable and interpretable results of the experiments.

Variety of muscle physiology applications

The physiological response of muscle tissue to training, disuse, nutrition, drug supply and others factors may be studied by adding accessories to the system, like:

- Study of the muscle's force production capacities in combination with the Ca^{2+} release from the sarcoplasmic reticulum (SR) and ATPase consumption. The perfect instrument for this is WPI's Biofluorometer (**SI-BF-100**) in combination with any system of WPI's Muscle Physiology line, controlled via **LABTRAX-MDAC**.
- Study of the muscle's force production capacities from direct muscle or peripheral nerve stimulation. For this experiment, use WPI's programmable isolated current stimulators (**A365**, **A380** or **A395**), controlled via **LABTRAX-MDAC**.

LABTRAX-MDAC provides easily used continuous stimulation protocols, so that especially cardiac cells/tissue remain intact during experimental resting periods.

LABTRAX-MDAC is also well suited for other software triggered instruments or as a stand-alone general data recorder for selected WPI Instruments.

The back panel of the Lab-Trax-8/16 has four analog outputs, digital inputs or outputs, a USB port, power socket and power switch.

LAB-TRAX-8/16 SPECIFICATIONS

ANALOG INPUTS	8 BNC connections
INPUT RANGE	± 10V
SYSTEM NOISE	< 1 mV RMS
ISOLATION	1,500V
OPERATING CURRENT	800 mA maximum
ANALOG OUTPUTS	4 BNC connections
OUTPUT RANGE	± 10V
IMPLEMENTED FILTER	5th order low-pass Bessel filter with 3dB cut-off frequency
OUTPUT IMPEDANCE	100Ω
OUTPUT CURRENT	15 mA
DIGITAL I/O	16/16 TTL (BNC or DB-9 Connector)
LOGIC HIGH VOLTAGE	3.3 V minimum
LOGIC LOW VOLTAGE	1.0 V maximum
ANALOG & DIGITAL INPUTS	Operating voltage protected to ±30V
PC INTERFACE	USB 2.0
RESOLUTION	16 bits
POWER SOURCE	12V DC

ORDERING INFORMATION

LABTRAX-MDAC	Lab-Trax-8/16 with MDAC software
LAB-TRAX-4	4-Channel General Data Acquisition System
2851	BNC to BNC Cable

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Novel Fiber Optic pH System

Referenced measurements with single excitation

PH-OPTICA-MINI

Features

pHOptica Meter

- Single-channel, compact, easy to transport fiber-optic meter for pH measurements with miniature sensors
- Two 12-bit, programmable analog outputs, with electrical isolation
- One external trigger input, with electrical isolation
- Computer with RS232 interface required for operation

pH Optical Sensors

- Immune to electrical interferences and magnetic fields
- Low drift
- High spatial resolution due to small tip size
- Measurement in very small sample volumes
- Additional optical isolation of the sensor tip is available for measurements in colored or photosynthetically active samples

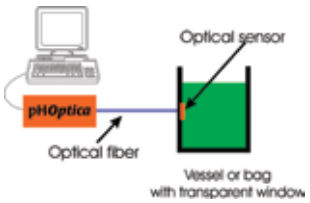
Benefits

- User-friendly software saves and visualizes measured values
- Several **pH*Optica*** meters can be connected to one computer
- Temperature variation is recorded using a temperature sensor
- No reference electrode is needed

Applications

pHOptica Micro System

The pH Optica micro system is a single channel pH system for use with fiber optic micro sensors. The applications include:



- Penetration or implantation into living tissue (heart, muscle or animal blood vessels).
- Soil implantation for pH measurement.
- Implantation into customer-made housing.

TIP: To protect the small glass fiber tip against breaking, suitable housings and tubings around it, depending on the respective application, were designed.

pHOptica Mini System

The pHOptica mini system is a one channel pH system for use with fiber optic mini sensors, foil and spot surface sensors for applications like:

- Non-invasive and non-distractive pH measurements from outside through flask walls (cell culture)
- Online pH monitoring by flow through cells
- Dipping probe pH measurements

pH Micro Sensors

- Tip size 140 micrometer
- Drift of 0.1 pH units for 2000 measurements (16 hours measurement in the 30 sec data update mode)

Implantable sensor—*without any housings implantation into animal blood circuits; soil implantation; implantation in custom-made housings*

Needle-Type Housing Sensor—*the glass-fiber with its pH-sensitive tip is protected inside a stainless steel needle (18 ga.); fiber has to be extended during measurement; penetration through septum.*

pH Mini Sensors

- OD of the dipping sensor is 4 mm
- Sterilization of the pH sensor spots via gamma radiation
- pH mini sensor meter is based on 2 mm PMMA waveguides
- Drift of 0.1 pH units for 10,000 measurements (4 days measurement in the 30 sec data update mode).

pHOptica™ is a pH measuring system which uses fiber optic sensors and patented DLR technology. This method allows referenced measurements with single excitation to be implemented.

Two different housings and sensor spots (sensorfoils) are available.

POF Coated with a pH-Sensitive Foil—*Small and robust pH dipping sensor; no reference electrode needed.*

Flow-Through Cell with Integrated pH Sensor—*On-line monitoring; can be easily connected via Luer-Lock adapters.*

SPECIFICATIONS

DATA INTERFACE	RS232
SAMPLE RATE	1 sample per sec
MEASURING PH RANGE	5 - 9
RESOLUTION (20ºC)	± 0.03 (microsensors) ± 0.01 (minisensors)
RESPONSE TIME	<1 min.
DIMENSIONS	185 x110 x 45 mm
WEIGHT	630 g
POWER SUPPLY	100-220 VAC

ORDERING INFORMATION

MINISENSOR SYSTEM *(cannot be used with microsensors)*

PH-OPTICA-MINI	Fiber Optic pH Meter for Minisensors, Foils and Spots
503538	pH MiniTip, fiber optic pH sensor dipping probe, disposable (4 mm OD), pkg. of 3. ***Requires cable 503110.***
501644	Polymer Optical Fiber with 1 SMA connector
503110	Fiber Optic Cable with 1 SMA connector

MICROSENSOR SYSTEM *(cannot be used with minisensors)*

PH-OPTICA-MICRO	Fiber Optic pH Meter for Microsensors
502124	pH MicroImplant, fiber optic pH implantable sensor (140 µm OD), pkg. of 3

Reference Electrodes

Low electrolyte leakage, stable potential with low resistance

Features

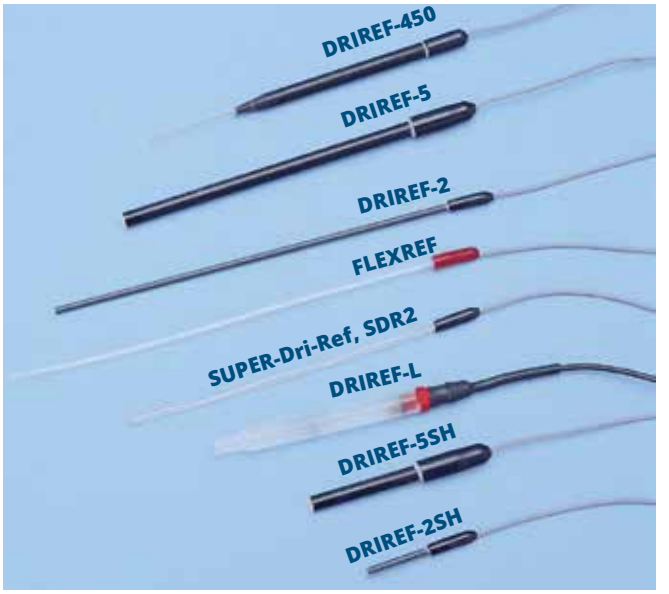
- Extremely low electrolyte leakage
- Stable, reproducible potential with low resistance
- Chemically resistant to strong acids and bases

Benefits

- May be used with ion selective electrodes without contamination from the reference electrode

Applications

- Small volume, low salt concentration measurement (SDR)



Dri-Ref™ reference electrodes were developed by WPI to have extremely low electrolyte leakage properties, hence the name "Dri-Ref." In addition to this key feature, these electrodes exhibit stable and reproducible potential and low resistance. Stored in KCl when not in use, they have a long life expectancy.

May be used with ion selective electrodes

Although the internal filling solution contains KCl, the low fluid leakage means Dri-Ref may be used in combination with ion selective electrodes, including those for K^+ and Cl^-, without significant contamination from the reference electrode.

The Dri-Ref electrodes are chemically resistant to strong acids and alkalines. Dri-Ref electrodes are not suitable for use in organic solvents. In addition, the long, thin FLEXREF may be easily manipulated to accommodate a difficult experimental setup.

SUPER-Dri-Ref – With a diameter of 2mm, SUPER-Dri-Ref *does not leak electrolyte at all.* Exhibiting the electrical stability of a classic flowing junction reference cell, this electrode exhibits low resistance and a stable half-cell potential essentially independent of sample electrolyte concentration. SUPER-Dri-Ref is ideal for small volume and low salt concentration measurements.

Micro-Reference Electrode – Only 450 µm in diameter and one inch long, the new **DRIREF-450** reference electrode can be used along with other sensors in space-restricted areas and very small sample volumes.

Luer-Tip Reference – The male luer fitting at the front of the **DRIREF-L** allows it to be easily connected to a female luer port (see WPI's luer fittings kit, page 219 to form a tight seal — a very convenient installation for a flow-through system.

DRI-REF ELECTRODE SPECIFICATIONS

	DRIREF-450	DRIREF-5	DRIREF-2	FLEXREF	SDR	DRIREF-L	DRIREF-5SH	DRIREF-2SH
LENGTH	2.54 cm	9 cm	13 cm	13 cm	9 cm	7.5 cm	3.5 cm	2.54 cm
DIAMETER	450 µm	4.7 mm	2 mm	1.5 mm	2 mm	Standard Luer	4.7 mm	2 mm
CONSTRUCTION	Coated Glass	Epoxy	Isoplast™	Teflon™	PVC	Polypropylene	Epoxy	Isoplast™
RESISTANCE (TYPICAL)	< 5 KΩ	~500 Ω	~2.7 KΩ	~2.7 KΩ	< 5 KΩ	~500 Ω	~500 Ω	~2.7 KΩ
ELECTROLYTE LEAKAGE (ML/HR)	—	~7.4×10^{-7}	~5.7×10^{-8}	~5.7×10^{-8}	—	7.4×10^{-7}	~7.4×10^{-7}	~5.7×10^{-8}
LEAD LENGTH	30 in. (76 cm)							
CONNECTOR	2 mm pin							
Filling Solution	KCl							

ORDERING INFORMATION

FLEXREF	Flexible Dri-Ref, 1.5 mm diam.
DRIREF-2	Dri-Ref, 2 mm diam.
DRIREF-2SH	Dri-Ref, 2 mm diam. (Short)
DRIREF-5	Dri-Ref, 4.7 mm diam.
DRIREF-5SH	Dri-Ref, 4.7 mm diam. (Short)
SDR2	SUPER-Dri-Ref, 2 mm diam.
DRIREF-450	Micro-Dri-Ref, 450 µm diam.
DRIREF-L	Reference Electrode with Luer Tip

Calcium Calibration Solutions

CALBUF-1

For use with calcium electrodes

A set of eight calcium buffers covering the range of concentration from 10^{-1} to 10^{-8} M Ca^{++}. Each buffer contains 20 mL of solution and enough potassium chloride to set the ionic strength to 0.1 M. Limited shelf life; use within 30 days.

Concentration: 1×10^{-1}, 1×10^{-2}, 1×10^{-3}, 1×10^{-4}, 1×10^{-5}, 1×10^{-6}, 1×10^{-7}, 1×10^{-8} M at 20°C. Limited shelf life; use within 30 days.

ORDERING INFORMATION

CALBUF-1	Kit of 8 Calcium Buffer Solutions

CALBUF-2

Use with calcium fluorescent indicators

CALBUF-2 is especially suitable for calibrating fluorescent Ca^{++} indicators. It provides eleven buffer standards in the 10^{-4} to 10^{-8} M Ca^{++} range, whereas other commonly used fluorescent Ca^{++} indicators have the apparent K_d in the range of 100 to 300 nM. As with any ionic sensitive indicator, the sensitivity range of these indicators is about 1.0 log unit above and below the K_d. CALBUF-2 provides seven calibration points in this sensitivity range. It has an osmolarity of 0.305, which is isotonic with most mammalian cells.

Concentration: 1×10^{-8}, 4×10^{-8}, 1×10^{-7}, 2.5×10^{-7}, 5×10^{-7}, 7.5×10^{-7}, 1×10^{-6}, 4×10^{-6}, 1×10^{-5}, 4×10^{-5}, and 1×10^{-4} M at 20°C. Ionic strength: 0.150 M. 11 bottles, 20 mL each. Limited shelf life; use within 30 days.

ORDERING INFORMATION

CALBUF-2	Kit of 11 Calcium Buffer Solutions

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Ion Selective Electrodes

Accurately measure calcium, potassium, hydrogen or TPP

Features

- Fast, accurate, economical
- Superior, stable PVC membrane
- Fast response
- 2mm diameter tips
- Interchangeable tip holder
- Each kit includes 3 electrode tips and MicroFil filling syringe

Benefits

- Inexpensive
- Use to measure various ions in biological media

Applications

- Detection of ions *in vivo* or *in vitro* for biological applications

These highly stable electrodes accurately measure calcium, potassium, hydrogen and TPP (Tetraphenylphosphonium) ion activity. Tips consist of 2 mm diameter plastic tubes sealed at one end with an ion-sensitive membrane. After filling with electrolyte solution, you can insert the tube into the holder and connect it to a pH meter. Tips and holders are interchangeable, so one tip may be replaced with another sensitive to a different ion. Replacing a tip takes less than a minute. Electrode tips normally last several months, when stored properly in saline solution. When replacement is necessary, only the tip needs be replaced.

Kwik-Tip electrodes are available separately and as kits. Each "KWIK" Electrode Holder kit includes a reusable holder and three removable tips. In addition to a 4-foot BNC cable and an electrolyte filling syringe; "TIP" Electrode Kits contain three electrode tips for a specific ion. ***A separate reference electrode, such as WPI's Dri-Ref™, is also required.***

ORDERING INFORMATION

COMPLETE KITS	
KWIKCAL-2	Holder & 3 Calcium Electrodes
KWIKH-2	Holder & 3 Hydrogen Electrodes
KWIKPOT-2	Holder & 3 Potassium Electrodes
KWIKTPP-2	Holder & 3 TPP (Tetraphenylphosphonium) Electrodes

HOLDERS AND REPLACEMENT TIPS	
KWIK-2	Electrode Holder with BNC cable
TIPCA	Calcium Electrode Tips (3)
TIPH	Hydrogen Electrode Tips (3)
TIPK	Potassium Electrode Tips (3)
TIPTPP	TPP+ (Tetraphenylphosphonium) Electrode Tips (3)

KWIK-TIP ELECTRODE SPECIFICATIONS

Part #	Electrode	Color Code	Recommended Filling Solution	Min. Slope/ Decade	Concentration Range	Selectivity Coefficients (-log)
TIPCA	Calcium	Green	0.1 M $CaCl_2$	28 mV	0.1 M - $10^{-6.75}$ M	Na^+ 5.5, K^+ 5.4, Mg^{++} 4.9
TIPH	Hydrogen	Red	1 M Citric Acid, 0.01 M NaCl, pH 5.6	54 mV	pH 5.0 - 12	Na^+ 10.4, K^+ 9.8, Ca^{++} 11.1
TIPK	Potassium	Yellow	0.1 M KCl	54 mV	0.1 M - $10^{-4.5}$ M	Na^+ 4.0, Ca^{++} 3.9, Mg^{++} 3.0
TIPTPP	TPP^+	Purple	10 mM TPP^+	54 mV	0.001 M - 10^{-4} M	K^+ 6.0

Liquid Ion Exchangers

Make micropipettes to record cellular concentrations

WPI's Liquid Ion Exchangers (LIX), for use with the **FD223A** Electrometer, allow intracellular measurements to be made for cations (hydrogen, potassium and calcium).

SPECIFICATIONS

ION	H+	K+	Ca++
CATALOG NO.	**IE 010**	**IE 190**	**IE 200**
SELECTIVITY COEFFICIENTS*			
Na^+	12.7	1.97	5.5
Mg^{++}	—	2.95	4.9
K^+	—	—	5.4
Ca^{++}	—	2.7	—
USEFUL pH RANGE	2-10	4-10	4-10
SLOPE	56 mV	58 mV	28 mV
LINEAR RANGE	pH 4-12	pK 0-3	pCa 1-7
APPROX. EQUIV.	—	Corning 477317	ETH1001

*Selectivity Coefficients are expressed here as -log Kij or pKij.

When used in micropipettes to record cellular ion concentrations, consider using WPI's Duo 773 electrometer (channel A).

ORDERING INFORMATION

IE010	Hydrogen Ion Exchanger (0.1 mL)
IE190	Potassium Ion Exchanger (1.0 mL)
IE200	Calcium Neutral Ion Exchanger (0.1 mL)

Multi-Port Measurement Chamber

4-port closed chamber for measurements of NO, O_2, H_2O_2 & other species in cell culture, temperature stabilized

Features

- Four port (**NOCHM-4**) chamber accommodates WPI's 2 mm sensors for nitric oxide (**ISO-NOP**), oxygen (**ISO-OXY-2**), hydrogen peroxide (**ISO-HPO-2**) and WPI's KWIK-TIP ion selective electrodes in combination with WPI's 2 mm Dri-Ref™ reference electrodes
- Two additional top ports for injection of reagents using WPI's MicroFil™ syringe needles
- Temperature control through an external circulating bath
- The chamber can be used for nitric oxide and other species calibration at temperatures from 4-40 °C

Benefits

- Closed chamber design greatly reduces the surface area of the solution exposed to air
- One top port and up to three side ports configuration provides adequate space for convenient sample and electrode manipulation

Applications

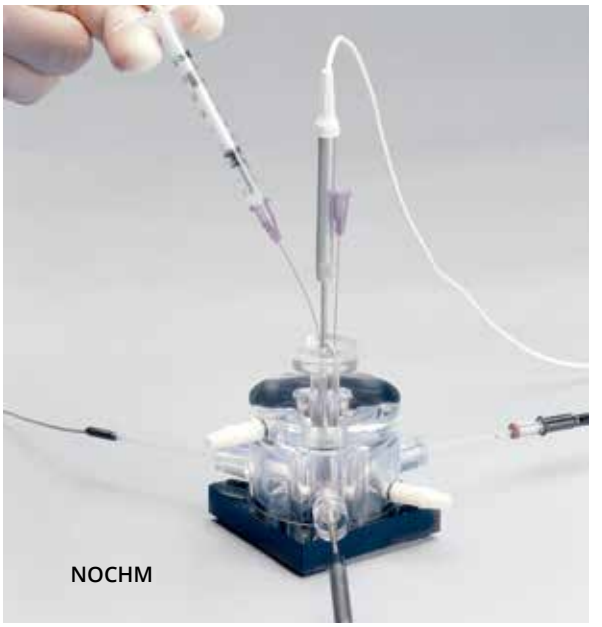
- Simultaneously measurement of free radicals such as NO, H_2O_2, H_2S, O_2 and other ions at controlled conditions for cultured cell, cell suspensions or biological media

References

Olson, K. R., et. al. (2017). Catalase as a sulfide-sulfur oxido-reductase: An ancient (and modern?) regulator of reactive sulfur species (RSS). Redox Biology, 12, 325–339. http://doi.org/10.1016/j.redox.2017.02.021

Zhou, D., et. al. (2017). Oxygen binding and nitric oxide dioxygenase activity of cytoglobin are altered to different extents by cysteine modification. FEBS Open Bio, 7(6), 845–853. http://doi.org/10.1002/2211-5463.12230

Liu, X., et. al. (2017). Cytoglobin regulates blood pressure and vascular tone through nitric oxide metabolism in the vascular wall. Nature Communications, 8, 14807. http://doi.org/10.1038/ncomms14807



Santos, S. S., et. al. (2017). NO production and potassium channels activation induced by Crotalus durissus cascavella underlie mesenteric artery relaxation. Toxicon, 133, 10–17. http://doi.org/10.1016/j.toxicon.2017.04.010

DeLeon, E. R., et. al. (2016). A case of mistaken identity: are reactive oxygen species actually reactive sulfide species? American Journal of Physiology-Regulatory, Integrative and Comparative Physiology, 310(7), R549–R560. http://doi.org/10.1152/ajpregu.00455.2015

ORDERING INFORMATION	
NOCHM-4	Four-Port Closed Chamber, for use with WPI's 2.0 mm electrodes (e.g., **ISO-NOP** and **ISO-OXY-2**, etc.)
NOCHM-P	Spare Plug-adapter for ISO-NOP nitric oxide electrode
800100-5	Spare Center Chamber Gasket (package of 5)

NSA Pre-polarizer

Keep extra NO sensors ready to use

Achieve a stable background current quickly. This small battery-powered device applies a potential to the NO electrode equivalent to the potential applied by the ISO-NO meter. A sensor, which has been connected to the activator, may be transferred to the meter for immediate use. **For use with all WPI NO electrodes.**

ORDERING INFORMATION	
NSA-3	ISO-NO Activator

SNAP

S-Nitroso-N-acetyl-D-penicillamine

SNAP is a stable green crystalline S-nitrosothiol compound that mimics the action of nitric oxide in vivo. It has vasodilatory properties and has been shown to relax isolated bovine coronary artery rings by activating soluble granulate cyclase. This reagent also actuates apoptosis in mouse thymocytes and has been accounted for reversible inactivation of protein Kinase C. SNAP can be used for calibration of all WPI NO sensors.

M.W. 220.2 • Purity > 98% by NMR or TLC

ORDERING INFORMATION	
SNAP25	SNAP, 25 mg vial
SNAP50	SNAP, 50 mg vial
SNAP100	SNAP, 100 mg vial

GSNO

S-nitrosoglutathione

GSNO has been identified *in vivo* as a potential storage and transport vehicle for NO in the body. GSNO has been used in clinical trials to treat a form of preeclampsia and to prevent platelet aggregation. It also has considerable potential as an NO donor in medicine.

M.W.336.3 • $C_{10}H_{16}N_4O_7S$ • Purity > 98% • Soluble in water or DMSO • Storage: -20°C

ORDERING INFORMATION	
GSNO-50	GSNO 50 mg vial
GSNO-100	GSNO 100 mg vial

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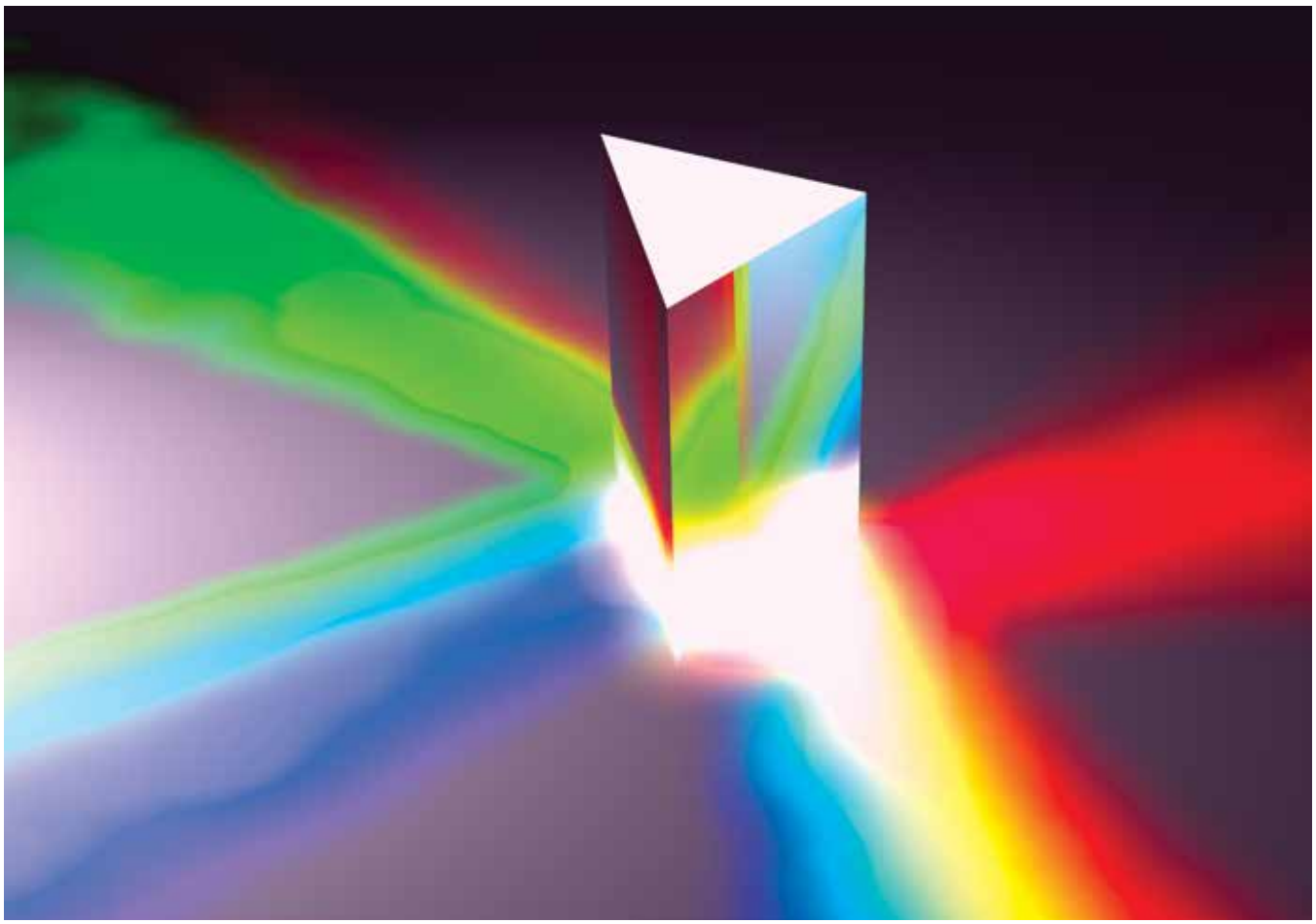
Optical Measurement Systems



All you need for optical measurements

WPI now provides a full range of components and solutions, from proprietary qualified fibers to optical assemblies and fully integrated spectroscopy measurement systems. WPI knows the importance of making measurements where the science happens, and WPI has a full range of reflectance and transmission dipping probes, flowcells and long pathlength liquid waveguide capillary cells (LWCCs) with up to 500 cm pathlength that eliminate the need to take a sample to an instrument. Our Photonics Center of Excellence in Friedberg, Germany also allows us to build proven custom configurations quickly. Whether that is a new optical design for a probe, an optical assembly or a customized measurement system.

Solutions for All Your Optical Needs

new

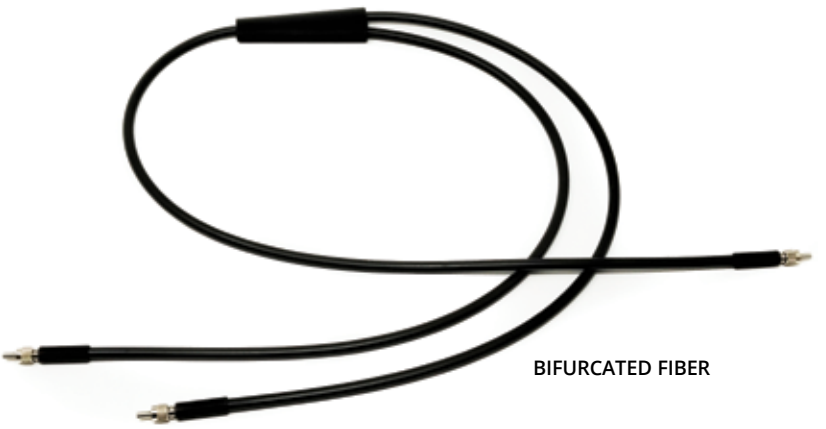
Optical measurement is important to researchers. Whether it is fluorescence studies or measuring absorbance of trace compounds, WPI is your solution partner who has the tools you need, and the technical understanding to help you solve your application challenges.

Starting in 1993 with our first patented liquid waveguide capillary cell (**LWCC**) for precise absorbance measurement of very low concentrations, WPI now provides a full range of components and solutions, including proprietary qualified fibers, optical assemblies and fully integrated spectroscopy measurement systems.

WPI's Photonics Center of Excellence in Friedberg, Germany, allows WPI to build proven custom configurations quickly. The close collaboration with key universities such as the THM University of Applied Sciences gives WPI a leading edge.

Features

- High quality silica/silica fibers for DUV/UV/VIS/NIR
- High quality silica/polymer clad fiber for high NA and broad wavelength range
- High flexible PMMA fibers for VIS wavelength range, large core fiber and high NA
- Industry leading solarization resistance at DUV-UV wavelengths: 180-1200 nm
- UV-enhanced broad range: 260-2200 nm
- High laser damage resistance
- Broad temperature range
- Easy customization by: core size, connector, jacketing, and configuration
- Assemblies manufactured with biocompatible materials (connectors, epoxies and furcation tubing)
- Radiation resistance – dose dependent
- Sterilizable by common methods



BIFURCATED FIBER

Benefits

- Robust fiber and assemblies for UV use. WPI's fiber resists degradation due to UV exposure better than virtually any fiber on the market. This means less changeouts and better data comparison run to run.
- Unique extended range fiber that covers the high UV to long NIR wavelength range
- Qualified fiber allows true "plug and play" replacement
- Qualified **QVLUX** fiber is ideal for OEM and applications requiring field service or where multiple instruments must be used for a battery of tests
- Wide selection of fiber materials and sizes to manufacture the optimum fiber assembly for your application
- WPI's fiber optic assemblies are uniquely designed for biology and physiology applications with small size and excellent photon efficiency
- Custom configurations for your specific application are easy to specify and quick to deliver
- Customer support with in-house engineering and manufacturing for optical assemblies
- For critical biological work, many of our assemblies can be sterilized with gamma radiation, H_2O_2, ETOH or autoclave. Ask for details.

The **QVLUX** proprietary fiber series is WPI's most advanced fiber product line. **QVLUX-DUV** silica fibers are very resistant to UV light down to 185 nm but also have the uniformity and performance that OEM applications require. **QVLUX-NIR** fibers perform exceptionally well in the 700 to 2200 nm wavelength region. WPI is the only company offering DIN 58145:2018-01 certified low solarization UV fibers and assemblies for 185 m to 340 nm. For less demanding applications, we offer our standard **WLUX** fiber in both silica and polymer cores. While WPI offers **QVLUX** and **WVLUX** assemblies in many standard configurations, custom configurations can be quickly manufactured in house.

Basics of using optical fibers in science

Different than the fiber used for telecommunications, scientific optical fibers efficiently transmit light at many wavelengths. The amount of light that can enter a fiber and be transmitted is determined mostly by three factors:

- Core diameter size
- Material of the core
- Material of the cladding.

The difference in the refractive index between core and cladding sets the numerical aperture, i.e. the maximum angle that light can enter the fiber and transmits through the fiber.

In addition, fibers are specified by wavelength region: typically, UV-VIS (190-800 nm) or VIS-NIR (400-2200 nm). For sensing and light delivery applications we offer fused silica, polymer cladded fused silica and solid polymer fibers, whichever are most suitable for your application. Silica fiber has a lower numerical aperture, but more efficiently transports light, especially at UV wavelengths. Polymer core fiber has a higher numerical aperture allowing more light to enter the fiber and may be a better choice for normal temperature conditions in a laboratory, especially in fluorescence detection.

Qualified fibers for UV applications

Our **QVLUX** fiber has been engineered to not only provide superior transmission in the UV but have excellent consistency over length. This makes **QVLUX** a perfect choice for critical measurements or where "plug-and-play" capability is required without having to recalibrate after a fiber assembly change. Standard silica fiber exhibits a "solarization impact" when transmitting light in the UV below ~280 nm. Over time, depending on the optically transmitted power, the fiber's ability to transmit UV light drops off. Our QVLUX fiber offers superior resistance to solarization, lowest basic attenuation at 200 nm (< 1 dB/m) and the lowest solarization at 214 nm on the market. WPI is the only company offering DIN 58145:2018-01 certified low solarization UV fibers and assemblies for 185 nm to 340 nm. Our standard WVLUX fused silica optical fibers are designed for value, but keep in mind that they lose their transmission over time and at high power due to the solarization effects of UV light below 280 nm.

Qualified fibers for NIR applications

We also offer **QVLUX** fiber for the 700-2200 nm range that works well in demanding petro-chemical, food and pharmaceutical applications. This region is very difficult for standard fibers from traditional suppliers since they cannot control their processes or glass chemistry sufficiently to have the purity required for high-standard of uniformity and superior optical throughput that these applications demand.

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Match your Fiber to your Needs

With WPI you can match the fiber, the assembly and even the instrument exactly to your application needs:

Fiber	QVLUXDUV	QVLUXNIR	WVLUXDUV
FIBER MATERIAL	Qualified Silica	Qualified Silica	Specialty Silica
WAVELENGTH RANGE (nm)	180-1200	260-2200	200-1200
AVAILABLE CORE DIAMETERS (µm)	400, 600	200, 400, 600	100, 200, 300, 400, 600
KEY SPECIFICATIONS	• Lowest attenuation @ 180 nm • Lowest solarization @ 214 nm • NA = 0.22 @ 633 nm	• Low solarization @ 248 nm • NA = 0.22 @ 633 nm	• Low solarization @ 214 nm • NA = 0.22 @ 633 nm

OPTICAL FIBER WITH SILICONE MONOCOIL TUBING

Fiber	WVLUXPV	WVLUXUVIS	WVLUXNXR	WVLUXHNA
FIBER MATERIAL	Silica/PolyClad	Silica	Silica	PMMA
WAVELENGTH RANGE (nm)	300-1200	260-1200	320-2200	365-720
AVAILABLE CORE DIAMETERS (µm)	200, 300, 400, 600, 800, 1000	100, 200, 300, 400, 600, 800, 1000	200, 400, 600	250, 500, 750, 1000, 1500, 2000, 3000
KEY SPECIFICATIONS	• 365 nm for low power UV applications • NA = 0.37 @ 633 nm	• Great general purpose fiber for UV-VIS spectroscopy • NA = 0.22 @ 633 nm	• Extended NIR range • NA=0.22 @ 633 nm • Custom core diameters available	• Solid polymer fiber (PMMA) • Highly flexible • Largest range of core diameters

Fiber Selection Guide

WPI offers standard, bifurcated and cross fiber assemblies. For Y assemblies and X assemblies, the split point is approximately at 50 cm. The standard jacketing is silicone monocoil.

1x1 Standard – S

Optical fibers with 2 connectors and furcation tubing

1x2 Bifurcated – Y

Split or combines similar intensities by mixing different or same fiber type.

2x2 Cross – X

Cross fiber assembly with mixed fiber types (call for details)

Ordering assemblies with our fiber is simple! Standard lengths are 100 cm and terminated with SMA connectors.

1 Choose fiber type.

2 Choose style.

3 Choose diameter (in microns).

The available diameters are limited by the fiber type chosen in step 1. Refer to the tables above for the options.

4 Select length (in centimeters)

If your assembly uses all the same fibers, start with the standard part number defined above. The standard fiber is 100 cm.

5 Choose connector type.

For example, the part number for a standard QVLUX-UV fiber with a Y assembly and 600 µm core diameter would be **QVLUXDUV-Y-0600**. For The part number for a custom cable of 250 cm with FC connectors using 750 µm high NA polymer fiber would be **WVLUXHNA-S-0750-250-F125**.

For a mixed fiber, mixed connectors, X-cross assemblies or a special configuration, contact WPI (wpi@wpiinc.com).

STEP 1 — CHOOSE A FIBER

- QVLUX-DUV
- QVLUX-NIR
- WVLUX-DUV
- WVLUXPV
- WVLUXUVIS
- WVLUXNXR
- **WVLUXHNA**

STEP 2 — CHOOSE A STYLE

S	**Standard**
Y	1:2 Bifurcated
X	2:2 Cross

STEP 3 — CHOOSE THE CORE DIAMETER

100 µm	750 µm
200 µm	800 µm
250µm	1000 µm
300 µm	**1500 µm**
400 µm	2000 µm
500 µm	3000 µm
600 µm	

STEP 4 — CHOOSE A LENGTH

- 100 cm
- XXX cm

STEP 5 — CHOOSE A CONNECTOR

SMA	SMA
FC	**FC**
ST	ST
DIN	DIN
F125	Ferrule 1.25 mm
F250	Ferrule 2.50 mm
LLG	Liquid Light Guide
N	Bare, unpolished

WVLUXHNA-S-0750-250-FC

STEP 1 | STEP 2 | STEP 3 | STEP 4 | STEP 5

Standard Option

Core diameters available depend on fiber chosen.

High Performance Spectrophotometer

A unique multiple long pathlength sample cell for absorbance spectroscopy

PERIPRO-4HS

UPUV

TIDAS S300

Features

- Process Control & Oceanography
- Rugged system for laboratory and onboard measuring
- Portable & easy to use
- User-selected optical path lengths: 2, 10, 50 & 200 cm
- Highly sensitive and stable

Benefits

- Designed with NASA for colored dissolved organic matter in seawater and fresh water
- Highly sensitive with extended dynamic range for UV and VIS absorbance measurements, with fewer complications associated with standard long pathlength systems
- Portable system for field operations and mobile lab environments

Application

- CDOM - Colored dissolved organic matter
- QFT - Quantitative Filter Technique

UltraPath™ is a unique high-performance spectrophotometer system offering selectable optical path lengths of 2, 10, 50 and 200 cm. The instrument operates in the wavelength range of 250 to 730 (**UPUV**) or 380 to 730 nm (**UPVIS**) and has an exceptional dynamic range. Designed for the detection of low absorbing species in aqueous solutions, **UltraPath** is an ideal tool for any study requiring precise and highly sensitive spectroscopic determination of analytes, either in the lab or in the field.

Designed with NASA for CDOM

UltraPath was developed by WPI under a collaborative agreement with NASA (Stennis Space Center) for the spectroscopic determination of colored dissolved organic matter (CDOM) in seawater and fresh water environments. It can be used in the laboratory and in the field (i.e., at sea). CDOM concentrations vary significantly between open ocean samples with low CDOM (e.g., 0.007 m-1 at 380 nm), and high CDOM freshwater environments (e.g., 10-20 m-1 at 380 nm). To address these problems, the design requirements of **UltraPath** mandated the development of a rugged portable system capable of high sensitivity measurements across a wide dynamic range. The **UltraPath** system meets these stringent design criteria and enables reliable measurement of CDOM in the range of 0.002 m-1 to 200 m-1 (250 to 730 nm).

Highly Sensitive, Extended Dynamic Range

UltraPath has four optical pathlengths contained within a single sample cell (i.e., 2 cm, 10 cm, 50 cm and 200 cm). The pathlengths are selectable, offering a very high sensitivity and an extended dynamic range for UV and VIS absorbance measurements. The fluid path of the sample cell is optimized to produce a laminar flow that is virtually free of interference from trapped air bubbles and adherence of dissolved substances to the cell wall. In particular, the design greatly minimizes the problems commonly found with flow cells of long optical pathlengths.

- Reduces the risk of trapping dust particles.
- Reduces contamination of fibers or particulate matter inside the cell.

The UV/VIS UltraPath system (UPUV) includes a low noise photodiode array-based **TIDAS S-300 UV/VIS** spectrophotometer with a deuterium/halogen light source. The VIS UltraPath system includes a low noise photodiode array-based TIDAS E-Base UV/VIS spectrometer module and a FO-6000 visible light source. Light is coupled from the light source to the sample cell and from the sample cell to the detector using two fused silica fibers. A peristaltic pump (PeriPro-4LS) draws the sample into the UltraPath sample cell.

A standard PC or laptop (not included) is connected to the TIDAS units using an RJ-45 Ethernet interface.

Portable system for field environments

The system is designed for mobility. The components of the **UltraPath** system are designed to function over a broad range of laboratory and field environments.

The Mini Star is a compact, lightweight peristaltic pump that fits just about anywhere. It can be mounted directly on the bench, in a regular rack or to a post. See page 53.

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References

M. G. Novak, A. Mannino, N. Nelson, E. D'Sa, R. Miller,J. Werdell, R. Del Vecchio, C. Del Castillo, J. Chaves, J. F. Berthon, E. Boss, M. Tzortziou, A. Neeley, S. Freeman, A. Bricaud, R. Röttgers, A. Matsuoka, M. Belz, N. Blough, Measurements of CDOM absorption spectra using different Instruments and techniques: A round robin exercise and extensive field data set., *Ocean Optics* XXII, (2014)

N. B. Nelson, D. A. Siegel, C. A. Carlson, C. Swan, W. M. Smethie Jr. and S. Khatiwala. 2007. Hydrography of chromophoric dissolved organic matter in the North Atlantic. *Deep-Sea Res.* I. 54: 710 – 731.

V. Kitidis, A. P. Stubbins, G. Uher, R. C. Upstill Goddard, C. S. Law, E. M. S. Woodward, "Variability of chromophoric organic matter in surface waters of the Atlantic Ocean", *Deep Sea Research Part II: Topical Studies*, Vol. 53, Issue 14-16, 2006, p. 1666-1684.

R. L. Miller, M. Belz, C. Del Castillo, R. Trzaska, "Determining CDOM Absorption Spectra in Diverse Coastal Environments Using a Multiple Pathlength, Liquid Core Waveguide System", *Continental Shelf Research*, July 2002, 22:9, p 1301-1310.

"System Analyzes Water Samples at Sea", NASA Aerospace Technology Innovation, 2001, 9 (5). http://nctn.hq.nasa.gov/innovation/innovation95/3-techtrans2.html

R. L. Miller and E. D'Sa. "Evaluating the influence of CDOM on the remote sensing signal in the Mississippi River Bight". In *Eos Transactions AGU Ocean Sciences*, 2002. Honolulu, HI, p. 171.

E. D'Sa, R.L. Miller and R. Trzaska. "Aparent Optical Properties in Waters Influenced by the Mississippi River", *Proceedings of the Seventh Thematic Conference, Remote Sensing for Marine and Coastal Environments*, 2002, 6 pg, Miami, FL.

R. L. Miller, C. Hall, C. Del Castillo, B. McKee and M. Dagg. "Bio-optical Properties of the Mississippi River Plume and Adjacent Shelf." *ASLO Aquatic Sciences*, Albuquerque, NM, 2001.

R. L. Miller, M. Belz and S. Y. Liu, "Measuring the absorption of CDOM in the field using a multiple pathlength liquid waveguide system", *Ocean Optics XV*, paper 1308, Monaco, October 2000.

ULTRAPATH SPECIFICATIONS

DYNAMIC RANGE	5 µAU/cm to 1 AU/cm 0.002 m^{-1} to 200 m^{-1}
WAVELENGTH RANGE	250 nm – 730 nm (UPUV) 380 nm – 730 nm (UPVIS)
WAVELENGTH RESOLUTION (FWHM)	5 nm
NOISE (PEAK TO PEAK)	< 0.2 mAU
DRIFT	< 1 mAU/h
OPTICAL PATHLENGTH	2, 10, 50 & 200 cm (user selectable)
SAMPLE CELL INNER DIAMETER	2 mm
CELL VOLUME	10 mL (at 200 cm pathlength)
SAMPLE INLET / OUTLET	1/8"
FIBER INPUT/OUTPUT	600 µm
SOLVENT RESISTANCE	Most organic and inorganic solvents
SHIPPING WEIGHT	UPUV: 44 lb. (20 kg) UPVIS: 33 lb. (15 kg)

ORDERING INFORMATION

UPVIS	Ultrapath System, Visible Light
UPUV	Ultrapath System, Ultraviolet & Visible Light

The UltraPath system includes Multiple pathlength cell, Tidas S300 (UPUV) with integrated light source or Tidas E Base (UPVIS) with TidasDAQ3 software, two WVLUXUVIS-S-600 optical fibers, PeriStar Pro peristaltic pump, silicone tubing, sample injector and Waveguide Cleaniing Kit.

501609	Waveguide Cleaning Kit
89575	QFT1, Fiber Optic Holder for Glass Fiber Filters
WLUXUVIS-S-1000	Fiber Optic Cable 1 m, SMA, 1000 µm core, UV enhanced

Applications

Simple measurements for particulate absorption

WPI's filter holder for particulate absorption measurements is specially designed for field use. It is rugged and portable. It performs as well with a laboratory-based spectrophotometer. It can be directly connected to WPI's line of fiber optic spectrometers and light sources. Improve your particulate absorption measurements on site, instead of loss of spectral information by transporting your sample to a laboratory (Sosik, Limnol Oceanogr. Vol 44, 1139-1141, 1999).

How does it work?

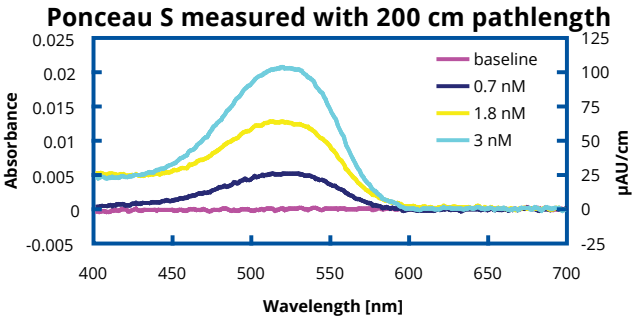
Particulate absorption of fresh and seawater can be determined by filtering a known amount of sample through a Glass Fiber Filter (GF/F) and measuring the particulate absorption coefficient concentrated on the filter. This technique is called quantitative filter technique (QFT) and corrects for pathlength amplification, an effect of scattering (Mitchell, SPIE Vol 1302, 137-148, 1990).

Advantages of QFT

WPI's filter holder for glass fiber filters is designed for particulate absorption or cuvette measurements in a single instrument. A further advantage of the filter holder is its large beam diameter of 5 mm, resulting in "averaging out" of larger non-organic particles frequently found on the filter pad when using natural samples. The removable filter fixture allows simple filter alternation and cleaning.

QFT for particulate absorption

Particulate absorption can be measured by the well established Quantitative Filter Technique (QFT). WPI now offers a fiber optic filter holder for Glass Fiber Filters (**QFT1**, page 168) which can be used with the spectrometer (Tidas E Base) and light source (**D4H** or **FO6000**) supplied with the **UltraPath**. With this accessory, particulate absorption can be measured on site, avoiding loss of spectral information due to freezing and shipping particulate samples to a laboratory.



Ponceau S absorption measured with UltraPath (200 cm cell). Ponceau S was dissolved in Millipore water.

Special attention should be drawn to the exceptional sensitivity of UltraPath enabling detection of CDOM absorption below 0.03 m^{-1}. To exemplify the performance of the UltraPath in laboratory chemistry and process control, Ponceau S absorbance was measured with the 200 cm pathlength of an UltraPath. Normalizing the Ponceau absorbance graph to AU/cm, the range of this measurement is 150 µAU with a noise level below 2 µAU peak to peak. Sub-nanomolar concentration of this dye can clearly and reliably be detected, which is a novelty in absorbance based spectroscopy.

Liquid Waveguide Capillary Cell

Long pathlengths for small sample volumes

LWCC-3050

MINISTAR, *see page 53.*

Features

- 10–500 cm pathlength
- 10–500 fold sensitivity improvement in comparison to 1cm cuvette
- 0.55 mm ID for low sample volume sampling
- 2 mm ID for unfiltered liquid samples
- SMA 905 fiber optic connections
- 250 nm – 720 nm wavelength range with MilliPore water (see datasheet for details)

Benefits

- Adapts to most fiber optic detection systems
- 20 years of manufacturing experience
- Low UV drift

Applications

- Trace detection of nutrients (nitrite, nitrate, phosphate, iron) in seawater
- Environmental and oceanographic monitoring
- Drinking water analysis
- Colored dissolved organic matter (CDOM)
- Process control

UV/VIS/NIR absorbance spectroscopy is governed by Beer's Law, where the absorbance signal is proportional to chemical concentration, light path length and the compound's specific molar absorption coefficient. Typical optical pathlengths of cuvettes and flow cells are between 0.1 cm and 10 cm. Longer pathlengths are difficult to achieve due to mechanical constraints. Liquid Waveguide Capillary Cells (**LWCC**s) fill this gap. **LWCC**s are fiber optic flow cells that combine an increased optical pathlength (10–500 cm) with small sample volumes ranging from 2.4 µL to about 3 mL. Compared with a standard 1 cm cell, a 1 mAU signal is enhanced one hundred fold with a 100 cm flowcell to 100 mAU, using WPI's patented aqueous waveguide technology.* They can be connected via optical fibers to a spectrophotometer with fiber optic capabilities. Ultra-sensitive absorbance measurements can be performed in the ultraviolet (UV), visible (VIS) and near-infrared (NIR) to detect low sample concentrations in a laboratory or process control environment.

Your sample is the core of a light guide

WPI's Liquid Waveguide Capillary Cells are made of fused silica tubing with an outer coating of a low refractive index polymer. Your liquid sample is guided through the capillary and represents the core of the waveguide. The hydrophilic character of the fused silica capillary inner wall results in high signal stability and easy removal of air bubbles trapped in the flow cell. However, the transmission of the **LWCC** is mainly dependent on the intrinsic attenuation of the sample liquid. In case of water, a usable wavelength range from 250 nm to 720 nm wavelength can be observed in a 100 cm pathlength **LWCC**. Using a 500 cm pathlength **LWCC** will reduce that transmission range from 300 nm to about 700 nm. However, when switching from water to methanol as a solvent, transmission into the NIR are possible with suitable light sources and detectors.

Connections

The **LWCC-3xxx** series of flow cells uses traditional HPLC type 10-32 coned port fittings with 1/32 inch tubing for liquid connection and 500 µm SMA fiber optic adapters for light input and output. The **LWCC-4xxx** series of flow cells uses 1/4-28 flangless flat bottom fittings with 0.125" tubing and 600 µm SMA fiber optic adapters. Liquid can be pumped into the flow cells using (in the simplest case) a sample injector (**58006**) and a ministar peristaltic pump (**MINISTAR**). The **LWCC** may be connected directly to a fluid injection analysis (FIA) system or to a gas segmented fluid injection analysis (GFIA) system via a debubbler. Finally, for routing discrete measurements, WPI's LWCC Injection system (**89372**) may be used where the sample is injected into a constant flow via an injection loop of 3–4 times the internal flow cell volume to ensure a stable baseline and avoid the introduction of micro air bubbles into the flow cell.

Applications

When the entire spectral shape of an absorbance curve is required for analysis, WPI's TIDAS E Base spectrometer with a **D4H** or a **FO-6000**, or the TIDAS S300 spectrophotometer can be used. **LWCC**s have been used in a variety of applications, such as liquid chromatography, stopped-flow and colormetric detection, drinking water analysis, as well as environmental and oceanographic monitoring systems.

Accessory: LWCC Injection System

For flow analysis, including simple fluid injection analysis (FIA) setups, add WPI's **LWCC** injection system (**89372**). A selection valve provides baseline or cleaning solutions to the sample stream. The injection valve injects a sample into the stream, avoiding the introduction of air bubbles or changes of flow rate.

89372 LWCC Injector System *(pump and LWCC not included)*

Related Patents

Micro Chemical Analysis Employing Flow Through Detectors, 1995, U.S. Patent No. 5,444,807.

Aqueous Fluid Core Waveguide, 1996, U.S. Patent No. 5,507,447.

Long Capillary Waveguide Raman Cell, 1997, U.S. Patent No. 5,604,587.

Chemical Sensing Techniques Employing Liquid-Core Optical Fibers, U.S. Patent No. 6,016,372

References

Yuhan Liu, Keding Lu , Huabin Dong, Xin Li, Peng Cheng, Qi Zou, Yusheng Wu, Xingang Liu, Yuanhang Zhang, (2016) In situ monitoring of atmospheric nitrous acid based on multi-pumping flow system and liquid waveguide capillary cell. *Journal of Environmental Sciences Volume 43*, 2016, Pages 273–284 http://dx.doi.org/10.1016/j.jes.2015.11.034

Ye, C., Zhou, X., Pu, D., Stutz, J., Festa, J., Spolaor, M., ... Knote, C. (2016). Rapid cycling of reactive nitrogen in the marine boundary layer. *Nature*, 532(7600), 489–491. http://doi.org/10.1038/nature17195

Catelani, T. A., Tóth, I. V., Lima, J. L. F. C., Pezza, L., & Pezza, H. R. (2014). A simple and rapid screening method for sulfonamides in honey using a flow injection system coupled to a liquid waveguide capillary cell. *Talanta*, 121, 281–7. http://doi.org/10.1016/j.talanta.2013.12.034

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LWCC SPECIFICATIONS

	LWCC-3050	LWCC-3100	LWCC-3250	LWCC-3500	LWCC-4010	LWCC-4050	LWCC-4100
OPTICAL PATHLENGTH	50 cm	100 cm	250 cm	500 cm	10 cm	50 cm	100 cm
INTERNAL VOLUME	125 µL	250 µL	625 µL	1250 µL	0.31 mL	1.57 mL	3.1 mL
FIBER CONNECTION	500 µm SMA	500 µm SMA	500 µm SMA	500 µm SMA	600 µm SMA	600 µm SMA	600 µm SMA
TRANSMISSION @254nm*	20	10	5	-	5	3	2
TRANSMISSION @540 nm*	35	30	25	20	5	4	4
NOISE [mAU]**	<0.1	<0.2	<0.5	<1.0	<0.1	<0.2	<0.2
MAXIMUM PRESSURE	100 PSI	100 PSI	100 PSI	100 PSI			
WETTED MATERIAL	PEEK, Fused Silica, PTFE						
LIQUID INPUT	LWCC-3xxx series: 10-32 coned port fittings for 1/16" tubing LWCC-4xxx series: 1/4-28 flangeless flat bottom fitting for 1/8" tubing						

* Referenced using coupled 500 µm fibers or LWCC-3xxx series and 600 µm fibers for LWCC-4xxx series

** Measured using ASTM E685-93

*** A one-meter waveguide of 550 µm internal diameter requires approximately 1.5PSI for water flow of 1.0 mL/min.

***Waveguide Cleaning Kit (#501609)**, above, includes the most commonly needed cleaning solutions for the LWCC waveguides. The **LWCC Start-up Kit (#KITLWCC)**, at right, includes two fiber optic cables (**#WVLUXUVIS-S-600**), Sample Injector Assembly (**#58006**), MiniStar™ Peristaltic Pump, and Waveguide Cleaning Kit (**#501609**).*

ORDERING INFORMATION

LWCC-3050	Liquid Waveguide Capillary Cell, 50 cm pathlength, 0.55 mm ID
LWCC-3100	Liquid Waveguide Capillary Cell, 100 cm pathlength, 0.55 mm ID
LWCC-3250	Liquid Waveguide Capillary Cell, 250 cm pathlength, 0.55 mm ID
LWCC-3500	Liquid Waveguide Capillary Cell, 500 cm pathlength, 0.55 mm ID
LWCC-4010	Liquid Waveguide Capillary Cell, 10 cm pathlength, 2 mm ID
LWCC-4050	Liquid Waveguide Capillary Cell, 50 cm pathlength, 2 mm ID
LWCC-4100	Liquid Waveguide Capillary Cell, 100 cm pathlength, 2 mm ID

Accessories

A sample injector assembly can be used to conveniently fill an LWCC with sample solution using a peristaltic pump. The LWCC requires two optical fibers to connect to spectrophotometer system. Choose between anti-solarized 400 µm core or UV-enhanced cables (ordered in 1 or 3 meter lengths).

89372	LWCC Injection System
58006	Sample Injector Attachment
PERIPRO-4LS	Peri-Star™ Pro Peristaltic Pump (See page 52.)
MINISTAR	Miniature Peristaltic Pump, 1-channel (See page 53.)
WVLUXUVIS-S-600	Fiber Optic Cable, 1 m, SMA, 600 µm core, UV-enhanced
501609	Waveguide Cleaning Kit (available only in USA)
KITLWCC	LWCC Start-up Kit*
58450	Kit, Adapter Syringe, LWCC

**includes WVLUXUVIS-S-600 (two), 58006, MINISTAR, 501609*

Low Volume Flow Cell

For FIA, HPLC and process analysis

Features

- UV/VIS flow cell for absorbance
- Low internal volume
- Fits 500 and 600 µm fibers
- High UV transmission
- 0–10 mL/min flow rate

Benefits

- High efficiency coupling
- Low refractive index offset
- Fits WPI **TIDAS** systems

Applications

- FIA, GFIA, HPLC, Optofluidics
- Process control

MicroLWCC is a new fiber optic low volume flow cell for UV/VIS/NIR absorbance analysis. Based on WPI's established liquid core waveguide technology, the analyte solution functions as the core of a fluid filled light waveguide. Wetted parts in the sample cell light path are PEEK, fused silica and PTFE. Optical fibers are used to transport light to and from the sample cell. The cell can be used in biochemistry for DNA, RNA & protein quantification, colorimetric nutrient and trace metal analysis, drug discovery and dissolution testing, process control, and HPLC analysis.

LWCC-M SPECIFICATIONS

	LWCC-M-10	LWCC-M-50	LWCC-M-100
OPTICAL PATHLENGTH	10 mm	50 mm	100 mm
INTERNAL VOLUME	2.4 µL	12 µL	24 µL
REFRACTIVE INDEX @ 280 nm**	< 15 mAU	< 20 mAU	< 30 mAU
TRANSMISSION @ 254 nm *	25%	20%	15%
TRANSMISSION @ 500 nm	40%	35%	30%
WAVELENGTH RANGE	200 – 1000 nm		
FIBER CONNECTION [µm]	500 (SMA)		
MAXIMUM PRESSURE	50 Bar		
WETTED MATERIALS	PEEK, Fused Silica, PTFE		

* Reference: 2 * 600 µm Fiber, butt-coupled

** Measured using ASTM E 685 - 93

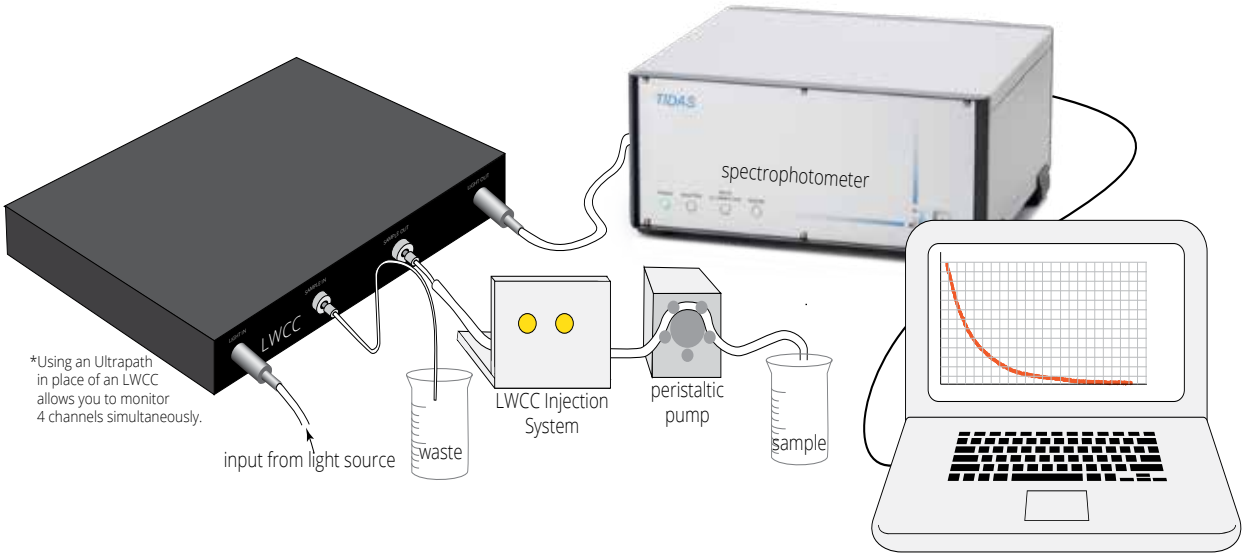
WPI U.S. Patents: 5,444,807; 5,570,447; 5,604,587; 6,603,556; 6,385,380.

ORDERING INFORMATION

LWCC-M-10	Low Volume Flow Cell, 10 mm pathlength
LWCC-M-50	Low Volume Flow Cell, 50 mm pathlength
LWCC-M-100	Low Volume Flow Cell, 100 mm pathlength

Measure Colored Dissolved Organic Matter

Detect lower concentrations of solutes & conduct broader range of measurement



Colored Dissolved Organic Matter (CDOM) is organic matter whose optical properties are measurable using WPI's Liquid Waveguide Capillary Cell (LWCC). CDOM occurs naturally in water systems and is derived from organic tannins. CDOM concentration depends on the location where samples are taken, with coastal waters showing higher CDOM concentrations compared to open-ocean waters. In addition, CDOM absorption depends on open-ocean water depth.

LWCCs are fiber optic flow cells that combine an increased optical pathlength (1–500 cm) with small sample volumes ranging from 2.4 µL to about 3 mL.

Features

Select models:

- 10–250 cm pathlength (depending on LWCC model)
- 0.31–3.1 mL internal volume (depending on LWCC model)
- Up to 230–730 nm wavelength range (depending on LWCC model)

All models:

- 10 to 500 fold sensitivity improvement in comparison to 1 cm cuvettes
- 0.55 mm ID for low sample volume sampling
- 2 mm ID for filtered and unfiltered liquid samples
- SMA 905 fiber optic connections

Benefits

- Improved dynamic range for broader range of absorbance measurements
- Improved sensitivity of measurement
- Detect low concentrations of solutes
- Measurements can be made using small sample volumes
- Compact, portable system for real time measurement aboard ship

Determining LWCC pathlength

Selecting the proper equipment is imperative when setting up your system. Here are a few considerations:

- Select the LWCC pathlength based on the desired absorption range. Here are some reference values for different water types:
  - Fresh water with absorption range > 4.0 m^{-1}
  - Coastal-ocean waters with absorption range 1.0–4.0 m^{-1}
  - Open ocean water with absorption range < 1.0 m^{-1}
- Select the usable internal volume.

Next, you can select components to complete your CDOM analysis system, depending on the selected LWCC. The effective pathlength of WPI's LWCC is defined as the equivalent pathlength of the cell, if it is assumed that the LWCC strictly follows the Beer-Lambert law.

Typically, the longer LWCC pathlength is used to increase the sensitivity when the maximum absorbance values are supposed to be <0.1 AU (Absorbance Unit). Inversely, when absorbance measurements are above 1.4 AU, the LWCC pathlength should be decreased to ensure that measurements still remain within the linear range of the LWCC detection system.

LWCC Type	Pathlength (cm)	Noise (mAU)	Absorbance Range (mAU)	Absorption Range (m^{-1})	Internal Volume (mL)
LWCC-4010	10	< 0.1	0.5 - 1400	0.012 - 32.0	0.31
LWCC-4050	50	< 0.2	1.0 - 1400	0.005 - 6.4	1.57
LWCC-4100	100	< 0.5	2.5 - 1400	0.006 - 3.2	3.1
LWCC-3050	50	< 0.1	0.5 - 1400	0.002 - 6.4	0.125
LWCC-3100	100	< 0.2	1.0 - 1400	0.002 - 3.2	0.250
LWCC-3250	250	< 0.5	2.5 - 1400	0.002 - 1.2	0.625

The useful absorption range calculation is based on the absorbance detection limits of the LWCC, considering a wavelength range of 300—700 nm.

Absorbance measurements obtained with WPI's LWCC and Tidas S300 UV/VIS spectrophotometer are linear up to 1.4 AU. The measured absorbance can be converted to the spectral absorption coefficient α(λ), commonly used in oceanography for CDOM measurements. Absorbance and spectral absorption are related by the formula: $\alpha(\lambda) = 2.303\ A(\lambda) / L$, where 2.303 is the conversion factor from decimal to natural logarithmic, A (λ) is the absorbance at wavelength λ and L the LWCC pathlength.

Common applications of CDOM detection

- Determine the biogeochemical cycles, *e.g.*, the organic carbon-based cycle in the ocean.
- Monitor and map surface-water masses.
- Measure the UV light penetration into the ocean to determine:
  - Photosynthesis reaction with effects on phytoplankton population
  - Effect on oceanic food chains
  - Atmospheric oxygen concentration
- Monitor the light absorption of CDOM as it relates to heat storage and the decline of sea ice.

Two typical absorption spectra recorded with an **UltraPath** (**UPUV**) of a seawater and a fresh water sample collected in November 2007 are shown in the figures. Due to their high absorbance, both samples were analyzed in the 10 cm pathlength. The CDOM sample labeled Mayagüez Bay is from oligotrophic, low productive waters with high salinity collected off the west coast of Puerto Rico in the Mayagüez Bay and was measured with a 200 cm pathlength.

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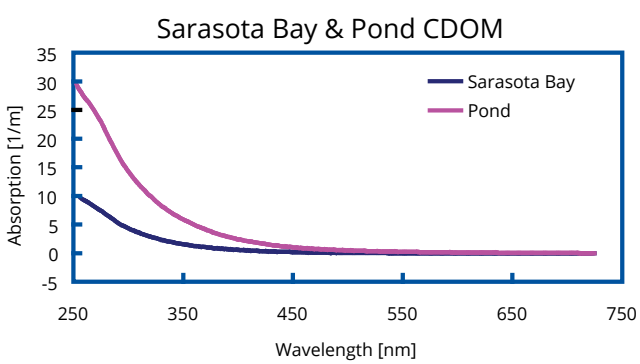
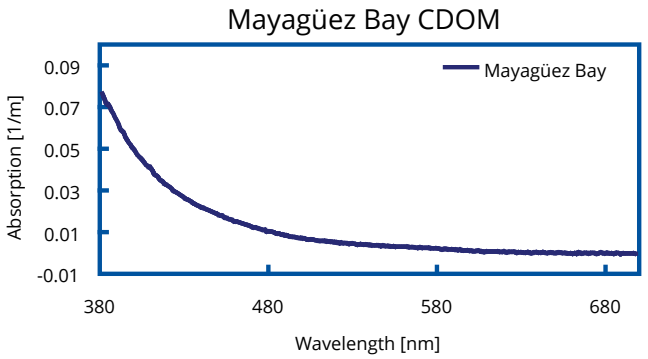


Two typical absorption spectra measured using UltraPath. The sample labeled "Sarasota Bay" is a CDOM sample with 34 PSU salinity collected from Sarasota Bay (Nov. 2007), and the sample labeled "Pond" is a highly concentrated CDOM sample collected from a local pond in Sarasota, Florida (Nov. 2007).



CDOM Sample "Mayagüez Bay" was collected from the high salinity oligotrophic waters of Mayagüez Bay on the west coast of Puerto Rico (2001). Data courtesy of NASA Stennis Space Center.

System Configurations

Refer to the table on the previous page for selecting the LWCC pathlength.

The CDOM-FRESH System > 4 m^{-1}

LOW VOLUME		HIGH VOLUME	
Product Description	**Item #**	**Product Description**	**Item #**
CDOM-FRESH-LV System Includes:	CDOM-FRESH-LV	**CDOM-FRESH-HV System Includes:**	CDOM-FRESH-HV
LWCC, 50 cm pathlength	LWCC-3050	LWCC, 10 cm pathlength	LWCC-4010
Photo Diode Array (PDA) Spectrophotometer System, UV/VIS (190-720 nm), with integrated deuterium/halogen light source	505067	PDA Spectrophotometer System, UV/VIS (190-720 nm), with integrated deuterium/halogen light source	505067
(2) UV-Enhanced Fiber Optic Cables, 1 m, 600 µm Core	WVLUXUVIS-S-600	(2) UV-Enhanced Fiber Optic Cables, 1 m, 600 µm Core.	WVLUXUVIS-S-600
Ministar Peristaltic Pump	504011	PeriStar Pro Pump	PeriPro-4LS
LWCC Injection System	89372	Injector Kit	72100
TTL Control Module for Ministar and/or Peristar	503120	TTL Control Module for Ministar and/or Peristar	503120
UV-Enhanced Fiber Optic Cable	WVLUXUVIS-S-200	UV-Enhanced Fiber Optic Cable	WVLUXUVIS-S-200
(2) SMA Bulkhead feed through Connector/Coupler	13395	(2) SMA Bulkhead feed through Connector/Coupler	13395

The CDOM-COAST System 1-4 m^{-1}

LOW VOLUME		HIGH VOLUME	
Product Description	**Item #**	**Product Description**	**Item #**
CDOM-COAST-LV System Includes:	CDOM-COAST-LV	**CDOM-COAST-HV System Includes:**	CDOM-COAST-HV
LWCC, 100 cm pathlength	LWCC-3100	LWCC, 50 cm pathlength	LWCC-4050
PDA Spectrophotometer System, UV/VIS (190-720 nm) with integrated deuterium/halogen light source	505067	PDA Spectrophotometer System, UV/VIS (190-720 nm) with integrated deuterium/halogen light source	505067
(2) UV-Enhanced Fiber Optic Cables. 1 m, 600 µm Core.	WVLUXUVIS-S-600	(2) UV-Enhanced Fiber Optic Cables. 1 m, 600 µm Core.	WVLUXUVIS-S-600
Ministar Peristaltic Pump	504011	PeriStar Pro Pump	PeriPro-4LS
LWCC Injection System	89372	Injector Kit	72100
TTL Control Module for Ministar and/or Peristar	503120	TTL Control Module for Ministar and/or Peristar	503120
UV-Enhanced Fiber Optic Cable	WVLUXUVIS-S-200	UV-Enhanced Fiber Optic Cable	WVLUXUVIS-S-200
(2) SMA Bulkhead feed through Connector/Coupler	13395	(2) SMA Bulkhead feed through Connector/Coupler	13395

The CDOM-Ocean System < 1 m^{-1}

LOW VOLUME		HIGH VOLUME	
Product Description	**Item #**	**Product Description**	**Item #**
CDOM-OCEAN-LV System Includes:	CDOM-OCEAN-LV	**CDOM-OCEAN-HV System Includes:**	CDOM-OCEAN-HV
LWCC, 250 cm pathlength	LWCC-3250	LWCC, 100 cm pathlength	LWCC-4100
PDA Spectrophotometer System. UV/VIS (190-720 nm) with integrated deuterium/halogen light source	505067	PDA Spectrophotometer System. UV/VIS (190-720 nm) with integrated deuterium/halogen light source	505067
(2) UV-Enhanced Fiber Optic Cables. 1 m, 600 µm Core	WVLUXUVIS-S-600	(2) UV-Enhanced Fiber Optic Cables. 1 m, 600 µm Core.	WVLUXUVIS-S-600
Ministar Peristaltic Pump	504011	PeriStar Pro Pump	PeriPro-4LS
LWCC Injection System	89372	Injector Kit	72100
TTL Control Module for Ministar and/or Peristar	503120	TTL Control Module for Ministar and/or Peristar	503120
UV-Enhanced Fiber Optic Cable	WVLUXUVIS-S-200	UV-Enhanced Fiber Optic Cable	WVLUXUVIS-S-200
(2) SMA Bulkhead feed through Connector/Coupler	13395	(2) SMA Bulkhead feed through Connector/Coupler	13395

Filter Holder for Glass Fiber Filters

Designed for field use

Features

- Simple measurements for particulate absorption
- Rugged and portable
- Performs as well as a laboratory based spectrophotometer

Benefits

- QFT corrects for the effect of scattering
- Averages out larger, non-organic particles

Applications

- Measurement of UV/VIS absorption of particulate matter in seawater

89575

WPI's filter holder for particulate absorption measurements is specially designed for field use. It is rugged and portable. It performs as well as a laboratory based spectrophotometer. It can be directly connected to WPI's line of fiber optic spectrometers and light sources. Instead of collecting your samples, transporting them to a laboratory, and accepting the loss of spectral information associated with it (Sosik, 1999), particulate absorption can now be measured on site.

QFT corrects for the effect of scattering

Particulate absorption of fresh water and seawater can be determined by filtering a known amount of sample through a Glass Fiber Filter (GF/F) and measuring the particulate absorption coefficient $a_p(\lambda)$ concentrated on the filter. This technique is called quantitative filter technique (QFT) and corrects for the pathlength amplification, an effect of scattering. The correction of the pathlength amplification and the correction of the non-linear relationship between the optical density of samples on a Whatman GF/F filter and in suspension are discussed in Mitchell (1990).

Averages out larger, non-organic particles

A significant advantage of the filter holder is its large beam diameter of 5 mm, resulting in "averaging out" of larger non-organic particles frequently found on the filter pad when using natural samples. The removable filter fixture allows simple filter alternation and cleaning.

System Requirements

The optical throughput of QFT1 equipped with a classical GF/F filter is very low and requires a matched light source/spectrometer system. TIDAS E Base UV/VIS (**504718**) in combination with a **D4H** UV/VIS light source or a **FO-6000** VIS light source, as it is offered in the Ultrapath system, are ideally suited, as well as TIDAS S300 UV/VIS (**505067**). Light should be coupled into the **QFT1** with a 1000 µm fiber (**WVLUXUVIS-S-1000**) and from the **QFT1** to a spectrometer with a 600 µm fiber (**WVLUXUVIS-S-600**).

SPECIFICATIONS	
GF/F FILTER DIAMETER	25 mm
WAVELENGTH RANGE	280-730 nm *
FIBER OPTIC CONNECTION	Input: 1000 µm Output: 600 µm
MATERIAL IN CONTACT WITH FILTER PAD	Delrin
WEIGHT	0.5 kg (1 lb)

* *Using a Tidas E Base spectrometer and D4H UV/VIS light source.*

References

M. Belz, K. Larsen, K.-F. Klein, "Fiber optic sample cells for polychromatic detection of dissolved and particulate matter in natural waters", *Proc. SPIE*, Vol. 6377, Oct 2006, 63770X

ORDERING INFORMATION	
89575	QFT1, Fiber Optic Holder for Glass Fiber Filters

In-Line Fiber Optic Filter Holder

Insert optical filters into a fiber optic pathway

Features

- In-line filter for SMA terminated fibers
- Collimators for UV/VIS/NIR
- Filter diameter 8–25.4 mm
- Filter thickness 2–10 mm

Benefits

- No stray light
- Solid design

Applications

- Stray light filtering
- Removal of excitation light in fluorescence detection

56200

This In-Line Fiber Optic Filter Holder allows the insertion of optical filters within a fiber optic pathway. The connectors of the filter holder assembly are compatible with WPI's range of fiber optic jumper cables and can be coupled using SMA connectors.

Filters with outer diameters from 8 to 25.4 mm and thicknesses from 2 to 10 mm can be accomodated. The design limits lateral and axial movement of the filter when secured in the holder.

Two fiber optic collimators are internally mounted in the holder to pass collimated light through the filter and then refocus the filtered light into the aperture of the output fiber. Spectral range will be largely limited by the bandpass of the optical fibers (from UV to near IR using WPI UV-enhanced cables).

ORDERING INFORMATION	
56200	In-Line Fiber Optic Filter Holder (SMA)

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Smallest Fiber Optic Dipping Probe

Perfect for UV/Vis spectroscopy

Features

- Compact and efficient dipping probe
- Tip diameter 1.8 mm

Benefits

- Connects with most standard spectrometers using a 600 µm connection
- Perfect for mobile applications

Applications

- Protein and DNA sample measurements
- Dissolution system

Mini DipTip™ is a miniature transmission probe for microliter spectroscopic sampling. **Mini DipTip'**s tip diameter is only 1.5 mm—the size of a 17-gauge needle. It will fit into all micro centrifuge tubes on the market. Microliter samples can be analyzed cost effectively when you combine the **Mini DipTip™** with one of the following:

- TIDAS E Base with **FO-6000** or **D4H**
- TIDAS S300 series
- Compatible with most fiber coupled spectrometers
- Ideal for multi channel applications with LEDSpec

DIP-UV-MINI-10 *10 mm light pathlength*

DIP-UV-MINI-5 *5 mm light pathlength*

DIP-UV-MINI-2 *2 mm light pathlength*

DIPTIP SPECIFICATIONS	
TIP DIAMETER	1.8 mm
LIGHT PATHLENGTH	2, 5, 10 mm
WAVELENGTH RANGE (nm)	200-1000
SAMPLE VOLUME REQUIRED	20-50 µL
DISTANCE FROM TIP TO UPPER EDGE OF SAMPLE WINDOW	7 mm
FIBER LENGTH	1.0 m
FIBER OPTIC CONNECTION	SMA 905
LAUNCH FIBER BUNDLE (7 x 200 µm)	680 µm*
RETURN FIBER BUNDLE (7 x 200 µm)	680 µm*

**Circular packaging of the fiber bundle results in an active area equivalent to a fiber with a core diameter of 680 µm. Using a 600 µm connection is recommended and will result in negligible light loss.*

ORDERING INFORMATION	
DIP-UV-MINI-2	Mini DipTip™ for UV/VIS/NIR (2 mm path)
DIP-UV-MINI-5	Mini DipTip™ for UV/VIS/NIR (5 mm path)
DIP-UV-MINI-10	Mini DipTip™ for UV/VIS/NIR (10 mm path)

Fiber Optic Collimator

Collimate an emitted light beam or couple light into an optical fiber

300051

Features

- Maximum coupling efficiency with fused silica fibers
- Easily adjust the distance between the lens and the optical fiber for focusing
- Not suitable for single mode laser applications

Benefits

- UV/VIS/NIR light collimation

Applications

- Generates plan-parallel beam with a 5mm beam diameter from UV/VIS light guided in an fiber

WPI's Fiber Optic Collimator can be used for both collimating a light beam emitted by an optical fiber or coupling light from a collimated light beam into an optical fiber. The numerical aperture of the collimator is optimized for maximum coupling efficiency into typical fused silica fibers. The collimator can, for example, be used to guide a parallel light beam through a sample cuvette or an optical filter with virtually no optical losses. In this application, one collimator collimates the light into a parallel beam 5 mm in diameter, enabling it to pass a long distance without losing the energy. After the light passes the sample media, a second collimator can be used to collect the beam into the receiving fiber. A unique design feature of this collimator is that the distance between the lens and the optical fiber can be easily adjusted. This permits it to be used as a focusing device or for fine-tuning the color balance when coupling light from a light source into multimode fibers.

COLLIMATOR SPECIFICATIONS	
LENS DIAMETER	5 mm
LENS FOCAL DISTANCE	10 mm
LENS MATERIAL	Ultraviolet grade synthetic fused silica (KU-1)
WAVELENGTH RANGE	220 nm-2 µm
MOUNTING THREADS	3/8-24 UNF
DIVERGENCE	< 0.1 rad for 1 mm core fiber
FIBER CONNECTOR INTERFACE	SMA or ST

ORDERING INFORMATION	
300051	Fiber Optic Collimator (SMA)
300052	Fiber Optic Collimator (ST)

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

13395	SMA Bulkhead feed through connector/coupler, D-hole
13370	SMA half-length bulkhead coupler/connector
CC-3-UV	Cosine Corrector

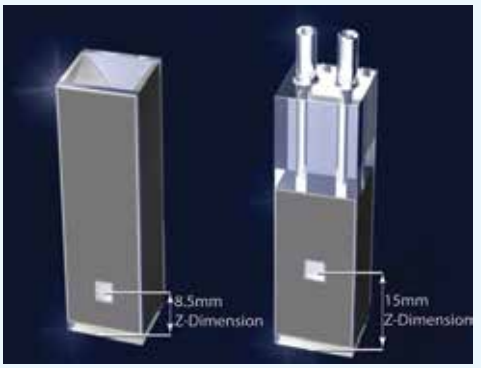
CC-3-UV

13395

13370

Z-Dimensions Are Not Created Equal

Cuvettes come in a variety of shapes and sizes, but one of the most important specifications of a cuvette is its Z-dimension. The Z-dimension of an instrument (cuvette holder or spectrometer) is the distance from the bottom of the cuvette chamber floor to the center of its light beam (see image). A cuvette's Z-dimension must match the Z-dimension of the instrument with which it will be used.



Each manufacturer designs its instruments with a specific Z-dimension. Common Z-dimensions include 8.5 and 15 mm, and sometimes 20 mm. When purchasing small volume cuvettes, the correct Z-dimension becomes critical. Matching the Z-dimension of the cuvette to the Z-dimension of the instrument ensures that the light beam passes through the center of small samples. The table below shows the standard Z-dimension of the spectrometer sample compartments for many manufacturers.

Manufacturer	Z-Dimension
Agilent®	15 mm
Avantes®	15 mm
Beckman®	8.5 mm
Bio-Rad®	8.5 mm
Cecil®	15 mm
Eppendorf®	8.5 mm
Hewlett – Packard®	15 mm
Hitachi®	8.5 mm
Jasco®	11 mm
J & M®	8.5 mm
Ocean Optics®	15 mm
Perkin – Elmer®	15 mm
Pharmacia®	15 mm
Shimadzu®	15 mm
Spectronics®	8.5 mm
Stellarnet®	15 mm
Turner®	8.5 mm
Varian®	20 mm
WPI	15 mm

To determine the Z-dimension of a cuvette holder:

- Use strips of heavy paper that will fit neatly into a cuvette (for example, 12 mm x 50 mm) and not allow light to pass through the cuvette.
- Poke a tiny hole in each paper "sample." For example, one paper sample could have a hole at 8.5 mm, one at 15 mm, one at 20 mm.
- One at a time, insert the paper samples into the cuvette and place the cuvette into the cuvette holder. The paper sample with the pin hole at the instrument's Z-dimension will allow light to pass. The other paper samples will not allow light to pass.

If you have an instrument that is not on the list and need to know its Z-dimension, please contact WPI at (941) 371-1003 or wpi@wpiinc.com.

Optical Glass and Quartz Cuvettes

For spectrophotometry and fluorometry

Features

- Absorbance and fluorescence cuvettes
- 2–100 mm path length
- Fused silica and glass cuvettes
- Flow cuvettes
- Microliter cuvettes

Benefits

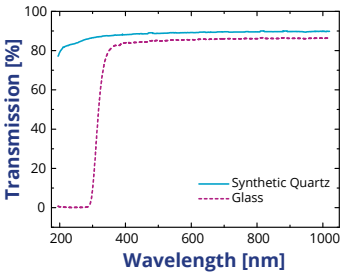
- Eight different styles
- Inexpensive single use glass cuvettes

Applications

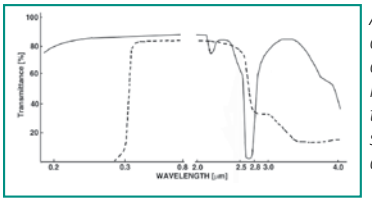
- Absorbance spectrophotometers
- Fluorescence fluorometers
- Chemistry, Biochemistry
- FIA, GFIA, Quality control

WPI's glass and synthetic quartz cuvettes are ideal for UV/VIS/NIR absorbance or fluorescence experiments.

Synthetic quartz can be used in deep UV applications and is recommended for fluorescent applications, as it does not exhibit background fluorescence. Quartz cuvettes (absorbance, fluorescence and flow) are shipped individually packaged, glass cuvettes are shipped in packages of 10 cuvettes. These economic quartz and glass cuvettes are ideal for precision measurements because of their high quality materials used and their low manufacturing tolerances. Typical transmission curves of glass and synthetic quartz cuvettes are shown below.



Transmission curves of Glass and Synthetic Quartz Cuvettes. The cuvettes were empty, thickness 1.25 mm x 2, including surface reflections, measured with a TIDAS II against air as reference.



A complete transmission spectrum of glass and synthetic quartz cuvettes from 190 nm to 4 mm is shown. Cuvettes were empty, thickness 1.25 mm x 2, including surface reflections, measured with a TIDAS II.

SPECIFICATIONS

Cuvette Material	Spectral Range (>80%)	Transmission Difference Between Different Cuvettes
OPTICAL GLASS	350 – 2500 nm	Less than 1%
SYNTHETIC QUARTZ	200 – 2500 nm	Less than 1%

Style G

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ORDERING INFORMATION

WPI PN	Style	material	Polished windows	path [mm]	Dimensions [mm]	volume [mL]	Beam width [mm]	
STANDARD RECTANGULAR CUVETTES								
CUV2101-1*	B	Quartz	2	1	3.5x12.5x45	0.35	10	
CUV2102-1*	B	Quartz	2	2	4.5x12.5x45	0.7	10	
CUV2011-1*	B	Quartz	2	5	7.5x12.5x45	1.7	10	
CUV1022-10	C	Optical Glass	2	10	12.5x12.5x45	3.5	10	**pack of 10**
CUV2012-1	C	Quartz	2	10	12.5x12.5x45	3.5	10	
CUV2105-1	C	Quartz	2	20	22.5x12.5x45	7	10	
CUV2106-1	C	Quartz	2	30	32.5x12.5x45	10.5	10	
CUV2107-1	C	Quartz	2	40	42.5x12.5x45	14	10	
CUV2108-1	C	Quartz	2	50	52.5x12.5x45	17.5	10	

*89341 Cuvette spacer for 1-mm cuvettes (part **CUV2101-1**)
*89342 Cuvette spacer for 2-mm cuvettes (part **CUV2102-1**)
*89337 Cuvette spacer for 5-mm cuvettes (part **CUV2011-1, CUV2023-1, CUV2063-1**)

SELF MASKING SEMI MICRO CELL CUVETTE								
CUV2023-1*	D	Quartz	2	5	7.5x12.5x45	0.7	4	
CUV2031-1	D	Quartz	2	10	12.5x12.5x45	1.4	4	
CUV2025-1	D	Quartz	2	20	22.5x12.5x45	2.8	4	
CUV2032-1	D	Quartz	2	10	12.5x12.5x45	1	3	
CUV2033-1	D	Quartz	2	10	12.5x12.5x45	0.7	2	
CUV2034-1	D	Quartz	2	10	12.5x12.5x45	0.35	1	
SELF MASKING CONTINUOUS FLOWTHROUGH CELL								
CUV2063-1*	E	Quartz	2	5	7.4x12.5x45	0.035	Ø 3	
CUV2061-1	E	Quartz	2	10	12.5x12.5x45	0.07	Ø 3	
CUV2065-1	E	Quartz	2	20	22.6x12.5x45	0.14	Ø 3	
CUV2066-1	E	Quartz	2	30	32.6x12.4x45	0.21	Ø 3	
CUV2062-1	F	Quartz	2	10	12.5x12.5x45	0.48	4x12	
SELF MASKING CONTINUOUS FLOW THROUGH CELL, SMALL INPUT, LARGE OUTPUT Z=8.5 MM								
CUV2614-1	H	Quartz	2	10	12.4x12.4x35.6	0.03	Ø 2	
MICRO CELL WITH BLACK WALLS								
CUV2674-1	J	Quartz	2	10	12.5x12.5x45	0.05	2	
FLUORESCENCE								
CUV2051-1	A	Quartz	4	10	12.5x12.5x45	3.5	10	
CUV2052-1	A	Quartz	4	10	12.5x12.5x45	1.4	4	
LONG PATH CUVETTE								
CUV2071-1	G	Quartz	2	100	102.5 x 22 Ø	28	19	

Style A Style B Style C Style D Style E Style F Style H Style J

Photodiode Array Based Spectrophotometers

High performance fiber optic spectrometer systems

504719

Features

Plug and Play – with help of standard accessories the TIDAS® E sits ready to be immediately operational

Increased Flexibility – the patented cuvette holder allows a variety of measurement configurations that are seamlessly integrated within one instrument

Diode Array Technology – enables quick and precise measuring with a low level of scattered light

Software – modular and user friendly, permits the data acquisition and evaluation of individual tasks

- Fiber-optic diode-array spectrometer
- Measures in transmission and absorption with external light source
- Supports external immersion probes, temperature-controlled cuvette holders and flow cells
- Supports external reflection measurement heads
- Perfoms film thickness measurement using white light interference
- Suitable for color measurement and analysis
- Chemometric modelling
- Certified instrument quality (wavelength and photometric accuracy)
- Software for instrument control, data acquisition and data evaluation included

Benefits

- Compact, rugged and transportable instruments
- Multimodal and combined methods
- High dynamic range
- Fast and reliable results
- Powerful, yet easy to use software

Applications

- Standard chemistry and biochemistry
- Trace level nutrient analysis
- Detection in flow injection analysis (FIA)
- HPLC analysis with WPI's **LWCC-M** flow cells
- CDOM detection with **UltraPath**

The **TIDAS** spectrometer and spectrophotometer series is based on a high performance monolithic spectrometer module manufactured by Zeiss for UV, UV/VIS and VIS/NIR applications. The **Tidas E Base** spectrometers are ideal for modular spectrometer systems with separate detectors, light sources and sample cells. The **TIDAS S300** spectrophotometers already include a light source.

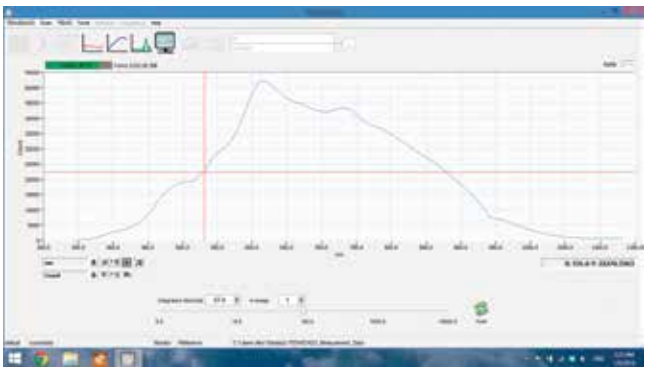
The **TIDAS** series instruments are specialized for research and instructional concepts. This Diode Array based technology allows for fast and precise measurements, and the instruments are universally applicable. The **TIDAS E Base** and the **TIDAS S300** are suitable for routine measurements in the laboratory and outperform conventional bench-based spectrophotometers and CCD-based spectrometer modules, when it comes to high precision fiber optic sampling. They rely on a monolithic optical bench made by Zeiss, which is optimized for fiber optic applications. Most cuvette-based standard spectrometers lose more than 90% of light through expensive prism decoupling. The Tidas systems are designed for fiber optic sampling cells. Using suitable light sources and sample cells, spectral detection in the wavelength range of 190 – 720 nm can be performed.

Applications

The Tidas systems are ideally suited for WPI's fiber optic sampling equipment. High sensitivity detection systems for flow analysis can be assembled using WPI's Liquid Waveguide Capillary Cells (**LWCC**) with effective pathlengths ranging from 50 to 500 cm. These setups are frequently used in fluid injection analysis systems for nutrient analysis (nitrite, nitrate, phosphate, iron) in oceanographic applications. Microliter sampling systems for UV/VIS applications can be assembled using WPI's **DipTip™** dipping probes.

Software

TidasDAQ 3 software is included with each instrument for data collection and data analysis. TidasDAQ is used to run the spectrometer module, collect spectra in either single or continuous mode, control the digital I/Os, save the experimental data to disk, and analyze the data. Further, TidasDAQ can export data directly into GRAMS/AI, a feature very useful for advanced data analysis for pharmaceutical applications and requirements.



TIDASDAQ acquisition window, showing an absorbance baseline.

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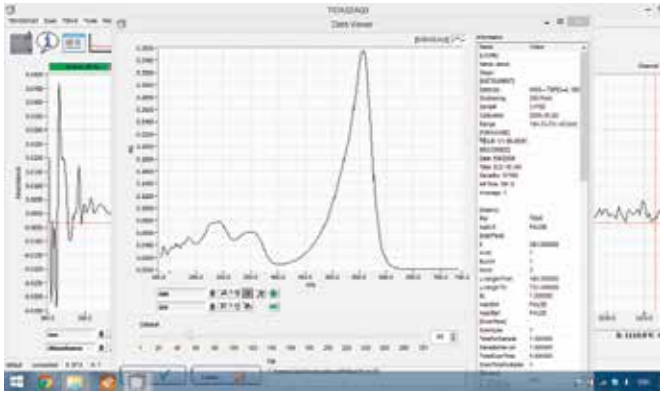


Spectra may be displayed and analyzed in 2D and 3D format. This allows the user to conveniently interpret "time acquisition" data typically done with a TIDAS-E-BASE-LWCC flow system.

TidasDAQ: Data Collection & Instrument Control

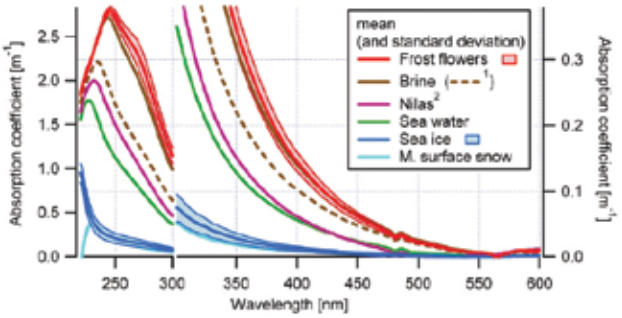
With TidasDAQ, high precision intensity, absorbance, transmittance or normalized spectra can be obtained in less than a second. Only a few parameters need to be adjusted to obtain spectral data. Sampling of single scans, continuous full spectra scans or triggered scans is possible. Chromatograms can be displayed and logged to disk at up to four wavelengths. Data Export of 2D and 3D Spectrograms, as well as Chromatograms is supported in ASCII, Spectralys/SpectraView, Excel and Grams/AI formats. Light sources and other sampling instrumentation can be controlled via the TTL level digital outputs, and data collection can be triggered by TTL leveled external inputs of the Tidas E Base.

Spectra can be recorded in 2D and 3D view. Mathematical computation, Derivation, Smoothing, Quantification and other functions are available to work with your data. The Quantification module allows single point and multiple point analysis, multiple linear regression, partial least square and principle component analysis. Data can be exported out of a 3D analysis file into separate scans. Furthermore, chromatograms as well as spectrograms can be copied directly into Excel for further data analysis.

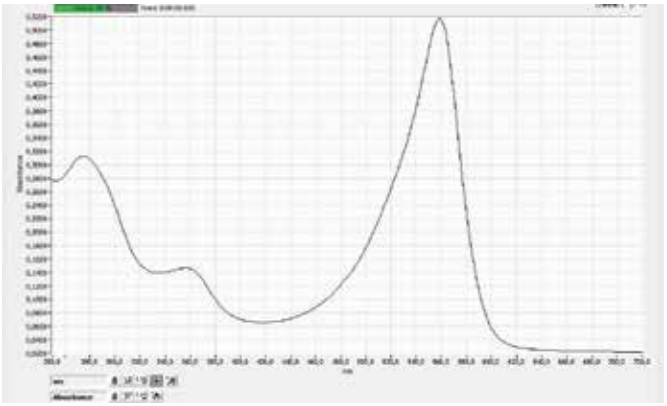
Typical Usage

These high performance spectrometer modules and spectrophotometers combine modularity, flexibility, ease of use and high quality in one unit. They are ideally suited for WPI's fiber optic sampling equipment. High sensitivity detection system for flow injection analysis (FIA) and gas segmented flow injection analysis (GFIA) systems can be assembled with WPI's proprietary Liquid Waveguide Capillary (**LWCC**) flow cells with effective pathlengths ranging from 50 to 500 cm. Typical applications include colorimetric trace detection of nitrite, nitrate, phosphate and iron in oceanographic research.

Small flow volume samples, like those that may be found in Optofluidics and High Performance Liquid Chromatography (HPLC), can be measured conveniently and accurately with WPI's **LWCC-M** series of flowcells. LWCC-M flow cells feature pathlengths of 10, 50 and 100 mm with corresponding sample cell volumes of 2, 4, 12 and 24 µL. Finally, small discrete samples of 2-40 µL volume often found in biochemistry (like, Protein or DNA) may be analyzed using WPI's **DIP-UV-MINI** miniature dipping probes with 2, 5 and 10 mm pathlength. Other applications for the TIDAS series spectrometers and spectrophotometers include material science (forensics, semiconductor technology), quality control (automotive and food), as well as new research in the field of nanotechnology and rapid kinetics.



Mean measured absorption spectra for marine samples, measured with TIDAS1 and a 100-cm pathlength LWCC (adapted from Beine et al., J Geophys Res, Vol. 117, D00R15).



Absorbance spectrum displayed using TIDASDAQ software

SPECIFICATIONS

	TIDAS S300/E BASE UV	TIDAS S300/E BASE UV/VIS	TIDAS S300/E BASE VIS/NIR
WAVELENGTH RANGE	190-390 nm	190-720 nm	300-1100 nm
SPECTRAL RESOLUTION	<3 nm	<7 nm	103 nm
WAVELENGTH ACCURACY	±1 nm	±1 nm	<3 nm
PHOTOMETRIC ACCURACY UV	±10 mAU	±10 mAU	-
PHOTOMETRIC ACCURACY VIS	-	±10 mAU	-
WAVELENGTH REPRODUCIBILITY	<0.1 nm	<0.1 nm	<0.1 nm
BASELINE DRIFT @250NM	$5x10^{-4}$ AU/h according to ASTM E685	$5x10^{-4}$ AU/h according to ASTM E685	$5x10^{-4}$ AU/h according to ASTM E685
SIGNAL-TO-NOISE RATIO	$<3x10^{-5}$ AU according to ASTM E685	$<3x10^{-5}$ AU according to ASTM E685	$<3x10^{-5}$ AU according to ASTM E685
NUMBER OF DIODES	256	256	256
LIGHT SOURCE *Not included for Tidas E Base*	Deuterium	Deuterium & Halogen	Halogen
OPTICAL BENCH	Monolithic spectrometer module with concave aberration corrected holographic grating;		
DETECTOR ARRAY	Hamamatsu photodiode array, 256 pixel		
A/D RESOLUTION	16 Bit		
FIBER OPTIC CONNECTION	SMA905, 600 µm		
SOFTWARE	Tidas DAQ3 (included)		
SCRIPT LANGUAGE FOR METHOD DEVELOPMENT	Yes		
SYSTEM REQUIREMENT	Windows 7, 8, 10		

ORDERING INFORMATION

504717	TIDAS E Base, UV 190-390 nm
504718	TIDAS E Base, UV/VIS 190-720 nm
504719	TIDAS E Base, VIS/NIR 300-1100 nm
505066	TIDAS S300, UV 190-390 nm with deuterium lamp
505067	TIDAS S300, UV/VIS 190-720 nm with deuterium/halogen lamp
505068	TIDAS S300, VIS/NIR 300-1100 nm with halogen lamp
505069	Tidas S300 VIS/NIR 300-1100 nm (without halogen lamp)

Systems includes power supply, TIDAS DAQ software, RJ-45 cable and manual.

Deuterium Halogen Fiber Light Source

For a continuous spectrum in the UV, VIS and NIR range

Features

- Continuous spectrum from 200 nm–1700 nm
- Integrated shutter with switch and TTL control
- SMA fiber optic connection
- Separate UV and VIS bulb control

Benefits

- Matched deuterium and halogen bulbs
- Matched optical output for WPI's flow cells and fiber optic probes
- Low drift < 1 mAU/h @ 254 nm
- Simple exchange of light bulbs

Applications

- UV/VIS/NIR absorbance spectroscopy
- Excitation light source for fluorescence applications
- Colored Dissolved Organic Matter (CDOM) detection in seawater
- Nutrient analysis in fresh water, drinking water and seawater using WPI's **LWCC**s
- Protein detection using WPI's **DIP UV MINI** fiber optic probes

The **D4H** is a combined deuterium and halogen light source for UV/VIS and NIR applications. This light source is ideally suited to work with WPI's spectrometer modules and sample cells. It supplies a continuous spectrum in the UV, VIS and NIR range from 200 nm to 1100 nm. The **D4H** is equipped with an integrated electrical shutter, which can be controlled by a switch or a TTL signal.

D4H

Replacement Deuterium Lamp
503847

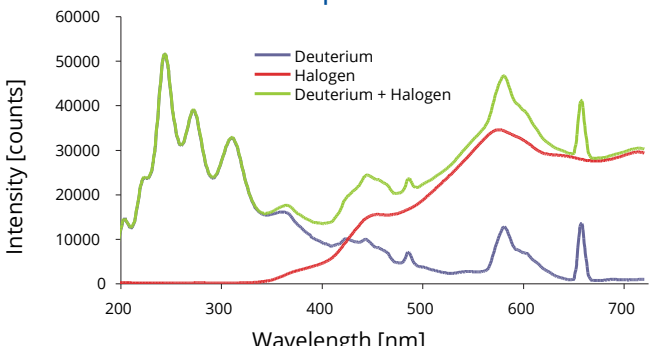
Replacement Halogen Lamp **503848**

LIGHT SOURCE SPECIFICATIONS

	D4H	FO-6000
APPLICATION	UV/VIS/NIR	VIS/NIR
SPECTRAL RANGE	200—1100 nm	380—1700 nm
DEUTERIUM LAMP LIFE	2000 hr	NA
TUNGSTEN/HALOGEN LAMP LIFE	2000 hr	3000* hr
STABILITY	1-2 mAU/h	<0.5 mAU/h
POWER CONSUMPTION	140 W	6 W
POWER REQUIREMENTS	110/240V, 50-60 Hz, 1A	12VDC/1A
SHUTTER/TTL TRIGGER	Yes	Yes
MAX. FIBER OUTPUT	1000 µm	1000 µm
CONNECTIONS	SMA	SMA
SHIPPING WEIGHT	13.2 lb (6 kg)	1.3 lb (0.6 kg)
DIMENSIONS (W/H/L)	7 x 6.2 x 9.8 in. (17.8 x 15.7 x 25 cm)	4.8 x 2.8 x 7.5 in. (12 x 7 x 19 cm)

**Lamp life is dependent upon internal power settings.*

D4H Spectrum



ORDERING INFORMATION

D4H	Deuterium Halogen Light Source (200 nm-1100 nm)
503848	Halogen Replacement Lamp for D4H
503847	Deuterium Replacement Lamp for D4H (> 215 nm)

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

TIDAS-D2	Replacement Deuterium Lamp, for Tidas II
TIDAS-H	Replacement Halogen Lamp (Type 1), for Tidas II
TIDAS-H2	Replacement Halogen Lamp (Type 2), for Tidas II
D2H-DB	Replacement Deuterium Lamp, for D2H
D2H-HB	Replacement Halogen Lamp, for D2H
D2H-HBER	Replacement Deuterium Lamp, Extended Range, for D2H

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Tungsten Fiber Light Source

High color temperature

FO-6000 CE

Features

- Visible light source
- 380 nm – 1700 nm
- Low drift < 0.5 mAU/h
- SMA fiber connection
- Electrical shutter control (switch & TTL)

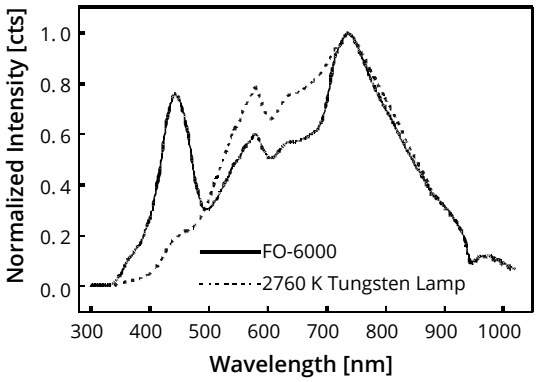
Benefits

- Bulb with 10,000-hour lifetime
- Fits all of WPI's fiber optic probes and flow cells
- Design matched to **LWCC** applications
- Temperature controlled optical bench

Applications

- Low noise VIS absorbance measurements
- Trace analysis of nutrients in seawater and freshwater
- CDOM analysis in seawater
- Analytical chemistry, environmental science and life science

The **FO-6000** is a continuous fiber optic light source featuring an extended visible part of the light source (380 nm - 1700 nm). It has a SMA fiber optic connector. The shutter and lamp can both be controlled via a switch or external TTL triggering. This light source offers a wide assortment of applications. A special feature of the **FO-6000** is its color balancing optics, which shifts the usable range of the light source from traditional 420 nm down to 380 nm wavelength. Due to its thermally controlled optical bench, it is particularly suitable for low noise and low drift applications.



ORDERING INFORMATION	
FO-6000	Fiber Optic Light Source
800120	Replacement Lamp for FO-6000

Absorbance Detection

Detection of organic compounds in water analysis

Absorption of light correlates to the energy of a photon that is taken-up by electrons of the substance atom. The electromagnetic energy is transformed into internal energy of the absorbent substance. The absorbance of a substance quantifies how much of the incident light is absorbed by it (instead of being reflected or refracted). Precise measurements of the absorbance at many wavelengths allow the identification of a substance via absorption spectroscopy, where a sample is illuminated from one side, and the intensity of the light that exits from the sample in every direction is measured (see Fig. 1). A few examples of absorption are ultraviolet–visible (UV-Vis) spectroscopy or infrared (IR) spectroscopy.

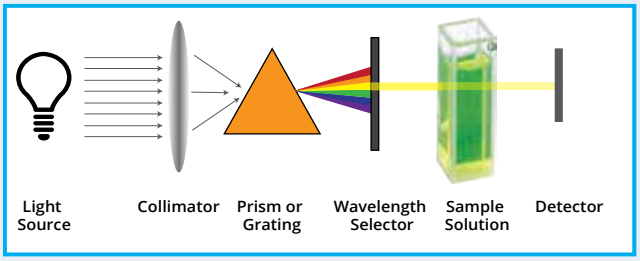


Fig 1. Concept of absorbance spectroscopy using white light and optical components to filter out light of a specific wavelength that interacts with molecules in the solution. Absorbance at this specific wavelength by the molecules in the solutions is detected as a decrease in light intensity (Spectrophotometer-Source: http://chemwiki.ucdavis.edu/).

Absorption is the amount of light that a substance takes in and does not allow to pass through it. Spectrophotometers actually measure transmission, the amount of light that passes through a sample, but this is converted into absorption by comparing the bulb output to the light that has passed through the sample. Light sources that can be used for absorbance spectroscopy depend strongly on the used substance to label a specific molecule and can span the entire electromagnetic spectrum of light.

Protein detection uses the UV- spectrum (typically, 260 nm and 280 nm, while further information is obtained at 230 nm and 320 nm, but compensated by a selection of ratios and background corrections) and is most commonly used to estimate DNA or RNA concentration and to analyze the purity of the preparation. Further application spans the measurement of the light scatter at 600 nm to monitor the growth rate of a cultured bacterial population and to identify the peak concentration.

Industrial applications that also cover the UV spectrum for protein detection is linked to food analysis (for example, characterizing the grading of olive oil as extra virgin, virgin oil, etc., as set out by European regulations) or quality control in the pharmaceutical industry. In addition, industrial applications of absorbance spectrophotometry cover the characterization of water purity or waste water analysis, in addition to the determination of specific organic molecules like nitrate, nitrite or phosphor. This last application is interesting when using the visible light (Vis) spectrum.

Biofluorometer

Reliable, 2-channel, LED-based fluorometer

Features

- Two photomultiplier inputs
- Light excitation with high power LEDs
- Modes: single excitation & single emission, single excitation & dual emission, dual excitation & single emission
- 2 channel mode (two single excitation & single emission)
- Optical connections: Liquid Light Guides (LLGs) and SMA terminated fibers
- Sampling rates up to 1 kHz (1000 ratios/second)
- Automatic LED light drift correction for long term measurements
- Automatic room light correction
- Optional fiber optic probes for horizontal tissue bath applications
- Optional imaging probes for Langendorff systems
- Optional attachments for direct connection to fluorescence microscopes via epifluorescence port (excitation) and C-Mount (Emission) via liquid light guides

Benefits

- Versatile instrument for horizontal tissue bath, Langendorff and microscope applications
- Warmup time < 1 minute
- Low bleaching mode (5% LED On time)
- Can be combined with imaging based Sarcomere Detection System (OptiSarc)
- SMA and Liquid Light Guide (LLG) may be exchanged (optional)
- Customized analysis techniques in WPI's MDAC data acquisition software

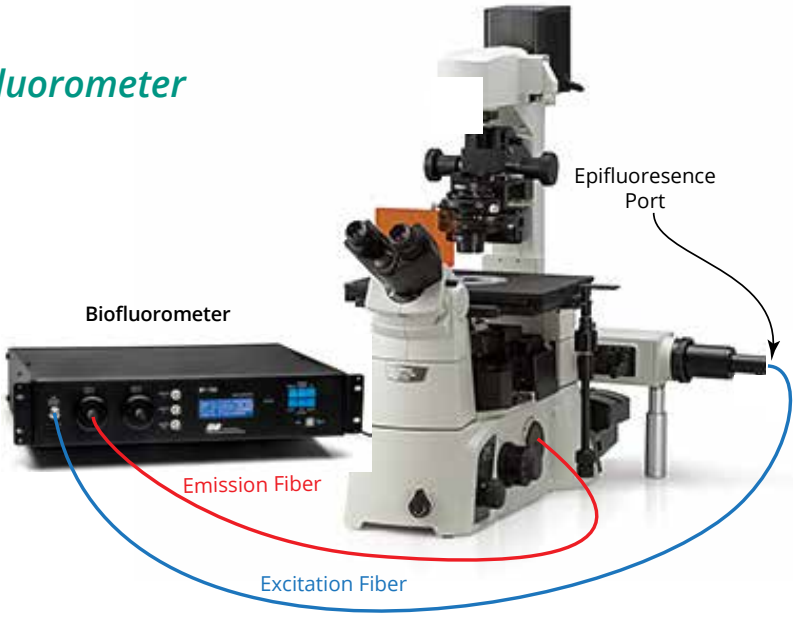
Applications

- Auto-fluorescence imaging

The **SI-BF-100** is an LED-based fluorometer for life science applications. It is ideally suited for ratiometric calcium detection (FURA-8) and ATPase detection (via NADH fluorescence). With up to three LED modules (wavelengths), the **SI-BF-100** covers many fluorometric applications in neuroscience and cell biology.

The **SI-BF-100** enables the detection and analysis of fluorescence signals in four different modes:

- Single excitation/single emission–In this classical mode, a fluorophore is excited at one wavelength and the fluorescence signal is detected at a single higher wavelength using one photomultiplier. The concentration of the analyte is directly proportional to the intensity of the detected signal.
- Dual excitation/single emission–A fluorophore is excited at two wavelengths and the fluorescence signal is detected at one wavelength using one photomultiplier. The concentration of the analyte is proportional to the ratio of the two detected fluorescence signals. This ratiometric concept minimizes the effect of indicator dye bleaching and motion artifact in experiments. A typical example is the detection of free calcium in muscle tissue using the indicator dye Fura-8™.
- Single excitation/dual emission–A fluorophore is excited at one wavelength and the fluorescence signal is detected at two wavelength using two photomultipliers.
- Dual excitation/dual emission–Two separate fluorophores are excited at different wavelengths and the fluorescence signal of each fluorophore is detected at two separate wavelengths using two photomultipliers.

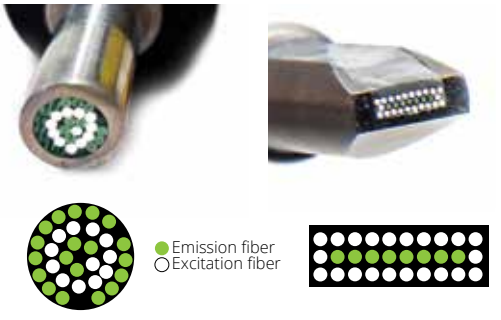


The Biofluorometer can be connected to the epifluorescence port of an inverted microscope and its high intensity LED light source is used for excitation of the corresponding dye.

Fluorescence Probe

The principle of a fluorescence probe is to bring light to a sample and to detect reflected or fluorescent light from the sample surface.These probes may be used for the detection of the transient response of free ion concentrations, like calcium, potassium, sodium, magnesium. Fluorescence probes can also be designed to detect pH and membrane potential. Auto-fluorescence like the detection of ATPase activity via NADH or FAD is another application. If a fluorescent dye is used to label a molecule, a custom fluorescence probe can be designed to detect the emission.

To select the appropriate fluorescent probe, consider the detection principle and the dye to be used. All probes use fibers with 300 µm core diameter. Excitation fibers have 1000 µm SMA connectors for excitation and double emission probes, and 1500 µm SMA connectors for excitation and single emission probes. The standard probes come with a rectangular head (3 mm × 0.7 mm) or round head (2 mm diameter). The fibers that are used for such probes are highly flexible plastic fibers or fused silica fibers. Custom fibers for your application may be designed with different core fiber diameters.



(Left) Customized single emission round probe with a 5 mm diameter for one excitation and one emission wavelength.

(Right) Customized rectangular probe.

Application	Probe	Excitation	Emission
Free Calcium via Indo-1	Double Emission	365nm	405nm/486nm
Free Calcium via Fura-8	Single Emission	365nm/410nm	525nm
ATPase via NADH/TAMRA	Double Emission	365nm	472/572nm
FAD	Single Emission	470nm	525nm

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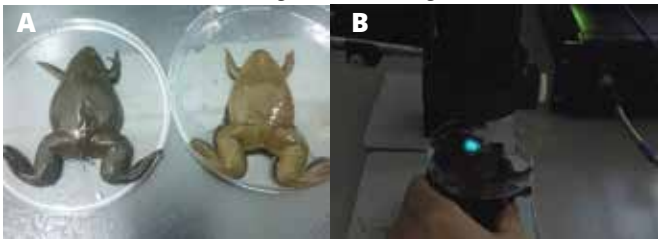
Auto-fluorescence imaging

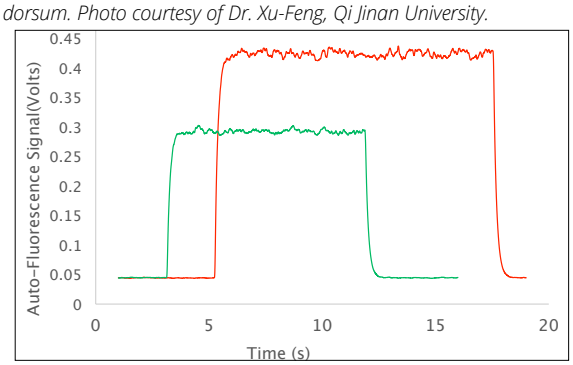
Genetically modified frogs

Fluorescence signaling with single emission probe on living frogs of wildtype tissue (wt) and genetically modified tissue from frog expressing a protein of "auto-fluorescence" called EGFP. Data below showing an increase in autofluorescence signal for EGFP frogs.



A *Wildtype (wt, left) and EGFP (right) frog strain, showing the difference in color between both strains. Photo courtesy of Dr. Xu-Feng, Qi Jinan University.*

B *Experimental setup for frog dorsum in vivo fluorescence measurement with single emission probe. Observe the LED beam/spot as measurement area of frog dorsum. Photo courtesy of Dr. Xu-Feng, Qi Jinan University.*

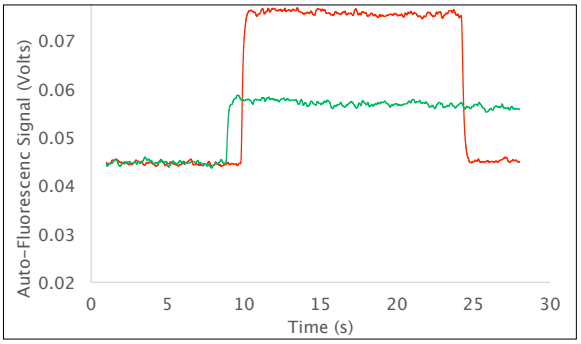


Fluorescence response of frog dorsum in vivo with single emission probe from whole frog dorsum measurements for EGFP (red) vs. wildtype (wt, green). Note the distinguishable increase in auto-fluorescence signal for EGFP frog dorsum but confounded with tissue color backreflection

Genetically modified mice isolated hearts

Fluorescence signaling with LLG Imaging probe of wildtype tissue (wt) and genetically modified tissue from mice isolated heart expressing a protein of "auto-fluorescence" called EGFP. Data below showing an increase in autofluorescence signal for EGFP heart at two LED current intensity.

Experimental setup for isolated mouse heart fluorescence measurement with LLG Imaging Probe.



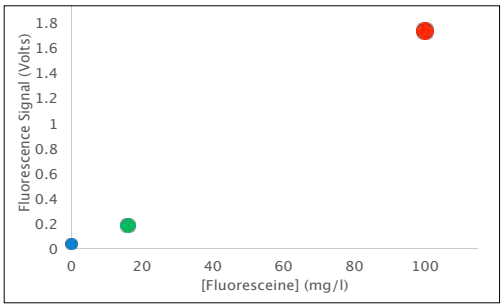
Fluorescence signal from isolated mouse heart with LLG Imaging Probe for EGFP (red) vs. wildtype (wt, green). Note that auto-fluorescence signals can be distinguished between EGFP vs. wildtype, although the signals and difference are weak. Note that back reflection can be considered as constant, as heart and dish support colors are the same. Photo courtesy of Dr. Xu-Feng, Qi Jinan University.

Dye loading concept for measuring fluorescence signal on a leaf

Often calcium fluorescence is measured in leaves via specific dye loading techniques, like microinjection. A simplified concept for dye loading can also be the use of the root fluid transport system. In this example Fluoresceine dye was used to exemplify this technique. Measurements of Fluoresceine in the leaf was done with the BF-100 and an SMA single emission probe for direct sensing under a dark condition. Backreflection is considered as constant as booth leaves had the same coloring.

For the setup, the plant with root was incubated in Fluoresceine solution (using physiological transportation) for ~1hr or 2~hrs in Fluoresceine concentration of 16 mg/l and 100 mg/l. Measurements were taken on the side without vein. Clear distinguishable effects of the different Fluoresceine concentration can be observed, notably regarding the control measurement with Milli-Q water.

Example of plant dye loading via the plant root for two different Fluoresceine concentration. Photo courtesy of Professor Yao Youli of Yangzhou University, China.



Plant dye loading of fluoresceine at two different concentrations (green, red) via the plant root. For comparison see only Milli-Q water (blue). Note that dye loading time was 1 hr (green) and 2 hrs (red). Fluorescence measurement was conducted by shining directly on the leaf under a dark condition.

SI-BF-100 SPECIFICATIONS

MEASUREMENT PRINCIPLE	Fiber optic fluorometer with 2 inputs and 1 output
DETECTOR INPUTS	2 PMTs
EXCITATION	High Power LED Modules: 365 nm, 420 nm, 470 nm, 530 nm (select any 3 modules, when ordering)
ANALOG OUTPUT RANGE	0–10V
OPTICAL CONNECTIONS	Choice of Liquid Light Guide (LLG) or SMA connections
POWER	12 V/2 A (includes external 100 – 240 V / 50 – 60 Hz power supply)
DIMENSIONS (h x w x d)	3.5 x 17 x 13 in. (88 x 431 x 330 mm)

ORDERING INFORMATION

SI-BF-100LLG	Biofluorometer with LLG Optical Connections
SI-BF-100SMA	Biofluorometer with SMA Fiber Optic Connections
99261	C-Mount Microscope Attachment for 2x PMTs
99259	C-Mount microscope attachment for 1x camera & 2x PMTs *(includes 1x camera C-Mount adapter with adjustable aperture,*

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

SI-BF-SMA-UPGRADE	Biofluorometer Upgrade Kit for SMA optical probes
SI-BF-LLG-UPGRADE	Biofluorometer Upgrade Kit for LLG connections
802407	Liquid Light Guide (LLG), 3mm diameter, 6' long
M3301	Manual Manipulator for securing the probe
M10	Magnetic Base
94650	Single Emission, Small Tissue Probe
94689	Dual Emission, Small Tissue Probe

Check our website for new LED modules, emission filters and dichroic mirrors for specific applications.

Precision Stereo Zoom Microscope

Modular, two parallel beam path design with high quality optics

Features

- Planachromatic objectives, no optical distortion
- Large zoom ratio: 8:1
- Large zoom range: 0.62x-5.0x
- Step and continuous zoom

Benefits

- True trinocular version available
- High-contrast imaging, ideal for observing transparent, low-contrast objects
- Long working distance option available

Applications

- Integrated optical and biological research

The fourth generation of WPI's precision stereo zoom microscopes uses modular, two parallel beam path design and high quality optical system. The advanced optical design with planachromatic objectives provides a sharp and distortion-free contrast image throughout the entire zoom range and comes with an impressive 5-year warranty.

The **PZMIV** is available in a binocular or trinocular version. In addition, an extensive list of optional accessories is available that makes the PZMIV suitable for integrated optical and biological research.

The microscope comes with a track stand, standard 10x eyepieces (wide-field, distortion-free and high eye point) and a 1x planachromatic distortion-free objective.

All **PZMIV** and **PZMTIV** microscopes come with 10x eyepieces, built-in 1x auxiliary lens and light ring adapter.

Long working distance option

A common application for the PZMIV and the **PZMIII** is to add a 0.5X objective to allow for more working distance under the lens. This increases the PZMIV working distance from 80 mm to 189 mm. The PZMIII working distance increases from 100 mm to 177mm.

The use of this auxiliary lens drops the magnification range to half, so we also recommend acquiring the 20X eyepieces to return the microscope to its standard magnifications.

See the specification tables marked areas for more details. On trinocular versions of the microscope with the LWD option, the camera view is nearly the same as the eyepiece visual field of view.

USBCAM50 *digital camera included with version shown, also available separately*

Z-LITE *fiber optic illuminator now included with systems below differs from unit in photo* *— See page 191.*

Computer and display not included

PZMTIV-BS-LWD-DIG50

The trinocular version is a true trinocular, with continuous operation of both eyepieces and photo tube simultaneously. There is no need to block the right eyepiece to use the photoport.

504134 *LED Ringlight*

See page 191

PZMIV & PZMTIV Eyepieces and Objectives

	10x Eyepiece		16x Eyepiece		20x Eyepiece		25x Eyepiece		
Objective	Mag	Field (mm) *(Video Field)*	Mag	Field (mm) *(Video Field)*	Mag	Field (mm) *(Video Field)*	Mag	Field (mm) *(Video Field)*	Working Distance
0.32x	1.9x - 16x	106 -13.1 *(49.8 - 6.1)*	3.2x 25.6x	70.6 - 8.8 *(49.8 - 6.1)*	3.9x - 32x	55.4 - 6.9 *(49.8 - 6.1)*	5x - 40x	45.4 - 5.6 *(49.8 - 6.1)*	296 mm
0.5x	3.1x - 25x	67.7 - 8.4 *(31.8 - 3.95)*	5x - 40x	45.2 - 5.6 *(31.8 - 3.95)*	6.2x - 50x*	35.5 - 4.4 *(31.8 - 3.95)*	7.8x - 62.5x	29 - 3.6 *(31.8 - 3.95)*	189 mm*
0.63x	3.9x - 31.5x	53.8 - 6.7 *(25.3 - 3.15)*	6.2x - 50.4x	35.8 - 4.4 *(25.3 - 3.15)*	7.8x -63x	28.2 - 3.5 *(25.3 - 3.15)*	9.8x - 78.8x	23 -2.9 *(25.3 - 3.15)*	149 mm
1.0x (inc)	6.2x - 50x	33.9 - 4.2 *(15.9 - 1.97)*	9.9x - 90x	22.6 - 2.8 *(15.9 - 1.97)*	12.4x - 100x	17.7 - 2.2 *(15.9 - 1.97)*	15.5x - 125x	14.5 - 1.8 *(15.9 - 1.97)*	80 mm

The Video Field is based on a 1/2-inch CCD (8 mm diagonal) and a 0.5x camera adapter.
**Long working distance (LWD) configuration*

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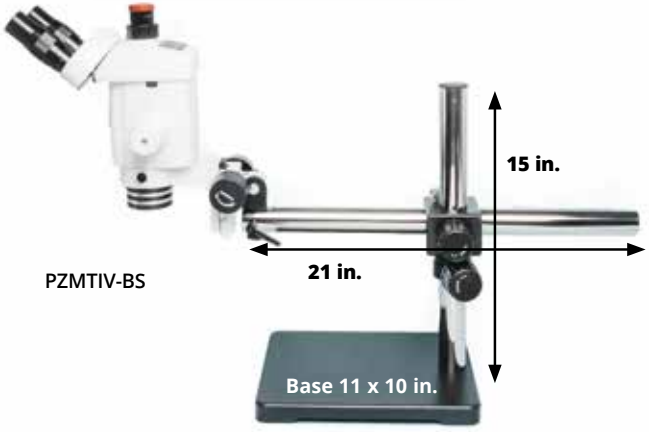
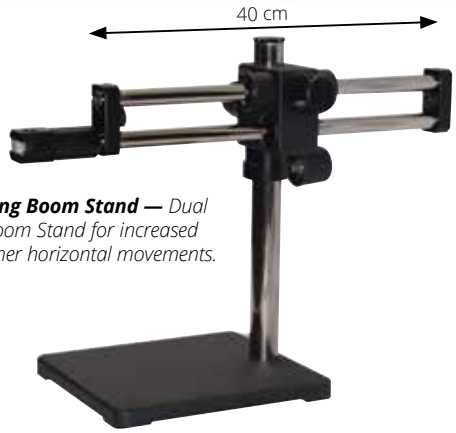
502002 *Stand*





502005 ***Ball Bearing Boom Stand —*** *Dual Arm Ball Bearing Boom Stand for increased stability and smoother horizontal movements.*

PZMIV SPECIFICATIONS

EYEPIECES	WFH 10×
AUXILIARY LENSES	1×
ZOOM RANGE	0.62× - 5×
TOTAL MAGNIFICATION	6.2× - 50×
ZOOM RATIO	8 : 1
FIELD OF VIEW	Ø33.9- Ø4.2 mm
WORKING DISTANCE	80 mm
BINOCULAR TUBE	Inclined 45°
INTERPUPILARY DISTANCE	50 – 75 mm
DIOPTER ADJUSTMENT	± 5 Diopter
MICROSCOPE BODY	Rotatable 360°
OPTIONAL ACCESSORIES	
Eyepieces	16×, 20×, 25×
Auxiliary lenses	0.32×, 0.5×, 0.63×
Total Magnification	1.9× - 125×
Field of view	Ø106 - Ø1.8 mm
Working Distance	80 – 296 mm
SHIPPING WEIGHT	23 lb.

ORDERING INFORMATION

PZMIV	Precision Stereo Zoom Binocular Microscope (Model IV), on Track Stand
PZMIV-BS	PZMIV Microscope on Boom Stand
PZMTIV	Precision Stereo Zoom Trinocular Microscope (Model IV), on Track Stand
PZMTIV-BS	PZMTIV Microscope on Boom Stand
* **PZMTIV-DIG50**	PZMTIV Microscope System, including PZMTIV, USBCAM50 USB Computer Camera, 0.5× CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide
* **PZMTIV-BS-DIG50**	PZMTIV Microscope System (80 mm WD), including PZMTIV, USBCAM50 USB Computer Camera, 0.5× CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide, Boom Stand
* **PZMTIV-BS-LWD-DIG50**	PZMTIV Microscope System (189 mm WD), including PZMTIV, USBCAM50 USB Computer Camera, 0.5× CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide, Boom Stand, 0.5× Objective, 20× Eyepieces for Long Working Distance Viewing

See website for complete configurations.

* ***Z-LITE-Z*** *may be substituted in EU countries.*

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

Optional Bodies	
502000	PZMIV Binocular Body, 10× Eyepieces, 1× Objective, Eye Guards
502001	PZMTIV Trinocular Body, 10× Eyepieces, 1× Objective, Eye Guards
Optional Stands, Mounts, Bases	
502002	76mm Rectanglular Track Stand
502004	Boom Stand (Heavy) without Focus Mount *(requires 502009 Focus Mount for PZMIV)*
502005	Ball Bearing Boom Stand (Heavy) without Focus Mount *(requires 502009 Focus Mount for PZMIV)*
502006	Boom Clamp Stand (Heavy) *(requires 502009 Focus Mount for PZMIV)*
502009	Universal Focus Mount for 76 mm PZMIV *(Required for BS, AAC, BBS, and BCS) (5/8" pin)*
504123	Extension for Heavy Clamp Stand
504929	LED Microscope Stand, 12.5-in. Post
Optional Eyepieces	
502010	10× Wide Field Eyepiece for PZMIV (pair)
502011	16× Wide Field Eyepiece for PZMIV (pair)
502012*	20× Wide Field Eyepiece for PZMIV (pair)
502013	25× Wide Field Eyepiece for PZMIV (pair)
500264	10× Eyepiece with Reticle (matches 10× eyepiece #502010)
500266	20× Eyepiece with Reticle (matches 20× eyepiece #502012)
Optional Objectives	
502016	0.32×, Planachromatic Objective (Distortion-free) (278 mm WD)
502017*	0.50×, Planachromatic Objective (Distortion-free) (174 mm WD)
502018	0.63×, Planachromatic Objective (Distortion-free) (138 mm WD)
502019	1.0×, Planachromatic Objective (Distortion-free) (73mm WD)
Other Accessories	
500028	1× CCD Camera Coupler
500261	0.35× CCD Camera Coupler, C-Mount (Use with USBCAM33)
500262	0.5× CCD Camera Coupler, C-Mount (Use with COLCAM, USBCAM50)
Z-LITE	Z-Lite Fiber Optic Illuminator
Z-LITE-186	Z-Lite Fiber Optic Illuminator with Bifurcated Light Guide and Lenses
500186	Bifurcated Light Guide with Lenses
R-8-8-WPI01	Ring Light Guide
502015	Ring Light Adapter for PZMIV *(For R-8-8-WPI01 Ring Light Guide)*
505131	Replacement Trinocular Tube
505132	Replacement Eye Guards for 30 mm Eyepieces *(pair)*

**Long working distance (LWD) option with the 502012 and 502017 on a trinocular microscope shows nearly the same scene on the screen as the viewer sees in the eyepieces.*

Precision Stereo Zoom Microscope

Quality and precision to improve your vision

Features

- Stereo viewing with ample working distance when used with the long working distance (LWD) option
- Affordably priced

Benefits

- Advanced optics
- True trinocular version available
- Perfect for a boom stand or articulating arm

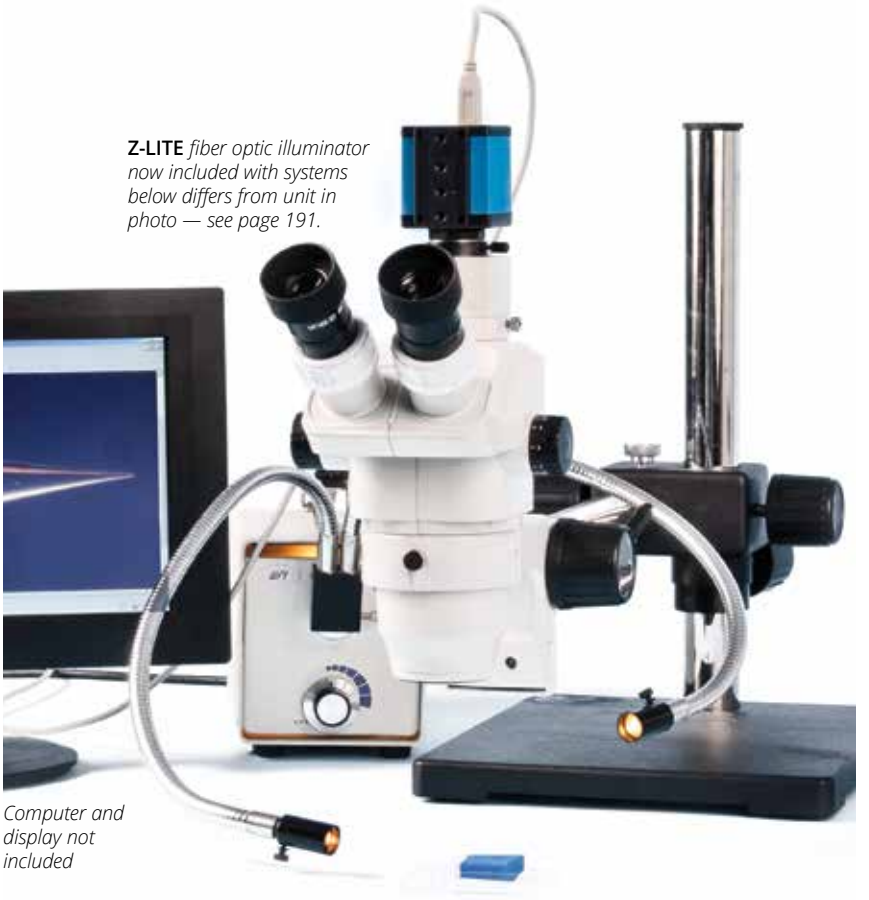
Applications

- Tissue Dissection
- Cell injection
- Specimen manipulation
- Electrode inspection

WPI's third-generation stereo microscope, **PZMIII**, is an ideal tool for tissue dissection, cell injection, specimen manipulation, electrode inspection, and many other applications that require a magnified, stereo viewing and ample working distance. It offers the leading brand's quality and performance at an affordable price. Advanced optics provide the sharpest image that can only be found among the best of this class. It is superior to many stereo microscopes costing almost twice as much. Zooming is achieved by a spring-loaded knob that is smooth and effortless. The compact size and light weight make it more stable and easily manipulated on the boom stand. A specially designed photo/video module is used in the trinocular version of the microscope (**PZMTIII**) for photo, video, or digital imaging. In addition, an extensive list of optional accessories is available that can make the PZMIII suitable for almost any bio-research applications requiring a stereo microscope. See next page for options.

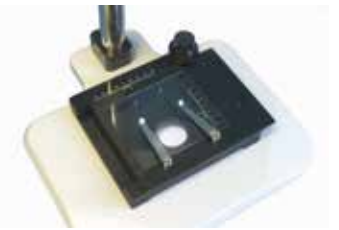
The PZMTIII trinocular version of this microscope offers a true trinocular view. Both eyepieces and the trinocular ports are active all the time. There is no need for the right eye piece to switch off. The left eye piece dims slightly, and the right eye piece is 50/50.

Z-LITE *fiber optic illuminator now included with systems below differs from unit in photo — see page 191.*



Computer and display not included

PZMTIII-BS-DIG50 *includes Boom Stand and USB Digital Camera*



503051 ***Manual Stage —*** *Mounts in the circular opening in the PZMIII base. XY travel distance: 75 x 56 mm. Glass size: 116 x 96 mm. Active diameter: 37.6 mm. Dimensions: 180 x 155 x 27 mm.* ***Fits 503102 base only.***

PZMIII

503102 *Stand*

PZMIII Eyepieces and Objectives

	10× Eyepiece		15× Eyepiece		20× Eyepiece		25× Eyepiece		
Objective	Mag.	Field (mm) *(Video Field)†*	Mag.	Field (mm) *(Video Field)†*	Mag.	Field (mm) *(Video Field)†*	Mag.	Field (mm) *(Video Field)†*	Working Distance (mm)
0.3×	2× - 13.5×	114 - 17 *(53.6 - 8)*	3× - 20.3×	84 -13 *(53.6 - 8)*	4× -27×	69 - 10.3 *(53.6 - 8)*	5× - 33.8×	44.8 - 6.7 *(53.6 - 8)*	287 mm
0.5×	3.4× - 22.5×	69 - 10 *(32.4 - 4.7)*	5× - 33.8×	51 - 7 *(32.4 - 4.7)*	6.7× - 45×*	42 - 6.2 *(32.4 - 4.7)*	8.4× - 56.3×	26.9 - 4.0 *(32.4 - 4.7)*	177 mm*
0.75×	5× - 33.8×	45 - 7 *(21.1 - 3.3)*	7.5× - 50.6×	34 - 5 *(21.1 - 3.3)*	10× - 67.5×	28 - 4.2 *(21.1 - 3.3)*	12.6× - 84.4×	17.9 - 2.7 *(21.1 - 3.3)*	117 mm
1.0×	6.7× - 45×	34 - 5 *(16 - 4.7)*	10× - 67.5×	25 - 3.7 *(16 - 4.7)*	13.4× - 90×	21 - 3.1 *(16 - 4.7)*	16.8×-112.5×	13.4 - 2.0 *(16 - 4.7)*	100 mm
1.5×	10× - 67.5×	23 - 3.4 *(10.8 - 1.6)*	15× - 101.3×	17 - 2.5 *(10.8 - 1.6)*	20.1×-135×	14 - 2.1 *(10.8 - 1.6)*	25.1×-168.8×	9.0 - 1.3 *(10.8 - 1.6)*	47 mm
2.0×	13.4× - 90×	12 - 2.5 *(5.6 - 1.17)*	20.1× - 135×	13 - 1.8 *(5.6 - 1.17)*	26.8×-180×	10 - 1.5 *(5.6 - 1.17)*	33.5× - 225×	6.7 - 1.0 *(5.6 - 1.17)*	26 mm

† The video field of view is based on a 1/2-inch (8 mm diagonal) CCD camera and a 0.5× camera adapter.

**Long working distance (LWD) configuration*

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502007 *Articulated Arm*

Max. clamp opening: 40 mm

502163 *Wall-Mount Plate — Mount the microscope on the wall for convenient storage when space is tight.*

504134 *LED Ringlight*

See page 191.

502006 Boom Clamp Stand — *Combines the stability of a boom stand with the versatility of an articulated arm.*

PZMIII-BS

ORDERING INFORMATION

PZMIII	Precision Stereo Zoom Microscope (Model III), on Post Stand
PZMIII-BS	PZMIII Microscope on Boom Stand
PZMIII-AAC	PZMIII Microscope on Articulated Arm with Table Clamp
PZMTIII	Precision Stereo Zoom Trinocular Microscope (Model III)
***PZMTIII-DIG50**	PZMTIII Microscope System (100 mm WD) *Including PZMTIII, USBCAM50 Computer Camera, 0.5× CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide*
***PZMTIII-LWD-DIG50**	PZMTIII Microscope System (177 mm WD) *Including PZMTIII, Pair of 10× Eyepieces and Eye Guards, Ring Light Adapter, USBCAM50 Camera, 0.5× CCD Camera Coupler, Z-Lite Optical Illuminator With Bifurcated Optical Fiber Light Guide, 0.5× Objective, 20× Eyepieces*
***PZMTIII-BS-DIG50**	PZMTIII Microscope System (100 mm WD) *Including PZMTIII, USBCAM50 Computer Camera, 0.5× CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide, Boom Stand*
***PZMTIII-BS-LWD-DIG50**	PZMTIII Microscope System (177 mm WD) *Including PZMTIII, USBCAM50 Computer Camera, 0.5× CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide, 0.5× Objective, 20× Eyepieces for Long Working Distance Viewing*
PZMTIII-BS	PZMTIII Microscope on Boom Stand
PZMTIII-AAC	PZMTIII Microscope on Articulated Arm with Table Clamp
	All PZMIII and PZMTIII microscopes come with 10x eyepieces and built-in 1x auxiliary lens.
PZMTIII-AAC-DIG50	PZMTIII Microscope System *Including PZMTIII, 10× Eyepieces and Eyeguards, USBCAM50 Camera, 0.5× CCD Camera Coupler, Ring Light Adapter, and Articulated Arm With Table Clamp*

* ***Z-LITE-Z** may be substituted in EU countries.*

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

Optional Bodies

501352	PZMIII Binocular Body, 10x eyepieces (pair), eye guards *13338 Ring Light Adapter NOT included*
501379	PZMTIII Trinocular Body, 10× eyepieces & eye guards *True trinocular view — 13338 Ring Light Adapter NOT included*

Optional Stands, Mounts, Bases

501353	Fan Post Stand with 76mm Focus Mount
502004	Boom Stand (Heavy) without Focus Mount
502005	Ball Bearing Boom Stand (Heavy) without Focus Mount
502006	Boom Clamp Stand (Heavy) *(requires 502009 Focus Mount)*
502007	Articulated Arm, 40 cm Table Clamp, without Focus Mount
502009	Universal Focus Mount, 76 mm ID for PZMIII, PZMIV body
502163	Wall-Mount Plate, 6" × 6" (or 15.24 cm × 15.24 cm)
503051	Manual Stage for PZMIII
503102	76 mm Rectangular Base Post Stand for PZMIII
504123	Post Extension for Heavy Boom Stand
504929	LED Microscope Stand, 12.5-in. Post

Optional Eyepieces

501369	Wide Field 10× Eyepieces (pair)
501370	Wide Field 15× Eyepieces (pair)
501371*	Wide Field 20× Eyepieces (pair)
501372	Wide Field 25× Eyepieces (pair)
504128	10× Eyepiece with Reticle (matches 10× eyepiece on PZMIII)
504129	20× Eyepiece with Reticle (matches 20× eyepiece 501371)

Optional Objectives

501373	0.3× Long Working Distance Objective Lens
501375*	0.5× Long Working Distance Objective Lens
501376	0.75× Long Working Distance Objective Lens
501377	1.5× Long Working Distance Objective Lens
501378	2.0× Long Working Distance Objective Lens

Other Accessories

13338	Ring Light Adapter for PZMIII Series *(included with all microscope configurations on previous page)*
501381	0.5× C-Mount CCD Camera Coupler
504596	76 mm Halogen-Halogen Dual Illuminated Track Stand
504597	Replacement Lamp for 504596

**Long working distance (LWD) option with the 501371 and 501375 on a trinocular microscope shows nearly the same scene on the screen as the viewer sees in the eyepieces.*

PZMIII SPECIFICATIONS

EYEPIECES	WFH 10×	
ZOOM RANGE	0.67× - 4.5×	
TOTAL MAGNIFICATION	6.77× - 45×	
FIELD OF VIEW	Ø 34 mm – Ø 5 mm	
WORKING DISTANCE	100 mm	
BINOCULAR TUBE	Inclined 45°	
INTERPUPILLARY DISTANCE	Adjustable 47-70 mm	
DIOPTER ADJUSTMENT	±5 Diopter (both eyepieces)	
MICROSCOPE BODY	Rotatable 360°	
AUXILIARY LENSES	Total magnification	2× - 225×
	Biggest Field of View	Ø 110 mm
	Working Distance	26-287 mm
SHIPPING WEIGHT	23 lb.	

Stereo Microscope with LED Illuminated Base

Articulating mirror ideal for Brightfield and Darkfield applications

Features

- Illuminated base
- Articulating mirror
- Includes base, microscope head and focus mount
- Trinocular version available
- Includes opaque, black/white contrast stage plate

Benefits

- Oblique, transmitted light for low magnification view of tissues, cells or embryo transfer
- Adjustable brightfield and darkfield illumination
- Pseudo DIC illumination

Applications

- Microinjection
- Nematode research

PZMIII-MI

PZMIII-MI Microscope with Illuminated Base and Articulating Mirror is perfect for microinjection and transfection. It includes our standard stereo microscope head mounted on a research grade Brightfield/Darkfield pole type stand. It has a large stable work surface and a rotatable lens/mirror system which provides transmitted LED intensity illumination.

The sliding mirror is gimbaled, allowing for a full range of movement front to back, as well as rotation. The mirror rotates 360º on one axis and can slide for further lighting effect directionally, front to back. A knob on the right of the base adjusts the mirror and a locking ring holds the desired mirror position.

The articulating mirror lets you vary the microscope illumination from Brightfield LED to Darkfield LED at an appropriate angle. It is an effective tool for viewing live bacteria. At low magnifications, view tissues, cells or embryo transfer where oblique, transmitted illumination is critical.

Microscope options

This unit is sold with our standard PZMIII binocular stereo microscope head. Other options are available. Speak with a specialist today to configure a microscope for your needs

Left: *If you want to add a camera or connect with a video monitor, select a PZMTIII trinocular head for your lighted microscope base.*

Right: *This trinocular microscope head has a camera attached. It also shows an M3301 mounted to the base using a M4C coupler for microinjection studies. A setup like this facilitates classroom or collaborative environments so everyone can see on the remote screen what the researcher is viewing through the microscope..*

Systems include

The scope mounting pole diameter is 32 mm.

This platform includes the PZMIII microscope, a focus mount, two stage clips, 94.5 mm glass stage plate, opaque black/white contrast stage plate and an automatic voltage sensing power supply and a 25.6 cm vertical post. The base may be fitted to other microscope heads.

PZMTIII-MI SPECIFICATIONS	
DIMENSIONS	13 x 11 x 3.37 in. (33 x 28 x 8.5 cm)
PILLAR HEIGHT	10 in. (25.6 cm)
GLASS STAGE PLATE	3.75 in. (9.5 cm) diameter
STAGE CLIPS	75 mm clip length, 4 mm pin, paired
ILLUMINATION PORT	Built in incident and transmitted variable intensity LED illumination
ROTATABLE MIRROR	Dual-reflection lens/mirror system provides transmitted brightfield/ pseudo-darkfield illumination
STAND MANUFACTURER	Made in Japan
WARRANTY	Limited lifetime warranty
SHIPPING WEIGHT	10 lb. (4.5 kg)

ORDERING INFORMATION	
PZMIII-MI	Stereo Microscope with LED Illuminated Base Stand with Articulating Mirror *Includes PZMIII microscope, a focus mount, 2 stage clips, 94.5 mm glass stage plate, black/white stage plate, automatic voltage sensing power supply*
PZMTIII-MI	Trinocular Microscope with LED Illuminated Base Stand with Articulating Mirror *Includes PZMTIII microscope, a focus mount, 2 stage clips, 94.5 mm glass stage plate, black/white stage plate, automatic voltage sensing power supply*

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Precision Surgical Microscope

Ideal for small animal surgery

Features

- Motorized focusing system, allows hands-free operation
- Optional video adapter
- Improved optics 119 lp/mm
- Convenient handles
- New head tilting mechanism

Benefits

- Light weight, compact and easy to maneuver—weighs only 70 lb.
- Dual bulbs prevent illumination failure during surgery
- Five magnification steps

Applications

- Small animal surgery
- Veterinary surgery

WPI's popular precision SurgioScope with five magnification steps is a portable, high quality surgical microscope offering outstanding image quality and value. Incorporating an agile extension arm and excellent working distance objectives, the SurgioScope provides convenient movement and maneuverability necessary for accurate positioning. These important features, together with a high quality optical system, provide sharp image contrast and enhanced large field of vision. The SurgioScope comes fully equipped with a foot-controlled motorized focusing system, normally only found in more expensive surgical microscopes. A unique dual lamp housing enables safe and rapid changing of the lamp during an operation, without the need to power down. The optional video port on the trinocular version permits operational procedures to be monitored or recorded simultaneously using a video recorder and a **COLCAM-HD** video camera or digital stills with **USBCAM50**.

SURGIOSCOPE SPECIFICATIONS

TOTAL MAGNIFICATION (F200)	3.2× — 25×
ADJUSTABLE DIOPTER	± 6 Diopter
ADJUSTABLE INTERPUPILLARY DISTANCE	min. 50 mm — max. 70 mm
EYEPIECE	12.5x
FINE FOCUS ADJUSTMENT RANGE	30 mm
WORKING HEIGHT (Arm Movement Range Above Floor)	
89 cm Post.....Focus from 34.5" (88 cm) to 51" (130 cm) above floor *	
103 cm Post.....Focus from 40.5" (103 cm) to 57" (146 cm) above floor *	
** Subtract Working Distance for height above specimen, 103 cm post recommended for F350 objective.*	
RANGE OF MOTION	
Maximum Stretch Radius of Arm .. 870 mm	
Vertical Movement Range ..... 700-1100 mm	
ILLUMINATION	
Spot = 42 mm	
Dual lamp housing with quick-change spare and internal coaxial fiber optic cable.	
HALOGEN-TUNGSTEN LAMP	12 V, 100 W, with cold reflection
OPTIONAL CAMERA	COLCAM-HD, COLCAM-HD1080P, USBCAM50 (½" CCD) USBCAM33 (⅓" CCD)
POWER	110 V, 50-60 Hz, or 220 V, 50-60 Hz
SHIPPING WEIGHT	94 lb. (43 kg)

OBJECTIVES

Objective	Working Distance	Magnification step	Visual Field of view (mm)	Camera field 1/2" CCD (mm)	Camera field 1/3" CCD (mm)
F100 #504284	90 mm	6.4, 10, 16, 26, 40x	25, 15.5, 10, 6, 4	25, 15.5, 10, 6, 4.5	17.5, 11.5, 7, 4.6, 2.8
F200 (included)	190 mm	3.2, 5, 8, 13, 20x	50, 31, 20, 12, 8	50, 31, 20, 12, 8	35, 23, 14, 9, 5.5
F250 #504285	240 mm	2.6, 4, 6.4, 10.4, 16x	65, 40, 25, 16, 10	63, 40, 25, 16, 10	45, 28, 18, 11, 7
F300 #504286	290 mm	2.1, 3.3, 5.3, 8.7, 13x	75, 46.5, 30, 18, 12	75, 46.5, 30, 18, 12	52.5, 34.5, 21, 13.5, 8.3
F350 #504287	340 mm	1.8, 2.9, 4.6, 7.4, 11x	91, 57, 36, 22, 14	88, 55, 35, 21, 13	60, 38, 24, 15, 9.5

For additional objectives and specifications, see www.wpiinc.com

ORDERING INFORMATION

PSMB5N	Binocular SurgioScope, F200 objective *(Specify post height)*
PSMT5N	Trinocular SurgioScope, beam splitter, standard video adapter, F200 objective *(Specify post height)*

Specify 89 cm or 103 cm post
Specify line voltage

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

501636	1/2" CS-mount Adapter *(requires Beam Splitter 501637)*
501637	Beam splitter
504284	F100 Objective
504285	F250 Objective
504286	F300 Objective
504287	F350 Objective
500162	Replacement lamp, 12V, 100 W

Inverted Trinocular Microscope

Excellent for video recording and photography

INV-101

Features

- Phase contrast at 10X and 20X
- 160 x 260 mm stage
- Infinity Optical System
- Trinocular head for attaching camera
- Abbe condenser
- Coarse and fine focusing
- Multiple objectives included

Benefits

- Stage includes inserts for holding standard culture dishes and slides
- Halogen illumination, offering an image with true to life coloring
- Fixed Stage—optics move during focusing—excellent for patch clamp and brain slice recording

Applications

- Video recording/photography
- Patch clamping
- Brain slice recording

The **INV-101** is an affordable inverted microscope for pathologists, biologists and medical researchers. Able to perform intricate and varied applications for vital tissue cultures, it is perfect for observation and education or for professional research in a clinical lab.

Accessories included: Green, blue and neutral filters, dust cover, immersion oil, manual and warranty card.

TRINOCULAR HEAD	
EYEPIECES	EW 10× /22 extra wide field eyepieces
CONDENSER	Abbe condenser with 10× / 20× phase
FOCUS	Coarse adjustment range +8 to -3 mm
	Fine adjustment: 0.002 mm
STAGE	160×250 mm
INSERTS	35 mm round, 50 mm round, 87×46 rectangular
STAGE DRIVE	Coaxial drive controls
MECHANICAL STAGE	X-Y coaxial control; 120×78mm range of traverseNosepiece
NOSEPIECE	Quintuple nosepiece
OBJECTIVES	Infinity optical system
	Plan 4× and 40×, Plan Phase 10× and 20×
ILLUMINATION	6V/30 W halogen bulb
	Centering eyepiece for phase objective
FIXED STAGE	Optics move during focusing—excellent for patch clamp and brain slice recording

ORDERING INFORMATION	
INV-101	Trinocular Inverted Microscope
503510	30 mm 10× Eyepiece with 100/10 reticle
503520	Replacement lamp

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LED Illuminated Microscopes

Superb optics, durable and high performance microscopes

504221

Features

- Binocular or trinocular
- Infinity plan achromat optics
- 20 mm FOV
- 3 W LED illuminator

Benefits

- Super bright LED illuminator

Applications

- Student laboratories
- Life science research

The ACCU-SCOPE® 3000-LED Microscope Series delivers outstanding optical performance, value and resolution to meet the exacting standards of life science professionals and students. With a newly designed infinity plan optical system, a best-in-class 20 mm field of view and a super-bright 3-watt LED illuminator, the 3000-LED Series provides high contrast images with outstanding resolution, precision design and enhanced illumination.

3000-LED SERIES SPECIFICATIONS

OPTICAL SYSTEM	Infinity Optical System, f=180 mm, Anti-Mold
VIEWING HEAD	Siedentopf type, inclined 30°; interpupillary distance adjustment 48-75 mm
EYEPIECES	HWF Plan 10× eyepiece, 20 mm field of view with built-in diopter adjustment; a pointer is standard in one eyepiece
NOSEPIECE	Rear facing quadruple
OBJECTIVES	Infinity Plan achromat 4× (N.A. 0.10), 10× (N.A. 0.25), 40×R* (N.A. 0.65), 100×R oil* (N.A. 1.25) are standard **spring-loaded*
STAGE	Stage size 140 mm × 132mm with X-Y movement range of 76mm × 50 mm
PHASE CONTRAST (OPTION)	Phase sliders for 10×/BF/40×
CONDENSER	N.A. 1.25 Abbe condenser
ILLUMINATION	3 watt LED with variable intensity control
ACCESSORIES	Dust cover, immersion oil and instruction manual, universal power supply 110v-240v
STAND	Cast alloy aluminum; coaxial coarse and fine focusing controls.
DIMENSIONS	15.25 × 7.75 × 15.4 in. (387 × 196 × 391 mm)
WEIGHT	16 lb. (7.26 kg)

ORDERING INFORMATION

504221	Binocular, Infinity Plan Achromat 4×, 10×, 40×R and 100×R oil objectives
504443	Trinocular, Infinity Plan Achromat 4×, 10×, 40×R and 100×R oil objectives
504445	Binocular, Plan Phase Contrast 10× and 40×R objectives
504444	Trinocular, Plan Phase Contrast 10× and 40×R objectives
504416	0.50× C-mount Adapter for 1/2" Sensors, adjustable focus
504417	0.35× C-mount Adapter for 1/3" Sensors, adjustable focus

Professional-Grade Microscope

Best-seller in universities, medical schools, research laboratories

W30S-LED

Features

- Titanium finished DIN or semi-plan optic
- 30-year antifungal coating

Benefits

- Affordable research grade microscope

Applications

- Universities, medical schools, and research laboratories

The **W30S** professional-grade microscope is a best-seller in universities, medical schools, and research laboratories. Equipped for performance, its features include titanium-finished DIN or Semi-Plan optics and a 30-year antifungal coating. The **W30S** is the choice for superior performance at a great price.

W30S SPECIFICATIONS

HEAD	Binocular (Seidentopf), True Trinocular Inclined 30°, rotates 360° Dual diopter adjustment, Interpupillary distance range 55-75 mm 10×/18 wide field eyepieces
NOSEPIECE	Quadruple forward-facing nosepiece
OBJECTIVES	DIN Plan, antifungal 4×, 10×, 40×, 100×R (oil) Parfocal, parcentric, color-coded
STAGE	Mechanical stage (140 mm × 140 mm) Coaxial drive controls XY Movement: 73 mm × 43 mm
FOCUS	Coarse adjustment: range of 30 mm Fine adjustment: graduation of 2 µm Tension control knob
ILLUMINATION	Moveable Abbe condenser, NA 1.25, Iris diaphragm Variable LED light source (3W bulb) 110 V/220 V switchable electronics
ACCESSORIES INCLUDED	Replacement 0.5 amp fuses, mirror attachment (for field use), blue and green filters, dust cover, immersion oil
DIMENSIONS AND WEIGHT	15" (38 cm) × 9" (23 cm) × 7" (17.8 cm) 14 lb. (6.4 kg)

ORDERING INFORMATION

W30S-LED	Binocular Microscope
W30ST-LED	Trinocular Microscope
503513	21 mm 10X Eyepiece with 100/10 reticle
500828	Stage Micrometer, 1 mm scale, 200 div. at 10 µm
504606	Stage Micrometer, 50-0.5 mm scale and 10 µm scale

High Definition Camera & Monitoring System

HD imaging for scientific and industrial applications

Features

- High definition camera and monitoring system
- 30 fps (HDMI) and 15 fps (USB 2.0), Aptina sensor and an 4 GB SD card
- Includes HD camera, 1/2.5" (7.182 diagonal), 11.6" HD display screen, 4 GB SD card, USB 2.0 mouse, CaptaVision PC Imaging Software, HDMI Cable, USB 2.0 Cable, 12 V Power Adapter, HDMI Adapter, Y Power Splitter, Mounting Brackets and Hardware
- Specify line voltage

Benefits

- Connect your way: use directly, USB to PC or HDMI to a projector
- Superior performance and color
- Built-in mouse control software for HDMI viewing and recording without a computer
- Fluorescence imaging with 3D noise reduction
- Many built-in camera functions

Applications

- Scientific and industrial imaging

PRO-300HDS *camera & screen mounted on* ***PZMTIII-MI*** *(sold separately).*

The new **PRO-300HDS** sets a new standard for excellence in high definition imaging for scientific and industrial applications. This full featured HD camera offers super fast frame rates in video preview, with unrivaled color fidelity and on-board image capturing capability.

PRO-300HDS lets you view and capture images and video directly to the supplied SD card without the need for a computer or separate monitor. The 11.6-in. HD display offers beautiful, crystal-clear image quality, and vibrant, true-to-life color with exceptional viewing from all angles.

Connect your way

PRO-300HDS can be used as a stand-alone system or connected to a PC via USB cable so images can be displayed simultaneously on a PC. For even more flexibility—and ideal for teaching environments—the HDMI architecture allows the device to be connected to an HDMI-enabled projector as well. Each camera is supplied with the PC/Mac-compatible on-board image capture software, as well as full-featured CaptaVision PC image analysis software.

Superior performance and color

PRO-300HDS incorporates dual FPGA processors and unique algorithms that produce perfect color reproduction. It offers full 1080p video preview for HD output with no lag time or compression.

Built-in mouse control software for HDMI viewing and recording without a computer

An external HDMI port allows you to connect directly to an HD monitor for live/real time viewing, capturing and saving of images to an SD card without being connected to a computer. On-board software lets you control the camera with a click of the mouse rather than searching for buttons on the camera, making **PRO-300HDS** the ideal choice for teaching, group presentations or when a computer set-up is not an option.

Fluorescence imaging

The ultra-high signal-to-noise ratio sensor lets you set exposure time from 1 ms to up to 10 seconds and adjust 20 scales of gain value. The incredibly efficient 3D noise reduction performance delivers detailed low light images, making **PRO-300HDS** a great choice for fluorescence applications.

Built-in camera functions

Auto or Manual Exposure Time Capability–You are in full control of exposure and gain. Use the Auto Exposure function or set the exposure time from 1 ms up to 10s and adjust 20 scales of gain value.

3D Noise Reduction–Longer exposure times increase image noise. The integrated 3D noise reduction keeps the image clean and sharp.

1080P Video Recording–Just click on the video record icon to start recording 1080P videos at 30fps. The recorded video files are saved directly to the high speed SD card. You can playback videos directly from the SD card.

Magnify (ROI), Rotate and Flip Images–Image operation buttons on the right side of the screen allow you to select a ROI (Region of Interest), as well as flip or rotate an image.

Side by Side Image Comparison–The image comparison function allows you to choose one image, move the image position or select the ROI area to compare with the live image.

Browse Captured Images and Video–Easily browse images on the SD card, zoom in on images or delete them. You can even playback video files saved to the SD card from the Browse feature.

On Board Imaging Tools–No driver is needed when you connect to a PC or Mac via the USB 2.0 camera port. You'll be up and running in no time with the on-board software that features basic imaging tools:

- Flip Horizontally
- Flip Vertically
- Zoom in
- Zoom Out
- Crop
- Divison
- Cancel
- Insert a Crossline
- Compare Images
- Browse Images

ORDERING INFORMATION

PRO-300HDS High Definition Camera with Screen

Specify line voltage

Includes HD camera, 11.6" HD display screen, 4GB SD card, USB 2.0 mouse, CaptaVision PC Imaging Software, HDMI Cable, USB 2.0 Cable, 12V Power Adapter, HDMI Adapter, Y Power Splitter, Mounting Brackets and Hardware

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Digital Microscope Cameras

Photograph or share your research images

USBCAM133/USBCAM152/USBCAM202

Features

- Ultra-Compact USB cameras with color CCD

Benefits

- Rear mini-USB connector
- Hardware & Software Trigger

Applications

- Image capturing from a microscope

USBCAM133

Options

- **USBCAM133** with a 1/3-inch color CCD, 6mm diagonal
- **USBCAM152** with a 1/2-inch color CCD, 8mm diagonal
- **USBCAM202** with a 1/1.8-inch color CCD, 8.9 mm diagonal

All three cameras are cased models with a rear mini-USB connector, hardware and software triggering image capture, digital zoom and a feature-rich, user based menu setup and control. Sentech USB cameras include a SDK, DirectX, Twain and Linux driver, as well as the Sentech Viewing Software.

SPECIFICATIONS

	USBCAM133	USBCAM152	USBCAM202
IMAGE SENSOR	1/3" Interline SXVGA color progressive CCD	1/2" Interline SXGA color progressive CCD	1/1.8" Interline UXGA color progressive CCD
CELL SIZE	3.75 (H) x 3.75 (V) µm, 6mm diagonal	4.65 (H) x 4.65 (V) µm, 8mm diagonal	4.40 (H) x 4.40 (V) µm, 8.9 mm diagonal
SCANNING SYSTEM	Progressive	Progressive	Progressive
RESOLUTION	1280 (H) x 960 (V)	1360 (H) x 1024 (V)	1600 (H) x 1200 (V)
MIN. SCENE ILLUMINATION	11 Lux at F1.2	18 Lux at F1.2	7.7 Lux at F1.2
SPEED	22.4 Frames per Second	19.26 Frames per Second	15.3 Frames per Second
ELECTRONIC SHUTTER	Auto/Manual (software selectable)	Auto/Manual (software selectable)	Auto/Manual (software selectable)
GAIN	Auto/Manual (software selectable)	Auto/Manual (software selectable)	Auto/Manual (software selectable)
GAMMA	Manual (software selectable)	Manual (software selectable)	Manual (software selectable)
WHITE BALANCE	Auto/Manual/One shot (software selectable)	Auto/Manual/One shot (software selectable)	Auto/Manual/One shot (software selectable)
INPUT/OUTPUT	USB 2.0 High Speed	USB 2.0 High Speed	USB 2.0 High Speed
POWER	+5 VDC through USB connector, < 300 mA	+5 VDC through USB connector, < 420 mA	+5 VDC through USB connector, < 450 mA
DIMENSIONS	28 (W) x 28 (H) x 37 (D) mm (excluding connector)	28 (W) x 28 (H) x 42 (D) mm (excluding connector)	28 (W) x 28 (H) x 42 (D) mm (excluding connector)
LENS MOUNT	CS mount	C mount	C mount
WEIGHT	Approximately 45 g	Approximately 45 g	Approximately 45 g
INTERFACE CONNECTOR	USB: mini-B USB connector IO signal: 6 pin connector (HR10A-7R-6PB or equivalent)	USB: mini-B USB connector IO signal: 6 pin connector (HR10A-7R-6PB or equivalent)	USB: mini-B USB connector IO signal: 6 pin connector (HR10A-7R-6PB or equivalent)
RoHS	RoHS Compliant	RoHS Compliant	RoHS Compliant

ORDERING INFORMATION

USBCAM133	Digital Microscope Camera
USBCAM152	Digital Microscope Camera
USBCAM202	Digital Microscope Camera
504570	Replacement USB Cable, 3 m (10 ft.)

USBCAM33/USBCAM50

Features

- Automatic and manual controls
- C/CS mount
- Software included

Benefits

- Connect via USB

Applications

- Image capturing from a microscope

USBCAM33

Record images directly to your computer. These digital microscope cameras offer flexibility, with a range of configurations for image capture, a choice of mount option (C or CS) and file output alternatives. Since both cameras connect via the USB port, installing the image capture software is simple. Either camera can be used on WPI's stereo microscopes **PZMTIV**, **PZMTIII**, compound microscopes **W30ST** and **GPL-T** and also the **PSMT5** Surgical Microscope. Choose from the one third-inch CCD with 1024×768 resolution and 30 frames per second (**USBCAM33**) or one half-inch CCD with 1280×960 resolution and 15 frames per second (**USBCAM50**).

These cameras include **IC Imaging Control** software that has:

- Real-time video preview
- Text and graphics can be drawn on a live video stream
- Scroll and Zoom
- Acquisition of single frames
- Capture pause, for intermittent image capture
- Timestamps

SPECIFICATIONS

	USBCAM33	USBCAM50
IMAGE SENSOR	1/3" Sony CCD, progressive scan	1/2" Sony CCD, progressive scan
MAX RESOLUTION	1024 x 768	1280 x 960
SIZE	4.65 µm x 4.65 µm, 6mm diameter	4.65 µm x 4.65 µm, 8mm diameter
SPEED (PC DEPENDENT)	30 fps, 15 fps, 7.5 fps or 3.75 fps	15 fps, 7.5 fps or 3.75 fps
SENSITIVITY	0.5 lux @ 1/15 s	0.5 lux @ 1/7.5 s
EXPOSURE, SHUTTER CONTROL, WHITE BALANCE	Automatic/Manual	Automatic/Manual
INTERFACE	USB 2.0 cable	USB 2.0 cable
SYSTEM REQUIREMENT	Windows Vista (32 & 64 bit), Windows 7 (32 & 64 bit), Windows 8 (32 & 64 bit) or Windows 10 (32 & 64 bit)	Windows Vista (32 & 64 bit), Windows 7 (32 & 64 bit), Windows 8 (32 & 64 bit) or Windows 10 (32 & 64 bit)
SOFTWARE	IC Imaging Control Software	IC Imaging Control Software
LENS MOUNT	C/CS-Mount	C/CS-Mount
CAMERA BODY	50.6 x 50.6 x 50 mm	50.6 x 50.6 x 50 mm
WEIGHT	265 g (9.5 oz.)	265 g (9.5 oz.)

ORDERING INFORMATION

USBCAM33	Digital Microscope Camera, 1/3-in. CCD
USBCAM50	Digital Microscope Camera, 1/2-in. CCD
503536	Cable, USB Extension (male-female)

Color CCD Video Camera for Microscopy

Watch live video images

COLCAM-HD1080P

Features

- 16:9 Aspect Ratio, 1:1, no scaling
- DVI signal output via HDMI cable
- Improved design of COLCAM-HD with better low light sensitivity
- Low cost alternative to existing HD and 3 CCD cameras, with outstanding image quality

COLCAM-HD1080P

Benefits

- Directly connect to HDTV, no PC required and no software to load

Applications

- Microscopy video output to HDTV

The **COLCAM-HD1080P** is a CMOS-based camera that outputs a true HD 1080P or 720P image at 60fps in the 16x9 format, with the capability to program individual DSP profiles accessed via remote hand held controller.

If still image or HDTV recording is required, contact WPI.

COLCAM-HD1080P SPECIFICATIONS

IMAGER	1/2.33" 14 MP CMOS Progressive
HD ACTIVE PICTURE ELEMENT	1920 (H) x 1080 (V)
CHIP SIZE	7.8 mm diagonal
MINIMUM SCENE ILLUMINATION	650 mV/Lux-sec
SYNC SYSTEM	Internal
VIDEO OUTPUT	DVI 1.0 conformity 1080P
	RGB, 1920 H x 1080 V 60/50/30 Hz
GAIN	AGC *
SHUTTER SPEED	Auto *
GAIN	AGC or Fixed gain *
GAMMA	presets or manual gamma *
WHITE BALANCE	Auto/Manual/Push-to-set *
POWER	12V power jack; 5.5x2.1 mm
DIMENSIONS	40 (W) x 45 (H) x 41.1 (D) mm
OPTICAL FILTER	IR cut filter included
LENS MOUNT	C/CS mount
VIDEO OUTPUT	HDMI connector
WEIGHT	88 g
ROHS	RoHS compliant

** Selectable via the UART communication*

ORDERING INFORMATION

COLCAM-HD1080P	Color Video Camera, 1920 x 1080 HD resolution *Includes 3m DV Cable, Power Supply, C/CS Mount*
504136	3 meter HDMI Cable

C-Mount Eyepiece Adapters

For 1/3-inch (6 mm diagonal) and 1/2-inch (8 mm diagonal) video cameras and eyepiece camera conversion, this lens and its accessories make it possible to connect a typical video or C-mount camera to almost any microscope on the market. The lens fits right into the ocular socket of standard 23.2mm microscopes and the 30 mm adapter allows for use on the typical stereo zoom microscope. If you already have a trinocular microscope you can add the included C-Adapter to the top of an existing 1X C-mount (no lens) adapter.

ORDERING INFORMATION

503097	C-Mount to Eyepiece Adapter Kit, 0.45X for 1/3-in. and 1/2-in. Video Cameras, 30 mm Stereo Adapter, 1X C-Mount Adapter

SLR Digital Camera-to-Microscope Eyepiece Adapter

This adapter connects T-mount SLR digital cameras to almost any microscope on the market. The adapter is built to 23.2 mm ocular tubes that are found on most high magnification (upright, inverted, standard) microscopes. The 30 mm adapter allows mounting on most stereo zoom microscopes that use 30 mm oculars. If you already have a trincocular microscope, you can add this adapter to the top of an existing 1X C-mount adapter.

The 2X magnification of this microscope adapter yields an approximate 65% field of view from the visual field as measured on a Canon 80D Digital camera. (CCD Sensor size = 22.7 x 15.1 mm). 35 mm film reference size is 24 x 36mm.

Please contact your camera dealer for a suitable T-mount to bayonet adapter for your camera.

ORDERING INFORMATION

503099	C-Mount to Eyepiece Adapter Kit, 2.0x for SLR digital Cameras *Includes 30 mm Stereo adapter, 1X C-mount adapter*

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High Intensity Fiber Optic Illumination Source

Uninterrupted, directed light for microscopes and other applications

Features

- Reliable, uninterrupted high-intensity light
- Use with microscopes
- Intensity controlled by rotary knob
- Use with ring light, or single/bifurcated guides, sold separately

Benefits

- Contains full spectrum of visible light

Applications

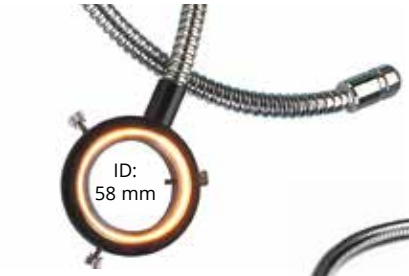
- General laboratory use
- Microscopy illumination

The **Z-LITE** Fiber Optic Illuminator provides reliable, uninterrupted high-intensity light for microscopes. **Z-LITE** allows a continuous range of subdued or concentrated lighting controlled by a rotary dimmer on the front panel. **Z-LITE** may be used with a ring light and single or bifurcated flexible fiber bundles, enabling the light beam to be placed exactly where it is needed. Forced air cooling prolongs the lamp life. Lamp color temperature is 3350°K. An interlock switch automatically cuts off power when the front panel is opened to replace the bulb.

Shown with Bifurcated Light Guide **500186**

Z-LITE

Light guides available separately



Ring Light ***R-8-8-WPI01*** *can be used with PZM Stereo Microscope for shadow-free illumination.*

18-in. (46 cm) flexible cable

504931

This single pipe light guide with focusing lens has a fiber diameter of 6mm. It is 18" (460 mm) long with a 5/8" standard adapter for attaching to a fiber optic illuminator like the Z-Lite series.

Z-LITE SPECIFICATIONS	
LAMP	150 W quartz halogen (EKE lamp)
SIZE	30.5×25×25 cm (12×10×10 in.)
POWER	115 VAC, 50/60 Hz, 3 A
WEIGHT	5.9 kg (13 lb.)

ORDERING INFORMATION	
Z-LITE-186	Z-Lite & Bifurcated Light Guide (115 V, 60 Hz, beige case)
Z-LITE-Z186	Z-Lite & Bifurcated Light Guide (230 V, 50 Hz, black case) *
Z-LITE	Z-Lite Fiber Optic Illuminator (115 V, 60 Hz, beige case)
Z-LITE-Z	Z-Lite Fiber Optic Illuminator (230 V, 50 Hz, black case) *

OPTIONAL ACCESSORIES/REPLACEMENT PARTS

500186	Bifurcated Light Guide (with lenses)
504930	Flexible Light Guide with Focusing Lens, 18" (46cm)
504931	Flexible Light Guide with Focusing Lens, 24" (61cm)
R-8-8-WPI01	Ring Light Guide for PZM and PZMIII Series *Ring Light Guide requires adapter #13338 for use with PZM, PZMII and PZMIII, included with each PZMIII and PZMIV microscope system.*
13338	Ring Light Adapter (48 mm ∅) for PZM, PZMII, PZMIII
502015	Ring Light Adapter for PZMIV
EJA	Replacement Halogen Lamp, 150W, 3350°K, 40-hour
EKE	Replacement Lamp, 150W, 3250°K, 200-hour

***** *Not available in EU countries*

LED Ring Light

For PZMIII & PZMIV stereo microscopes

504134

Features

- "White" light illumination — 72 LED bulbs
- Maximum opening 61 mm
- Ring light is divided into four areas and each area is turned on and off separately
- Brightness adjustable
- ESD safe
- Power supply AC 90-264V, 50/60 Hz, US plug only

Benefits

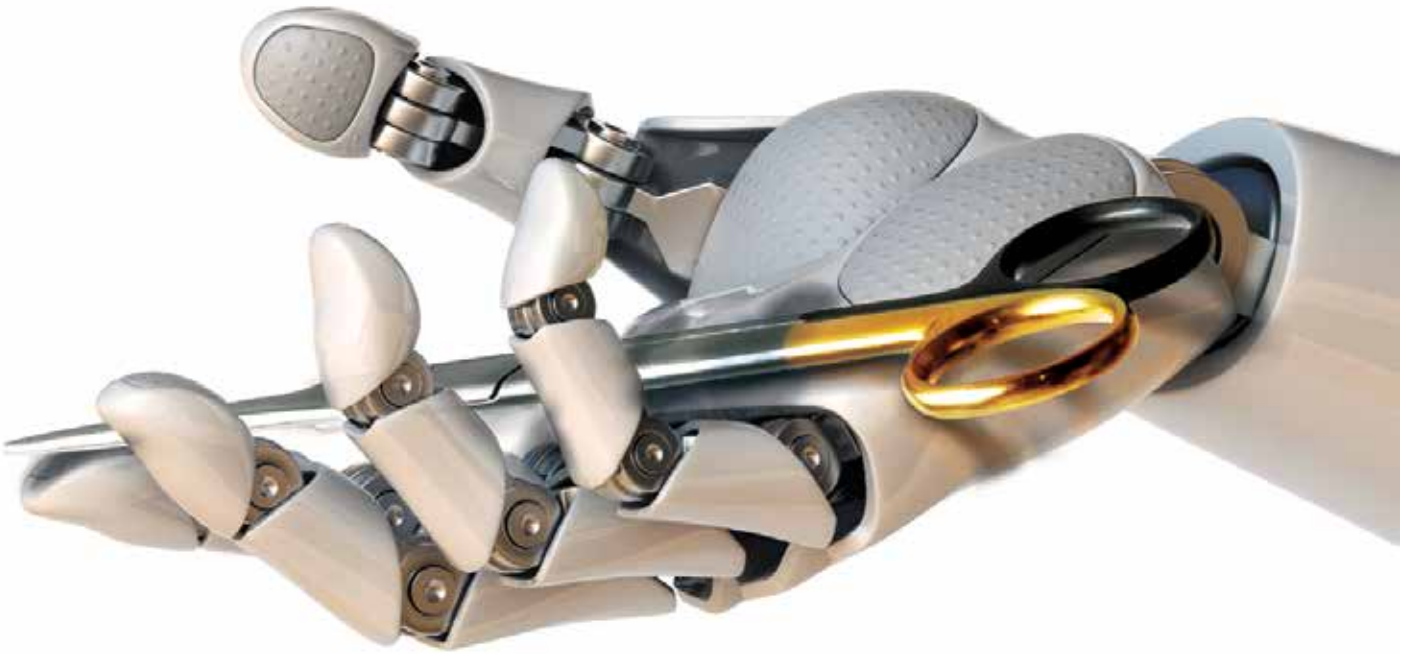
- Direct top illumination plus four zones for shadows
- Low cost
- Less bulky than Halogen
- Cold light with no heat

Applications

- Stereo microscope use

ORDERING INFORMATION	
504134	LED Ringlight

Microdissection Instruments



Quality you can count on

WPI surgical instruments are manufactured with the highest quality materials and craftsmanship to provide you with reliable instruments at a cost-effective price. We offer a wide variety of instruments, including surgical kits. Whether you are looking for a pair of quality European surgical instruments, marine grade stainless steel forceps or precision scissors, the quality of our surgical instruments is backed by our 100% satisfaction guarantee.

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Swiss Tweezers

Our Swiss surgical tweezers are manufactured from fine Swiss steel. We offer a variety of tweezers and forceps.

WPI SWISS TWEEZERS

- Used in microsurgical procedures to grasp fine tissue
- Sharp tips may puncture tissue
- 10.5 cm (4.1 in.) Long
- Extra fine 90° angled tips

504508	Stainless Steel
504509	Acid-Resistant/Anti-magnetic

Tips: 0.06 × 0.02 mm

504508

504508
504509

WPI SWISS TWEEZERS

BEST SELLER

- 11 cm (4.3 in.) Long
- Handcrafted to perfection in Switzerland
- For use in general laboratory and medical applications, microscopy, precision manufacturing, electronic industry, watch making
- 0.1 x 0.06 mm Straight tips

504506	Stainless Steel
504507	Acid-Resistant/Anti-magnetic

504506

504506
504507

WPI SWISS TWEEZERS

- 11 cm (4.3 in.) Long
- Diamond Like Carbon coated tips to improve hardness, toughness and wear characteristics

504524	Ni-Cr-Mo Superalloy
504516	Ni-Cr-Mo Superalloy, Diamond Coated Tips
504515	Anti-magnetic, Diamond Coated Tips

504516

504516

504515

504524

WPI SWISS TWEEZERS

- 11.5 cm (4.5 in.) Long
- Stainless Steel

504505	Acid-Resistant/Anti-magnetic, Curved Tips

504505

504505

WPI SWISS CUTTING TWEEZERS

- 11.5 cm (4.5 in.) Long
- Angled blades
- Stainless Steel

504744	Stainless Steel
504745	High Precision, Tungsten Carbide Tips

504745

504744

504745

Dumont Forceps

High quality Dumont tweezers are available in a variety of metals.
Dumostar – Anti-magnetic. Dumostar is more elastic and more corrosion-resistant than the best stainless steel.
Dumoxel – Extremely flexible. Dumoxel is 95% anti-magnetic and stain resistant.
Stainless Steel – This is the standard metal for most surgical instruments.

MINI DUMONT #M5S

- 8.2 cm (3.25 in.) Long
- 0.09 x 0.05 mm Tips
- Stainless Steel

501764	Mini Dumont #M5S

501764

DUMONT #3C

- 11 cm (4.3 in.) Long
- 0.08 x 0.04 mm Tips
- Non-magnetic
- Non-corrosive
- Dumostar Steel

500064	Dumont #3C

500064

DUMONT #4

- 11 cm (4.3 in.) Long
- 0.06 x 0.02 mm Tips
- Non-magnetic
- Non-corrosive
- Dumostar Steel

500339	Dumont #4

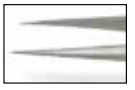
500339

DUMONT #4

- 11 cm (4.3 in.) Long
- Stainless Steel

500340	0.13 x 0.08 mm Tips
500231	0.02 x 0.06 mm Tips

500340



500340

500231

DUMONT #5

- 11 cm (4.3 in.) Long
- Non-magnetic
- Non-corrosive
- Dumostar Steel

500085	0.025 x 0.015 mm Tips
500233	0.1 x 0.06 mm Tips

500085

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Dressing Forceps

Dressing forceps are used when dressing wounds. They hold gauze and other dressings. They may also be used during wound debridement to remove infected or necrotic tissue or debris from the wound. They may also be used for suturing.

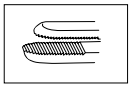
ADSON FORCEPS

- Used to grasp tissue during stapling of the skin
- 12 cm (4.75 in.) Long
- Serrated
- Stainless Steel

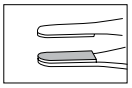
14226	1.5 mm Tips
14226-G	1.5 mm Tips, **German**
500222	Tungsten Carbide Jaws
500222-G	Tungsten Carbide Jaws, **German**

Standard and German versions may differ slightly in appearance.

500222



14226



500222

IRIS FORCEPS

- Used for grasping tissue and dressing applications in microscopy
- 10 cm (4 in.) Long
- 0.8 mm Tips
- 1x2 Teeth
- Stainless Steel

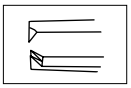
15916	Straight
15916-G	Straight, **German**
15917	Curved
15917-G	Curved, **German**

Standard and German versions may differ slightly in appearance.

15916

15916

15917



Hemostatic Forceps

Ring forceps (also called hemostatic forceps) are hinged and look like ring scissors. Frequently, hemostatic forceps have a locking mechanism, called a ratchet, which is used for clamping. The jaws of the locking forceps gradually come together as each increment of the ratchet is employed.

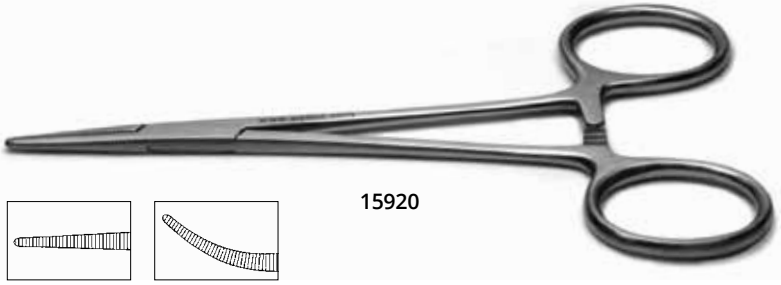
- Used to compress blood vessels or other tubular structures to obstruct the flow of blood or fluids
- Used for small, delicate vessels
- Full serrated jaws
- Used in ophthalmology, biopsy, skin grafting or general surgery and lab procedures

HALSTED MOSQUITO HEMOSTATIC FORCEPS

- Serrated
- Stainless Steel

15920	12.5 cm (5 in.), Straight
15920-G	12.5 cm (5 in.), Straight, **German**
15921	12.5 cm (5 in.), Curved
15921-G	12.5 cm (5 in.), Curved, **German**
501705	9 cm (3.5 in.), Straight
501705-G	9 cm (3.5 in.), Straight, **German**
501291	9 cm (3.5 in.), Curved
501291-G	9 cm (3.5 in.), Curved, **German**

Standard and German versions may differ slightly in appearance.



15920

Titanium Forceps & Needle Holders

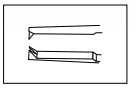
100% anti-magnetic, corrosion-resistant, lightweight and strong, titanium alloy is ideal for biological and medical applications. Titanium has the tensile strength of carbon steel and is completely resistant to corrosion from nitric acid, chloride, salt water, and industrial and organic chemicals. Titanium is more flexible and 40% lighter than Inox. When heated or cooled, the dimensions of titanium alloy change less than half of what stainless steel alloys will, making titanium surgical instruments much more durable. Titanium is stain-free and temperature resistant up to 430°C. Titanium tools are the premium choice for corrosive environments or MRI applications.

- 100% non-corrosive (great for sea water procedures)
- 40% lighter than stainless steel (reduces hand fatigue)
- 100% non-magnetic (MRI compatible)
- Anodized, non-glare blue finish

FORCEPS

- 8.5 cm (3.3 in.) Long
- 12 mm Tips
- 4.5 mm Tying platform
- Straight
- **Titanium**

WP5000	Forceps

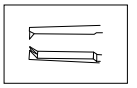


WP5000

FORCEPS WITH TYING PLATFORM

- 8.5 cm (3.3 in.) Long
- 12 mm Tips
- 5 mm Tying platform
- Straight with 0.12 mm teeth (1x2)
- **Titanium**

WP2000	Forceps with Tying Platform



WP2000

TROUTMAN NEEDLE HOLDER

- 11.5 cm (4.5 in.) Long
- Curved
- 10 mm Jaws
- Blunt
- **Titanium**

WP3620	Troutman Needle Holder

WP3620

NEEDLE HOLDER, SERRATED JAWS

- 16 cm (6.3 in.) Long
- Straight
- Serrated Jaws
- **Titanium**

503391	Needle Holder

503391

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Spring Scissors

Vannas scissors – small, sharp blades designed for researchers working in tight spaces.

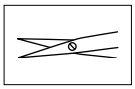
- May be used with either left or right hand
- Designed for neurosurgical, vascular and ophthalmic procedures
- Cuts by shearing, reduces crushing of tissue
- Fine tips are ideal for use in very restricted spaces
- Curved tips are useful to avoid cutting of underlying tissue
- Heavier blades are helpful when a thick tissue or vessel is to be cut
- Length of the scissor tips can help with the depth of the incision:
  Shorter tips for near-to-surface incision
  Longer tips for deep incision

VANNAS SCISSORS

BEST SELLER ★★★★★

- Small, long blades for uses in ophthalmology, neurosurgery, microsurgery
- Super fine
- 8 cm Long
- 3 mm Blades
- 0.015 mm Tips
- Stainless Steel

501778	Straight
501839	Curved



501778

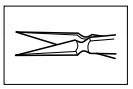
VANNAS SCISSORS

BEST SELLER ★★★★★

- Diamond shaped tips
- 9 cm (3.5 in.) Long
- 5 mm Blades
- 0.1 mm Tips
- Stainless Steel

14003	Straight
14003-G	Straight, **German**

Standard and German versions may differ slightly in appearance.



14003-G

NOYES SCISSORS

- 12 cm Long
- 15 mm Tips
- Originally designed to remove the iris (iridectomy)
- Fine for multi-purpose use
- Best for trimming tissue from nerves

500228	Sharp/Sharp Tips, Straight
500228-G	Sharp/Sharp Tips, Straight, **German**
501236	Sharp/Sharp Tips, Curved
501236-G	Sharp/Sharp Tips, Curved, **German**
503305	Sharp/Blunt Tips, Straight
503306	Blunt/Blunt Tips, Straight
501237	14 cm, 20 mm Tips, Straight
501238	14 cm, 20 mm Tips, Curved

Standard and German versions may differ slightly in appearance.

500228

500228

501236

503305

503306

501237

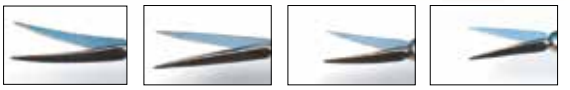
501238

KATENA-VANNAS SCISSORS

- 11 cm (4.3 in.) Long
- Stainless Steel

504024	7 mm Thin Blades, Straight
504025	7 mm Thin Blades, Curved
504026	10 mm Thin Blades, Straight
504027	10 mm Thin Blades, Curved

504024



504027 504026 504025 504024

MICRO SCISSORS – DIAMOND LIKE CARBON COATED BLADES

Diamond like carbon coated blades increase the longevity of the cutting edge and improve the quality of the cut. Used to reduce wear on razor blades and industrial metal cutting tools, this coating is now being used in biomedical applications. Some studies have shown that even after double the normal usage of the cutting implement, no blade wear was detected.

- Hardness of coated surface resists wear and increases life of cutting edge
- Anti-reflective coating resists glare and assists in better view of surgical field
- Coating is corrosion resistant
- Reduced friction at cutting site decreases necrosis of surrounding tissue and bone
- 12 cm (4.75 in.)
- Sharp coated tips
- 8 mm Blades
- Stainless Steel,

503365	Straight
503364	Curved

503365

503365 503364

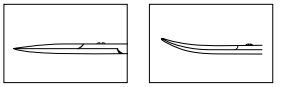
SPRING SCISSORS

- 12 cm (4.75 in.) Long
- 12 mm Extra fine, long blades
- Stainless Steel

14125	Straight
14125-G	Straight, **German**
14126	Curved

Standard and German versions may differ slightly in appearance.

14125



14125 14126

Titanium Scissors

100% anti-magnetic, corrosion-resistant, lightweight and strong, titanium alloy is ideal for biological and medical applications. Titanium has the tensile strength of carbon steel and is completely resistant to corrosion from nitric acid, chloride, salt water, and industrial and organic chemicals. Titanium is more flexible and 40% lighter than Inox. This reduces hand fatigue during long procedures. When heated or cooled, the dimensions of titanium alloy change less than half of what stainless steel alloys will, making titanium surgical instruments much more durable. Titanium is stain-free and temperature resistant up to 430°C. Titanium instruments are the premium choice for corrosive environments or MRI applications.

- 100% non-corrosive (great for seawater procedures)
- 40% lighter than stainless steel (reduces hand fatigue)
- 100% non-magnetic (MRI compatible)
- Anodized, non-glare blue finish

VANNAS SCISSORS

- 8.2 cm (3.2 in.) Long
- Sharp 9.5 mm tips
- **Titanium**

WP5050	Straight
WP5070	Angled Up

WP5070

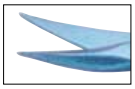
WP5050

WP5070

IRIS SCISSORS

- 9 cm (3.5 in.) Long
- Curved
- Sharp 11 mm tips
- **Titanium**

WP4410	Iris Scissors

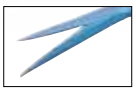


WP4410

VANNAS CAPSULOTOMY SCISSORS

- 9.5 cm (3.7 in.) Long
- Angled
- Sharp
- 10.5 mm Tips
- **Titanium**

WP5070L	Vannas Capsulotomy Scissors

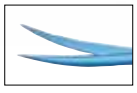


WP5070L

VANNAS CAPSULOTOMY SCISSORS

- 9.5 cm (3.7 in.) Long
- Curved
- Sharp
- 12.5 mm Tips
- **Titanium**

WP5060	Vannas Capsulotomy Scissors



WP5060

Ring Scissors

Our standard scissors all have ring handles. You can typically recognize the construction style of scissors based on the following color code:

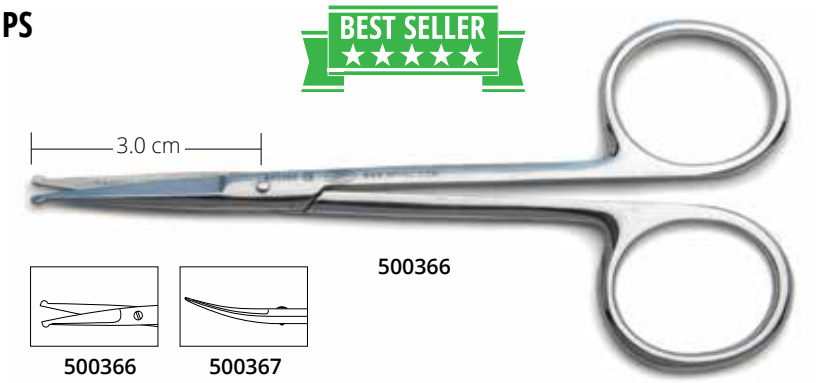
- Black handled rings indicate SuperCut scissors (with one serrated blade).
- Gold handles indicate that the scissors have tungsten carbide inserts.
- One gold handle and one black handle indicates that the scissors have serrations in one blade (black handle) and tungsten carbide on the other (gold handle).
- Blue instruments are typically titanium.

IRIS DISSECTING SCISSORS WITH PROBE TIPS

- Multi-purpose
- Ideal for detailed dissection of delicate tissues and can be used in suture removal
- 10 cm (4 in.) Long
- Blunt probe tips
- Stainless Steel

500366	Straight
500366-G	Straight, **German**
500367	Curved
500367-G	Curved, **German**

Standard and German versions may differ slightly in appearance.

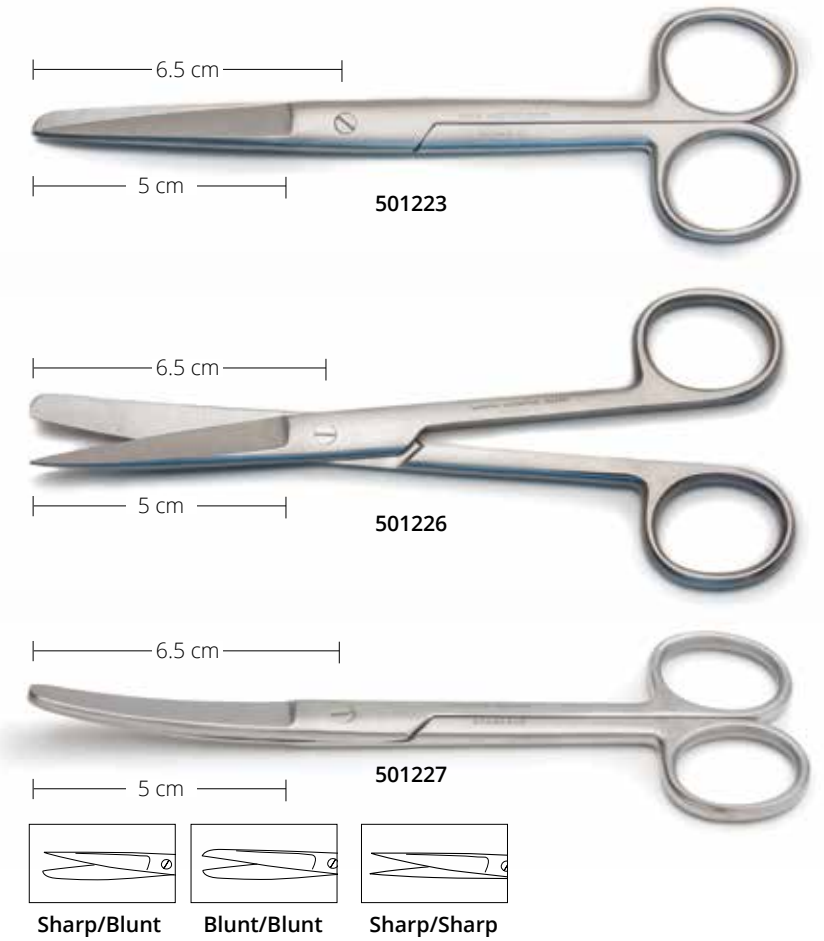


OPERATING SCISSORS

- Recommended for cutting and dissecting tissue
- Also used for cutting surgical drapes
- 16 cm (6.25 in.) Long
- Stainless Steel

501223	Sharp/Blunt, Straight
501223-G	Sharp/Blunt, Straight, **German**
501224	Blunt/Blunt, Straight
501224-G	Blunt/Blunt, Straight, **German**
501225	Sharp/Sharp, Straight
501225-G	Sharp/Sharp, Straight, **German**
501226	Sharp/Blunt, Curved
501226-G	Sharp/Blunt, Curved, **German**
501227	Blunt/Blunt, Curved
501227-G	Blunt/Blunt, Curved, **German**
501228	Sharp/Sharp, Curved
501228-G	Sharp/Sharp, Curved, **German**

Standard and German versions may differ slightly in appearance.



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SuperCut Scissors

Our black handled surgical scissors designate our SuperCut scissors. These scissors have one on razor sharp blade and one micro-serrate blade. This construction offers a couple of advantages for surgeons.

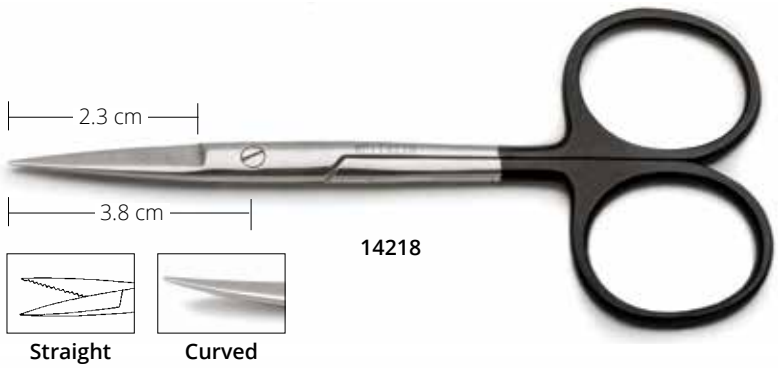
- Sharp edge gives a clean cut with minimal tissue damage
- Serrated edge actually holds the tissue to prevent it from slipping while you are making an incision

IRIS SUPERCUT SCISSORS

- One edge micro serrated, one edge honed to the sharpness of a knife edge—prevents tissue slippage
- Stainless Steel

14218	10 cm (4 in.), Straight
14218-G	10 cm (4 in.), Straight, **German**
14219	10 cm (4 in.), Curved
14219-G	10 cm (4 in.), Curved, **German**
503259	11.5 cm (4.5 in.), Straight
503260	11.5 cm (4.5 in.), Curved
14225	12.5 cm (5 in.), Straight
14225-G	12.5 cm (5 in.), Straight, **German**
14224	12.5 cm (5 in.), Curved
14224-G	12.5 cm (5 in.), Curved, **German**

Standard and German versions may differ slightly in appearance.



Tungsten Carbide SuperCut Scissors

Our black handled surgical scissors designate our SuperCut scissors. These scissors have one on razor sharp blade and one micro-serrate blade. Surgical scissors with one black handle and one gold handle are SuperCut scissors with tungsten carbide inserts. Tungsten carbide is harder than steel, which means the instruments last longer. The SuperCut edges offer a couple of advantages for surgeons.

- Sharp edge gives a clean cut with minimal tissue damage
- Serrated edge actually holds the tissue to prevent it from slipping while you are making an incision

IRIS SUPERCUT SCISSORS, TUNGSTEN CARBIDE

- Gold blade has tungsten carbide insert — black blade is serrated
- Produces clean cut without tearing the tissue
- Used for cutting delicate or heavy tissue
- 11 cm (4.3 in.) Long
- Sharp tips
- **Tungsten Carbide** blades
- Stainless Steel

501263	Straight
501263-G	Straight, **German**
501264	Curved
501264-G	Curved, **German**

Standard and German versions may differ slightly in appearance.

Ring-Handle Needle Holders

OLSEN-HEGAR NEEDLE HOLDER WITH SUTURE SCISSORS

- Straight
- Serrated
- **Tungsten Carbide** jaws
- Stainless Steel

501312	12 cm (4.75 in.)
500227	14 cm (5.5 in.)
500227-G	14 cm (5.5 in.), **German**
501725	16.5 cm (6.5 in.)
501725-G	16.5 cm (6.5 in.), **German**

Standard and German versions may differ slightly in appearance.

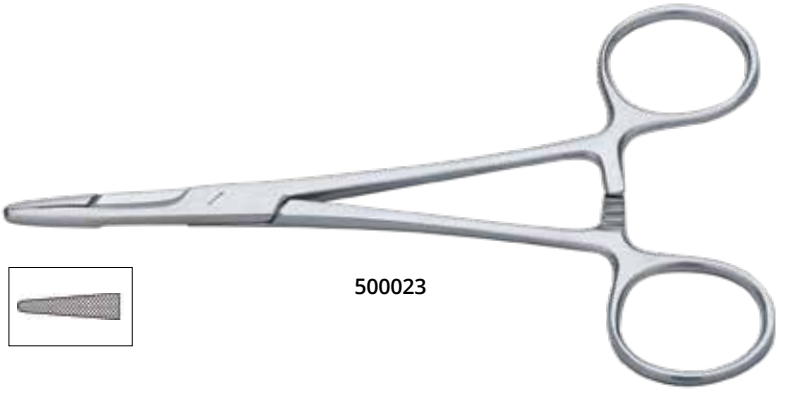
500227-G

OLSEN-HEGAR NEEDLE HOLDER

- 14 cm (5.5 in.) Long
- Straight
- Serrated jaws with suture scissors
- Stainless Steel

500023	Olsen-Hegar Needle Holder
500023-G	Olsen-Hegar Needle Holder, **German**

Standard and German versions may differ slightly in appearance.



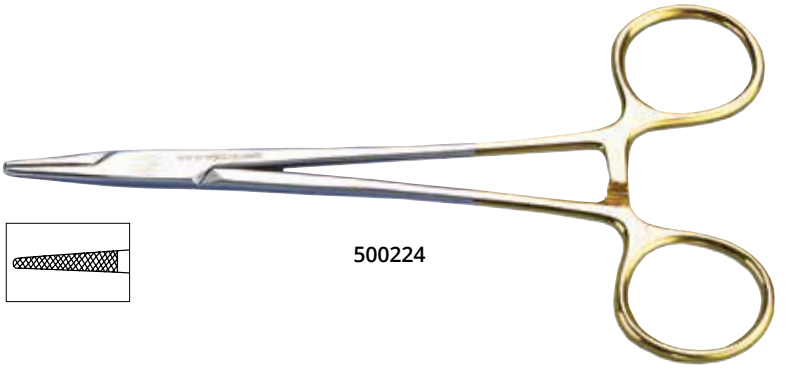
500023

CRILE-WOOD NEEDLE HOLDER

- Straight
- Serrated
- **Tungsten Carbide** jaws
- Stainless Steel

500224	14.5 cm (5.75 in.)
500224-G	14.5 cm (5.75 in.), **German**
503741	15 cm (5.9 in.), Left-Handed

Standard and German versions may differ slightly in appearance.



500224

MAYO-HEGAR NEEDLE HOLDER

- 15 cm (6 in.) Long
- Straight
- Stainless Steel

V503382	Mayo-Hegar Needle Holder

V503382

Black Instruments

JAFFE FORCEPS

- 10 cm (3.9 in.)
- Curved 0.52 mm Tip
- Stainless Steel with black coating

WPB505210	Jaffe Forceps, Black

WPB505210

IRIS SUPERCUT SCISSORS, TITANIUM POWDER COATED

- More resistance to rust and body fluids
- Anti slippage serrated blade
- Used in microsurgery
- 11 cm (4.3 in.) Long
- Anti-reflective
- One serrated blade
- Stainless Steel

504487	Straight
504500	Curved

504487

BLACK EPOXY COATED TWEEZERS WITH PATENTED EZ LEVER

- 11 cm (4.25 in.) Long
- Strong blades
- Stainless Steel with black coating

WPB315AB	4.5 mm from tip to bend
WPB315AS	6.5 mm from tip to bend

WPB315AB

WPB315AB

WPB315AS

Skin Stapler

The **WPSS01** skin stapler is an affordable, reliable solution for ideal veterinary wound closures.

- Made in the U.S.A.
- Designed specifically for veterinarians
- Clear handle makes it easy to spot contaminants
- Uses reloadable cartridges containing 35 stainless steel staples
- Autoclavable handle
- Improves patient safety by considerably reducing surgery and anesthesia time
- Angled tip design helps you maintain a clear view of the incision line at all times
- Lightweight but durable with a comfortable ergonomic grip design
- Simple to use — simple to reload
- Designed to reduce problems with rotated staples

WPSS01	Skin Stapler (one staple cartridge included)
WPSS02	Staple Cartridge (35 staples)

WPSS01

Stainless steel skin staples are 3.6 mm high by 6.9 mm wide after closure.

Reusable Biopsy Punches with Plunger

Features

- Individual Sterile Packs, Limited Reuse
- Tip material: 304 stainless steel
- Sterilization: ETO (ethyline oxide)

Applications

- **Electrophysiology**—Patch recording (various regions of the specimen can be punched prior to separation).
- **Biomedical Pharmacology**—Collect samples from the brain neurotransmitters for analyzing the metabolic changes in response to active substances, or skin samples to analyze the response of anti aging medications.
- **Anatomy**—Sample brain regions for analysis of neurotransmitter concentrations of mRNA levels.
- **Forensic Sampling**—WPI punches can easily cut, retrieve, store and eject material like skin, gel, films, paint chips and paper. (Better samples are collected using one of our self-healing cutting mats **504620** or **504621.**)
- **Microfluidics**—Punch flow inlets in microfluidics chambers molded of PDMS (polydimethylsiloxane).

Surgeons and laboratory technicians use biopsy punches and curettes to remove tissue samples. These punches are for use in research laboratories.

504529

504638	ID 0.35 mm, OD 0.63 mm, Wall 0.15 mm
504528	ID 0.50 mm, OD 0.80 mm, Wall 0.15 mm
504529	ID 0.75 mm, OD 1.07 mm, Wall 0.15 mm
504646	ID 1.0 mm, OD 1.26 mm, Wall 0.15 mm
504530	ID 1.2 mm, OD 1.5 mm, Wall 0.15 mm
504647	ID 1.5 mm, OD 1.9 mm, Wall 0.20 mm
504531	ID 2.0 mm, OD 2.4 mm, Wall 0.20 mm
504648	ID 2.5 mm, OD 2.9 mm, Wall 0.20 mm

504649	ID 3.0 mm, OD 3.4 mm, Wall 0.20 mm
504650	ID 3.5 mm, OD 3.9 mm, Wall 0.20 mm
504651	ID 4.0 mm, OD 4.4 mm, Wall 0.20 mm
504652	ID 5.0 mm, OD 5.5 mm, Wall 0.25 mm
504653	ID 6.0 mm, OD 6.5 mm, Wall 0.25 mm
504654	ID 7.0 mm, OD 7.5 mm, Wall 0.25 mm
504655	ID 8.0 mm, OD 8.5 mm, Wall 0.25 mm

Reusable Rapid-Punch Biopsy Kit

The Rapid-Punch consists of a razor sharp cutting tip designed to cut, retrieve and store cored samples from source materials such as tissue, gels, paper, cloth, leaves, paint chips, films or other thin substrates. The Rapid-Punch is recommended as the special DNA sampling tool. It is ideal for forensic and most laboratory sampling purposes. Designed for heavy, numerous and precise sampling operations. It is durable, lasting up to 2000 punches.

504639	Reusable Rapid Punch Kit with 0.5 mm Tip
WP1010	Reusable Rapid Punch Kit with 1.0 mm Tip
WP1212	Reusable Rapid Punch Kit with 1.2 mm Tip
WP2020F	Reusable Rapid Punch Kit with 2.0 mm Tip
WP3030	Reusable Rapid Punch Kit with 3.0 mm Tip
504640	Replacement Tip for Rapid Punch size 0.5 mm
504641	Replacement Tip for Rapid Punch size 1.0 mm
504642	Replacement Tip for Rapid Punch size 1.2 mm
504643	Replacement Tip for Rapid Punch size 2.0 mm
504644	Replacement Tip for Rapid Punch size 3.0 mm
504735	Replacement Plunger for Rapid Punch, 0.5 mm
504736	Replacement Plunger for Rapid Punch, 1.0 mm
504737	Replacement Plunger for Rapid Punch, 1.2 mm
504738	Replacement Plunger for Rapid Punch, 2.0 mm
504739	Replacement Plunger for Rapid Punch, 3.0 mm

WP1010

Rapid-Punch with 0.5 mm tip

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Clips and Clamps

Save time in surgery using our reflex clips. They are a fast, effective suture alternative for wound closure. Choose the 9 mm clips for use in rats or 7 mm clips for mice and young rats. The spring-loaded clip applier is easy to use. You get minimal tissue trauma and maximum holding power. Use the clip remover to extract the clips when the wound heals. The clips, applier and remover are all autoclavable.

Vessel clips are used to clamp arteries or veins during surgical procedures. These vascular clamps come in a variety of shapes and sizes.

REFLEX CLIP APPLIER

- 11 cm (4.3 in.) Long

500343	For 7 mm Clips
500345	For 9 mm Clips

500343

REFLEX CLIP

- 100 per box
- Non-sterile
- Stainless Steel

500344	7 mm
500346	9 mm

500344

VESSEL CLIPS

- 5 per pack
- Stainless Steel

15911	0.8 x 5 mm Jaws, 10 g Pressure
15913	1 x 6 mm Jaws, 15 g Pressure
14120	1.5 x 5 mm Jaws, 30 g Pressure
14121	1.5 x 8 mm Jaws, 60 g Pressure

15911 **14120** **15913** **14121**

Disposable Scalpels

- Carbon steel blades
- Non-slip handles
- Used for incisions and underlying tissue
- Packed 10 per box
- Sterile
- Individually wrapped

500348	#10
500349	#11
500350	#12
500351	#15
500352	#20
500353	#21
500354	#22
500355	#23

500348

500351

500355

Rodent Accessory

Features

- Large, stable base
- Hardened blades for long service
- Ambidextrous configuration
- 3 sizes
- Cuts through bone

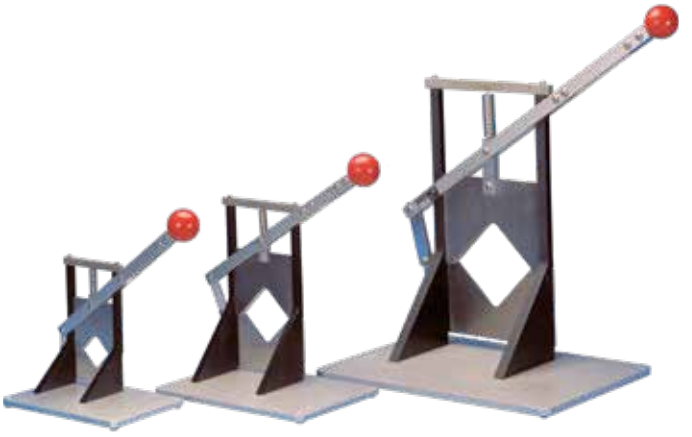
Benefits

- Blades are drawn together by magnetic force to ensure a clean and precise cut through very strong bones and skin
- Spring action, locking device prevents blades from accidentally falling
- Fluoropolymer coated base for easy cleanup

Applications

- Decapitator

DCAP	For Rodents/Other Small Animals, 1.5 x 1.5 in. Opening
DCAP-M	For Large Rodents/Other Medium Animals, 2.5 x 2.5 in. Opening
DCAP-L	For Larger Animals, 4.0 x 4.0 in. Opening



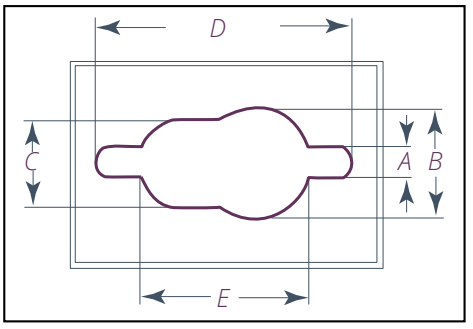
DCAP **DCAP-M** **DCAP-L**

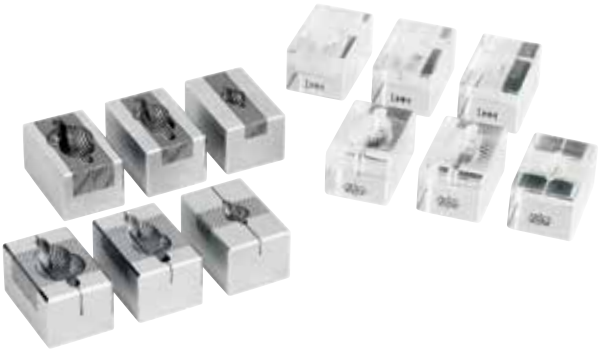
The small animal guillotine is easy to use with extra added safety features. There is a large base for stability, long handle for extra leverage, spring action so the blades can not fall down unexpectedly, hardened stainless blades for endurance, simplified construction for easy maintenance. The fluoropolymer coated surface on the base makes cleaning easy.

The guillotine is considered one of the most humane methods to sacrifice a subject.

Rodent Brain Matrices

WPI offers a large selection of acrylic and stainless steel brain matrices. These matrices are sturdy and can be heated, chilled, autoclaved, scrubbed and stand up to rigorous daily use. Coronal matrices have the additional feature of a mid-line sagittal cut to facilitate splitting of the left and right hemispheres. Sections can be as fine as 1 mm. The olfactory/spinal/notch is cut into each matrix.





SPECIFICATIONS

Order #	Subject	Material	Section	A	B	C	D	E	Cavity Depth	Weight
RBMA-200C	Adult Mouse, 40-75 g	Acrylic	Coronal	3.18	11.1	8.73	19.1	12.2	7.4	0.5 lb.
RBMA-200S	Adult Mouse, 40-75 g	Acrylic	Sagittal	3.18	11.1	8.73	19.1	12.2	7.4	0.5 lb.
RBMA-300C	Rat, 175-300g	Acrylic	Coronal	4.76	15.9	12.7	36.6	23.8	7.61	0.5 lb.
RBMA-300S	Rat, 175-300g	Acrylic	Sagittal	4.76	15.9	12.7	36.6	23.8	7.61	0.5 lb.
RBMA-600C	Rat, 300g-600g	Acrylic	Coronal	4.76	19.8	14.7	36.6	24.7	10.91	0.5 lb.
RBMA-600S	Rat, 300g-600g	Acrylic	Sagittal	4.76	19.8	14.7	36.6	24.7	10.91	0.5 lb.
RBMS-200C	Adult Mouse	Stainless Steel	Coronal	3.18	11.1	8.73	19.1	12.2	7.4	1.0 lb.
RBMS-200S	Adult Mouse	Stainless Steel	Sagittal	3.18	11.1	8.73	19.1	12.2	7.4	1.0 lb.
RBMS-300C	Rat, 175-300g	Stainless Steel	Coronal	4.76	15.9	12.7	36.6	23.8	7.61	1.0 lb.
RBMS-300S	Rat, 175-300g	Stainless Steel	Sagittal	4.76	15.9	12.7	36.6	23.8	7.61	1.0 lb.
RBMS-600C	Rat, 300g-600g	Stainless Steel	Coronal	4.76	19.8	14.7	36.6	24.7	10.91	1.0 lb.
RBMS-600S	Rat, 300g-600g	Stainless Steel	Sagittal	4.76	19.8	14.7	36.6	24.7	10.91	1.0 lb.

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Surgical Kits

PHYSIOLOGY KIT I

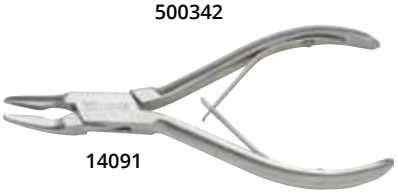
Kit Includes:

- SuperCut Tenotomy Scissors, Curved (14396)
- Dumont Forceps (500342)
- Rongeur, 3 mm jaw (14091)
- Filter Forceps, 11 cm, Straight, Flat Jaw (500456)
- Utility Scissors (501322)
- Probe, 1.0 mm Diameter, Blunt (501313)
- Operating Scissors, Straight, Sharp/Blunt (14192)

KIT-PHYSIO-I Physiology Kit I (7 instruments)


14396


500342


14091


500456

501313


501322

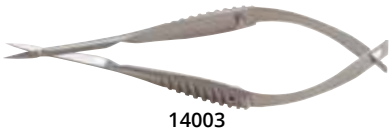

14192

PHYSIOLOGY KIT II

Kit Includes:

- Vannas Scissors (14003)
- Stevenson Retractor (14131)
- SuperCut Iris Scissors, Straight (14218)
- Iris Forceps, Curved, Serrated (15915)
- Rongeur, 1.3 mm Jaw (14292)
- Adson Forceps, 1x2 Teeth (500092)
- Utility Scissors, Straight, Sharp/Blunt (501322)
- Olsen-Hegar Needle Holder (500227)
- Probe, 1.0 mm Diameter, Blunt (501313)
- Dumont Forceps (500342)
- Operating Scissors, Straight, Sharp/Blunt (14192)
- Portfolio (501319)

PHYSIO-II Physiology Kit II (11 instruments plus zipper case)


14003


500092


14131

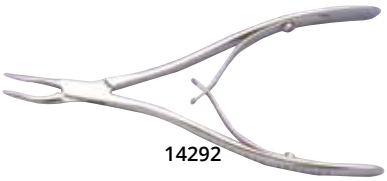

501322


14218


14192

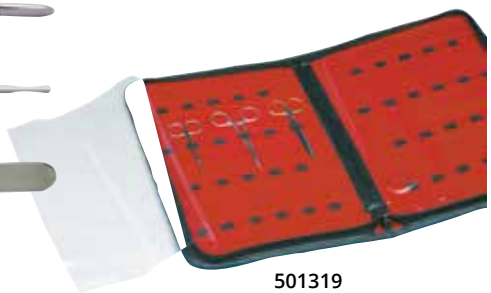

15915


500227


14292

501313


500342


501319

MOUSE DISSECTING KIT

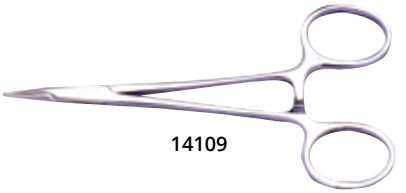
Kit Includes:

- Dumont Forceps (500342)
- Wire Retractor (14130)
- Vannas Scissors (14003)
- Needle Holder (14109)
- Iris Forceps, Curved, Serrated (15915)
- Probe, 1.0 mm Diameter, Blunt (501313)
- Dissecting Scissors, 10 cm, Straight (14393)
- Portfolio (503294)

MOUSEKIT	Mouse Kit (7 instruments plus zipper case)
504741	Mouse Kit for Telemetry Training *(includes **500453**)*

Vessel Cannulation Forceps (500453)

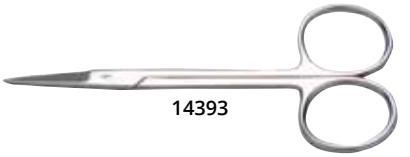
*Included only with Kit **504741***



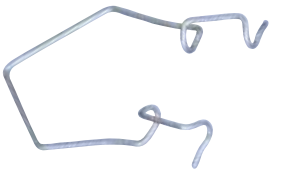
14109

500342

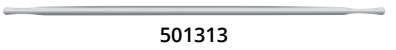
15915



14393



14130



501313

503294

14003

RAT DISSECTING KIT

Kit Includes:

- Dumont Forceps 500342
- Alm Retractor 14240
- Vannas Scissors 14124
- Needle Holder 14110
- Iris Forceps, Curved, Serrated 15915
- Probe, 1.0 mm Diameter, Blunt 501313
- SuperCut Iris Scissors, Straight 14218

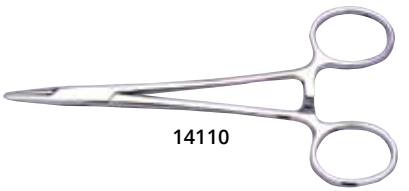
RATKIT	Rat Kit (7 instruments)
504740	Rat Kit for Telemetry Training *(includes **500453**)*

Vessel Cannulation Forceps (500453)

*Included only with Kit **504740***

15915

14240



14110

500342

501313

14218

14124

STORAGE PORTFOLIO

501319	Large Surgical Instrument Storage Portfolio, Holds up to 40 Instruments
503294	Small Surgical Instrument Storage Portfolio, Holds up to 10 Instruments

503294

501319

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OmniDrill35 Micro Drill

Drill, grind or finish bone or teeth

Features

- Excellent tool for grinding, finishing, and drilling bone and other material
- High-torque motor (35,000 rpm) is quiet
- Includes foot switch

Benefits

- Removable nose cone that can be cleaned and sterilized
- Consistant power for the duration of its use
- Variable speeds so you control the amount of heat generated

Applications

- Grinding, finishing, cutting and drilling bone, teeth and other material

This line-powered micro drill will make easy work of grinding, finishing, cutting and drilling bone, teeth and other material. The high-torque 35,000 rpm (maximum) motor is quiet and has minimal vibration which reduces wear on the motor and provides greater comfort for you. It also features a forward and reverse switch, "E Type" handpiece and handpiece holder. The handpiece has a removable nose cone that can be cleaned and sterilized. It accepts 3/32" and 2.33mm bur shanks. Unlike battery-powered drills, this unit maintains consistent power for the duration of use. The wide range of speeds allows you to control the amount of heat generation.

503598

OMNIDRILL35 SPECIFICATIONS	
INPUT	110 V, 50/60 Hz (**503598**) 240 V, 50/60 Hz (**503599**)
OUTPUT	0-32 VDC
FUSE	1 A
OPERATING SPEED	0-35,000 RPM
DIMENSIONS	178 x 114 x 89 mm (7 x 4.5 x 3.5in.)
WEIGHT	1.7 kg (3.75 lbs.)

ORDERING INFORMATION	
503598	OmniDrill35 Micro Drill System, 110 V
503599	OmniDrill35 Micro Drill System, 220 V

Stand, tips, cutoff disk, mandrels and foot switch are all included. Replacements available below.

OPTIONAL ACCESSORIES/REPLACEMENT PARTS	
501851	Abrading Tip, Stone, pkg. of 5
501852	Accessory Stand
501853	Ball Mill, Carbide, #1, .031" Diameter, pkg. of 5
501854	Ball Mill, Carbide, #2, .039" Diameter, pkg. of 5
501855	Ball Mill, Carbide, #3, .047" Diameter, pkg. of 5
501856	Ball Mill, Carbide, #4, .055" Diameter, pkg. of 5
501857	Ball Mill, Carbide, #5, .063" Diameter, pkg. of 5
501858	Ball Mill, Carbide, #6, .071" Diameter, pkg. of 5
501842	Ball Mill, Carbide, #7, .083" Diameter, pkg. of 5
501860	Ball Mill, Carbide, #1/4, .019" Diameter, pkg. of 5
501861	Ball Mill, Carbide, #1/2, .027" Diameter, pkg. of 5
501862	Cutoff Disk, pkg. of 20
501863	Mandrel, Screw, pkg. of 5
501864	Mandrel, Threaded, pkg. of 5
504459	Foot switch
502237	Stereotaxic Holder for OmniDrill35 Microdrill

Economy Electrosurgical Unit

Cut and coagulate with a press of the foot switch

Features

- 10 levels of output intensity
- Three operational modes (cut, coagulate, cut/coagulate)
- Choice of electrodes

Benefits

- Ready to use out of the box.
- Includes a variety of electrodes, which are also sold individually

501274

Applications

- Cutting and coagulation of tissue

Electrosurgery utilizes alternating current at radio frequencies to cut and coagulate. Using this method, the current enters the subject's body and the subject becomes part of the electrical circuit. This requires the use of a return, or ground, plate. This economically priced electrosurgical unit has 10 levels of output intensity, three operational modes (cut, coagulate, and cut/coagulate) and various choices of electrodes. The unit comes complete and ready-to-use with a handpiece, ground plate, foot switch and one of each electrodes. All accessories can also be ordered separately.

ELECTROSURGICAL UNIT SPECIFICATIONS	
OPERATION FREQUENCY	1.5 MHz
STABLE & FINE POWER SETTING	10 Steps
POWER SUPPLY	115 V ± 10% - 50/60 Hz 1.8 A, 210 VA 230 V ± 10% - 50/60 Hz 0.9 A, 210 VA
OUTPUT POWER	70 W ± 5%
WORKING FRQUENCY	1.5-1.7 MHZ ± 5%
DIMENSIONS	24 cm x 22 cm x 8.5 cm (lxwxh)
SHIPPING WEIGHT	10 lb. (4.5 kg)

ORDERING INFORMATION	
501274	Electrosurgical Unit, 110 V
501284	Ball Electrode, Ø 1.6 mm shaft

Dry Sterilizer

Heat sterilize instruments in seconds

Features

- Large LED control panel
- Adjustable temperature control up to 300°C
- Sterilizes forceps, needles and other instruments
- Choose Bead capacity: 300 g (**ST5193**), 150 g (**ST5191**)

Benefits

- No chemicals
- No flames
- No risk of burns
- No disinfectant fluids

Applications

- Sterilize your microdissecting and tissue culture instruments, thoroughly and conveniently, in seconds

WPI's **Steri-Lite Micro Bead Sterilizer** is ideal for the sterilization of small research instruments (forceps, scissors, etc.). When the chamber is filled with the included glass beads, high temperatures (up to 300°C) can be used to eliminate bacteria, spores and other microorganisms.

Chamber temperature is displayed on the large LED control panel and may be adjusted with the control knob. The outer casing of the unit stays cool to the touch, even when it is used continually. The supplied safety cover can be placed over the chamber to conserve energy and reduce the heating/ramping rate. The Steri-Lite Sterilizer does not use gas, flame or chemicals and is safe for use in hoods.

With adjustable temperature, the sterilizer can be used for incubations and the decontamination of plastic objects/tools.

This product is designed for RESEARCH and DEVELOPMENT USE ONLY.

STERI-LITE SPECIFICATIONS		
TEMPERATURE RANGE:		100 to 300°C
PREHEAT TIME:		Approximately 25 min. to 300°C
CHAMBER DIAMETER:		40 mm
CHAMBER HEIGHT:	ST5191:	80 mm
	ST5193:	140 mm
DIMENSIONS:	ST5191:	14x14.5x15.5 cm (5.5x5.7x6.1 in.)
	ST5193:	14X14.5X21.5 cm (5.5X5.7X8.7 in.)
BEAD CAPACITY:	ST5191:	150 g
	ST5193:	300 g
WEIGHT:	ST5191:	2 Kg
	ST5193:	2.5 Kg
ELECTRICAL:	ST5191:	115 V or 230 V, 50-60 Hz, 120 W
	ST5193:	115 V or 230 V, 50-60 Hz, 250 W
WARRANTY:		2 Years

ORDERING INFORMATION	
ST5193	Steri-Lite Micro Bead Sterilizer, large, 300 g capacity
ST5191	Steri-Lite Micro Bead Sterilizer, small, 150 g capacity

Request the surgical instrument catalog to see the full line of instruments:

www.wpiinc.com/catalog

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Ultrasonic Cleaning Systems

Quantrex® bath with a timer

Features

- 60 Minute Timer
- Vinyl-clad steel and stainless steel
- 14 quality inspection steps for strength and durability

Benefits

- Provides super-strength cleaning every time
- When used with L&R's specialty formulated solutions, the self-contained, compact unit offers efficient trouble-free cleaning
- Each Quantrex machine comes standard with increased power—strength you can see as soon as you turn the unit on
- Stainless steel drain with multi-positional outlet for easy removal of solution

Applications

- Versatile enough for a variety of cleaning applications

SPECIFICATIONS	
DIMENSIONS	26.0 x 16.5 x 21.0 cm (10.25 x 6.5 x 8.25 in.)
SHIPPING WEIGHT	4.5 kg (10 lb.)
TANK CAPACITY	3.2 L (0.85 gal.)
INTERNAL DIMENSIONS	23.8 x 13.7 x 10.2 cm (9.38 x 5.38 x 4.0 in.)

504216

ORDERING INFORMATION	
504216	Quantrex Ultrasonic Cleaning System

Includes Timer, Drain and Cover. Heater Optional.

Economy ultrasonic cleaner

UBATH-Y

504766

504767

504768

ORDERING INFORMATION	
UBATH-Y	Ultrasonic Cleaner (110 V)
13740	Ultrasonic Detergent (4 lb)
504766	Sterilization mesh casette 40x40x20 mm
504767	Sterilization mesh casette 80x80x34mm
504768	Sterilization mesh casette 105x70x25 mm

Features

- Half liter stainless steel tank
- Durable and compact

Benefits

- Robust all-metal construction allows for continuous duty

Applications

- Microdissection and veterinary instrument cleaning

UBATH SPECIFICATIONS	
INPUT POWER	22W
PEAK OUTPUT	70W, 55 kHz
TANK CAPACITY	0.53L (18 oz.)
TANK I.D.	12.1 x 8.6 x 6.6 cm, (4.75 x 3.375 x 2.625 in.)
TANK O.D.	13.7 x 10.5 x 12.1 cm, (5.375 x 4.125 x 4.75 in.)
SHIPPING WEIGHT	1.8 kg (4 lb.)

Request a complete catalog of sterilization baskets and trays:

www.wpiinc.com/catalog

Lab Supplies

Affordable laboratory equipment

Looking for a quality source for affordable laboratory equipment? From capillary glass and adhesives up to micromanipulators, pumps and microscopes, we offer the full range for the well stocked scientific laboratory.

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Which Adhesive is Right for Me?

ADHESIVES APPLICATION GUIDE			
WPI Part #	**Description**	**Curing time**	**Useful Applications and Characteristics**
Epoxies	Form strong bonding. Used in wire bonding applications.		
4898	Silver filled conductive Epoxy	12 hr @ 50°C; 5 min @ 150°C	Connecting conductors that can't be soldered. Constructing or connecting Ag/AgCl pellets.
7335	Carbon filled conductive Epoxy	48 hr @ 25°C; 5 min @ 150°C	Constructing carbon electrode.
4886	High performance Structural Epoxy	12 hr @ 25°C.	Forms a strong and slightly flexible bond on plastic, metal, & glass. Bonds some low surface.
Hot Melt (EVA)	Easy to use for bonding. For large gap filling.		
13316	Mini Glue Gun with glue sticks	As soon as it cools down	Bonds wood, glass, metals, and many plastics.
Silicone Adhesives/Sealants/Primers		Good moisture resistance and elasticity. Low toxicity.	
1571	Room temperature vulcanizing (RTV) adhesive. Acyloxy/moisture cure system. Acetic acid is cure by-product.	24 hr @ 25°C	Has the best adhesion property in this silicone family. Will bond to many materials.
7128	RTV sealant. Alkoxy/Moisture cure system. Methanol as cure by-product.	72 hr @ 25°C	Good for bonding or sealing electronics circuits (metal).
SYLG184	Sylgard, two parts, vinyl/platinum cure sealant. Hydrogen as cure by-products. Very low toxic	24 hr @ 25°C, 15 min. @ 150°C	Coating Patch Clamp electrodes, Cell culture dish, making dissection pads.
KWIK-SIL	Two part, adhesive. Vinyl/platinum system, Hydrogen as cure by-products. Very low toxic.	< 5 min. @ 25°C	Live tissue and nerve studies. Medium strength adhesion.
KWIK-CAST	Two part sealant. Vinyl/platinum cure system. Hydrogen as cure by-products. Very low toxic.	< 5 min. @ 25°C	Sealant for live tissues. Embedding peripheral nerves with electrodes.
6820	Primer for silicone	N/A	Enhances adhesion of silicone adhesives for difficult to bond plastic surfaces
Cyanoacrylate	Forms an instantaneous bond.		
7341	Ethyl Cyanoacrylate, low viscosity 90-120 cps	<10 seconds	Mounting rat/mouse brain slices. Ideal for relatively small gaps and smooth surfaces.Bonds plastic, metals and rubber. Package of 10 vials, each approximately 1.5 mL.
7342	Ethyl Cyanoacrylate, high viscosity 1100-1600 cps	<30 seconds	Use on brain slice exp. Ideal for larger gaps, allows slightly longer bonding time. Bonds plastic, metals and rubber. Package of 10 vials, each approximately 1.5 mL.
VETBOND	Butyl Cyanoacrylate, low toxic	<10 seconds	Bonds tissues, alternative to suture, helps small wound healing. Antimicrobial effect. Used in forensic science.
503763	Octyl Cyanoacrylate, low toxic	<15 seconds	Suitable for surface wound bonding, protection, holding a sensor or other device on the tissue.

Easy Application Silicone

Kwik-Gard™ is specially packaged **Sylgard 184** silicone for quicker and easier application, eliminating the messy procedure of preparing the mixture before application. Its special cartridge controls the precise mixing ratio to ensure proper curing. The disposable tip mixes resin and hardener as they are dispensed. Since no air is introduced during mixing, the resin does not need degassing for most applications. The mixed silicone is applied directly to the site, reducing preparation time and material waste.

Each Kwik-Gard cartridge contains 37 mL of resin and hardener. The dispensing tip has a dead volume of 0.75 mL. Perfect for PDMS.

Biopsy punches (0.5–8mm) are available online at www.wpiinc.com/punch.

ORDERING INFORMATION	
KWIKGARD	Kwik-Gard Start-up Kit *(incl. dispenser, 1 cartridge, 5 tips)*
KWIKGLUE	Kwik-Gard Refill *(2 cartridges, 10 dispensing tips)*
KWIKMIX	Dispensing Tips *(pkg. of 10)*
KWIKGUN	Kwik-Gard Dispenser

Structural Epoxy

Scotch-Weld 2216 remains the best epoxy for bonding plastic, often used as the benchmark for testing the binding strength of other adhesives. The slightly rubbery texture also makes it less easy to break off. *It is the only epoxy known that can bond PEEK.*

Color: gray
Cures at room temperature.
Shipping weight: 1 lb. (0.5 kg)

ORDERING INFORMATION	
4886	Scotch-Weld 2216 (2 oz.)

Low Toxicity Adhesive

Ideal for neuroscience applications, nerve studies and more

Features

- Bio-compatible adhesive for live tissue and nerve studies
- Pre-mixing tips simplify use
- Medium strength adhesion
- Low toxicity
- Rapid curing silicone adhesive, cure on contact
- Cures without producing heat
- Includes 10 Mixing Tips
- Volume discounts - Save up to 15%!

KWIK-SIL

KWIK-CAST

Benefits

- Low toxicity
- Rapid cure time

Applications

- Neuroscience and nerve studies
- Biomedical applications


600022

Kwik-Sil and **Kwik-Cast** silicones have very low toxicity before, during and after curing. The by-product of curing is a small amount of hydrogen gas, which is much less toxic to cells than acetic acid or alcohol from traditional RTV silicone sytems.

Kwik-Sil and **Kwik-Cast** curing speed is hundreds of times faster than traditional RTV silicones. A curing time of a few minutes at room temperature is especially useful for encapsulation of live tissue or implanting into a live animal.

Unlike many vinyl-based silicones in which the platinum complex catalysts are easily poisoned by contamination from amines and animal tissue, **Kwik-Sil** and **Kwik-Cast** are not sensitive to contamination from animal tissue.

Kwik-Sil™ is a translucent, medium-viscosity silicone adhesive, developed for chronic peripheral nerve studies such as anterograde tracing with fluorescent indicators or electrode recording. Good adhesion and mechanical properties (tear strength and elongation) allow days of study without breaking of the bonding. Curing speed is very reproducible.

Kwik-Cast™ is a very low viscosity silicone sealant developed to embed peripheral nerves with electrodes for acute multi-fiber recordings. It flows easily, filling the small spaces around the nerve and leaving no channels through which peritoneal fluid can travel and thus short the nerve/electrode contact. Equally important is the ability of the material to flow into itself and create one continuous mass from underneath the nerve all the way to the top of the nerve/electrode contact to ensure long-term recording stability. **Kwik-Cast** is color-coded to make the mixing foolproof. The catalyst is yellow and the base is blue. When uniformly mixed, it is green. **Kwik-Cast** can be applied and cured underneath mineral oil. After recording, electrodes are easily recovered due to the low tear strength.

KWIK-CAST & KWIK-SIL SPECIFICATIONS

	Kwik-Sil	Kwik-Cast
MIX RATIO	1 to 1	1 to 1
WORKING TIME	< 5 minutes*	4 minutes
SETTING TIME (ROOM TEMP., 1:1 RATIO)	5–10 minutes**	<10 minutes
CURE TIME	~15 minutes	
VISCOSITY, CPS	15,000	10,000
GUARANTEED SHELF LIFE AT 23 °C	6 months	6 months
VOLUME	5 mL	5 mL
NUMBER OF MIXING TIP	10	10
DEAD VOLUME OF THE MIXING TIP	<0.12 mL	<0.12 mL
AFTER CURING 24 HOURS:		
TEAR STRENGTH, PPI	90	44
ELONGATION %	650	60
DUROMETER (SHORE A-2)	30	36
COLOR	translucent	green
VOLUME RESISTIVITY, W/CM	$1x10^{15}$	$1x10^{15}$

** 3 minutes average with about 90 seconds of liquidity*
*** no longer mixable at this point*

ORDERING INFORMATION

KWIK-SIL	Silicone Adhesive Compound (two 5 mL syringes)
KWIK-CAST	Silicone Casting Compound (two 5 mL syringes)
600022	Replacement KWIK Mixing Tips (pkg. of 10)

Quantity discounts available

MicroFil™ Non-metallic Syringe Needle

Perfect for filling micropipettes

WPI's **MicroFil™** fills micropipettes easily and reliably. Its long and fine tip allows you to start the filling very close to the pipette tip, eliminating both air bubble formation and clogging due to the washing down of dust particles. The transparent amber **MicroFil™** needle is constructed from a combination of plastic and fused silica — no metal components are used. The **MicroFil™** needle can be stored for days with the filling solution inside without clogging.

The **MicroFil's** tip elasticity is sturdy and very flexible though not unbreakable. Since it is more flexible than stainless steel needles, moderate bending will not block or damage the **MicroFil™** needle. The combination of plastic and fused silica in the **MicroFil™** tip is sturdier than plastic tips, allowing easy and repeated insertions into micropipettes. **MicroFil's** luer fitting allows easy coupling to syringes and syringe filters.


U.S. PATENT
5,294,325

ORDERING INFORMATION

MF34G-5	MicroFil™, 34 ga., 67 mm long (pkg. of 5)
MF28G-5	MicroFil™, 28 ga., 97 mm long (pkg. of 5)
MF28G67-5	MicroFil™, 28 ga., 67 mm long (pkg. of 5)

Custom MicroFil™

All **MicroFil™** *products, including custom orders, can be shipped immediately. Custom orders for special needs can be made using nine sizes of* **MicroFil™** *tubing in lengths up to 50 cm — except for* **CMF90U** *which has a maximum length of 10 cm because of its high resistance to flow. Quantity discounts available. Specify length when ordering.*

CMF20G	MicroFil™, 20 ga, 700 µm ID, 850 µm OD (pkg. of 4)
CMF22G	MicroFil™, 22 ga, 530 µm ID, 700 µm OD (pkg. of 4)
CMF23G	MicroFil™, 23 ga, 530 µm ID, 665 µm OD (pkg. of 4)
CMF26G	MicroFil™, 26 ga, 320t µm ID, 430 µm OD (pkg. of 4)
CMF28G	MicroFil™, 28 ga, 250 µm ID, 350 µm OD (pkg. of 4)
CMF31G	MicroFil™, 31 ga, 100 µm ID, 238 µm OD (pkg. of 4)
CMF34G	MicroFil™, 34 ga, 100 µm ID, 164 µm OD (pkg. of 4)
CMF35G	MicroFil™, 35 ga, 75 µm ID, 144 µm OD (pkg. of 4)
CMF90U	MicroFil™, ~36 ga, 20 µm ID, 90 µm OD (pkg. of 4)

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"Super" Adhesives for Life Science Research

Four times stronger than butyl cyanoacrylate and less toxic

Cyanoacrylate adhesives have been on the market since 1958. Most industrial or household grade cyanoacrylate is made of shorter alkyl chain derivatives such as methyl or ethyl cyanoacrylate (**7341** and **7342**). They are very useful for temporarily holding tissues such as mounting specimens for microtome sectioning. However, they are not suitable for bonding wounds on live animals. The difficulties of using cyanoacrylate for bonding live animals include:

- A strong, irritating odor
- Quick loss of bonding strength due to breakdown of the bonding by hydration
- Breakdown products (cyanoacetate and formaldehyde) are toxic and can cause inflammatory reactions
- Low flexibility and tend to be brittle.

VETBOND

To overcome these problems, several longer alkyl chain cyanoacrylates have been developed especially for veterinary and human use. The first longer alkyl chain product is butyl cyanoacrylate. This product has been used for animal and human applications outside the USA since 1970. It is much less toxic and has a lower odor than the methyl or ethyl cyanoacrylate. The butyl cyanoacrylate offered by WPI is **Vetbond™**.

A family of adhesives containing octyl cyanoacrylate, a plasticizer and stabilizer, was developed In the 1990's (one of them approved by FDA for human use). When bonding to tissue, these new adhesives are four times stronger and less toxic than butyl cyanoacrylate. Compared with the traditional suture, the new super adhesive has several advantages. On average, it takes only one-tenth of the time to close an incision.

The bonding strength is equal to 5-0 monofilament suture. It also has a mysterious antimicrobial effect that can decrease infection rates in contaminated wounds. Bonding will slough off naturally in 5 to 7 days. Cosmetic appearance of the healed incision is also better.

Gluture Topical Tissue Adhesive **503763** forms a strong and flexible film and is thus more suitable for surface wound bonding, protection, and holding a sensor or other device on the tissue. Setting time is about 10 seconds, which gives ample time for application. It can also be used for temporarily holding a live tissue. For example, there is a report of using it to hold nematodes on a glass slide for patch-clamp neurons recording.

All of the products offered by WPI are veterinary grade (not suitable for human application). Though very similar to the grade for human use, they are not sterile and do not have FDA approval.

ORDERING INFORMATION	
503763	Gluture Topical Tissue Adhesive (10 tips), 1.5 mL
7341	Cyanoacrylate Adhesive, Low Viscosity—90-120 cps (package of 10 vials, each approximately 1.5 mL)
7342	Cyanoacrylate Adhesive, High Viscosity—1100-1600 cps (pkg. of 10 vials, each approximately 1.5 mL)
VETBOND	3M Vetbond™ Adhesive (3 mL)

Sylgard

SYLG184

A two-part silicone elastomer, ideal for potting and encapsulating applications. Very low dielectric constant sealing compound used in patch clamping and many other lab applications. After cure, will withstand -55° to 200 °C.

ORDERING INFORMATION	
SYLG184	Sylgard, 0.5 kg (1.1 lb)

Silicone Dissecting Pad Kit

Make your own silicone dissecting pads easily and quickly. Mix the 2-part silicone right in the plastic petri dishes and allow to cure 24 hours at room temperature. Kit includes enough 2-Part Sylgard silicone elastomer to prepare 20 dishes, pins and 20 plastic petri dishes with lids, 65 mm.

ORDERING INFORMATION	
501986	Silicone Dissecting Pad Kit

Electrically Conductive Silver Epoxy

Two-component silver-filled epoxy for electrical connections which cannot be soldered, such as Ag/AgCl pellets. This widely used silver-filled epoxy features low viscosity and smooth flowing character. Pure silver is dispersed in both resin and hardener. Cures in 15 minutes at 120 °C. Mix ratio 1:1. May be premixed and frozen for later use.

ORDERING INFORMATION

4898	Silver Epoxy, 28 g (1 oz)

Electrically Conductive Carbon Epoxy

Two-component carbon-epoxy, curable at room and elevated temperatures. Ideal for electrostatic discharge protection and EMI/RFI shielding. 1:1 mix ratio. May be premixed and frozen for later use.

ORDERING INFORMATION

7335	Carbon Epoxy, 56 g (2 oz)

Silicone RTV Adhesive (non-acidic)

Because it is non-corrosive, this material is ideal for use on metal, for encapsulating small circuits on connectors. After cure, will withstand -55° to 200 °C. No mixing required.

ORDERING INFORMATION

7128	RTV Coating, 90 mL (3 fl oz)

Silicone RTV Adhesive

Clear silicone sealant provides good bonding to plastic. After cure, will withstand -55 to 200 °C. No mixing required. A handy, general purpose laboratory sealant. (Releases acetic acid during curing.)

ORDERING INFORMATION

1571	RTV Sealant, 139 mL (4.7 fl oz)

RTV Prime Coat

Enhances adhesion of silicone adhesives to many difficult-to-bond plastic surfaces.

ORDERING INFORMATION

6820	RTV Prime Coat, 400 mL (13.5 fl oz)

Mini Glue Gun

Comes with three sticks of special formula hot melt glue. UL approved. 110V 60 Hz only.

ORDERING INFORMATION

13316	Mini Glue Gun

Glass Capillaries

Quality glass, superior prices for microinjection/microelectrodes

Features

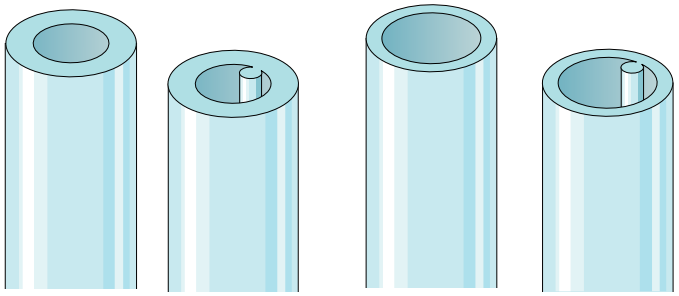
- Quality borosilicate glass capillaries
- Large variety available, including fire polished, filaments, thin wall, specialty glass and multi-barrel

Benefits

- Superior pricing
- Most glass orders ship within 48 hours

Applications

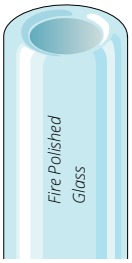
- Microinjection
- Electrophysiology
- Patch clamp
- Fluid Handling



Standard, no Filament | *Standard Filament* | *Thin Wall, no Filament* | *Thin Wall Filament*

FIre Polishing

Fire-Polished glass capillaries are easier to insert into microelectrode holders without damaging the gasket. More importantly, fire-polished glass won't scratch the chloridized wire used in a recording electrode. Fire-polishing does not affect the glass's mechanical or electrical properties.



Making Uniform, Reproducable Microelectrodes

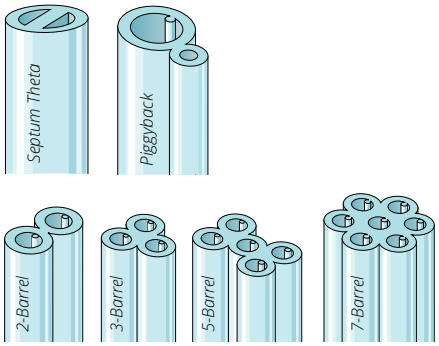
Borosilicate glass capillaries: Close dimensional tolerances assure microelectrode uniformity and reproducibility. Capillaries are available in 1, 2, 3, 5 and 7-barrel configurations, complete range of single barrel thin-wall sizes and a variety of special configurations. Capillaries with filaments contain a solid filament fused to the inner wall, which speeds filling of electrodes. Capillaries with or without inner filaments are available for making microelectrodes in a wide range of diameters.

Filament Glass Capillaries

Single Barrel standard wall thickness capillaries are offered either with or without inner filaments for quick filling in a variety of lengths and diameters.

Thin Wall Glass Capillaries

Thin Wall single barrel capillaries are offered both with or without inner filaments.



Specialty glass is also available. See page 105.

ORDERING INFORMATION

	Length	OD(mm)	ID(mm)	Filament	Fire-Polished	Quantity	Item
Single Barrel Standard Borosilicate Glass	3 in. (76 mm)	1.0	0.58	✔		500	**1B100F-3**
	3 in. (76 mm)	1.0	0.58			500	**1B100-3**
	3 in. (76 mm)	1.2	0.68	✔		350	**1B120F-3**
	3 in. (76 mm)	1.2	0.68			350	**1B120-3**
	3 in. (76 mm)	1.5	0.84	✔		225	**1B150F-3**
	3 in. (76 mm)	1.5	0.84		✔	300	**1B150-3**
	4 in. (100 mm)	1.0	0.58	✔	✔	500	**1B100F-4**
	4 in. (100 mm)	1.0	0.58		✔	500	**1B100-4**
	4 in. (100 mm)	1.2	0.68	✔	✔	400	**1B120F-4**
	4 in. (100 mm)	1.2	0.68			350	**1B120-4**
	4 in. (100 mm)	1.5	0.84	✔	✔	300	**1B150F-4**
	4 in. (100 mm)	1.5	0.84		✔	300	**1B150-4**
	4 in. (100 mm)	2.0	1.12	✔		125	**1B200F-4**
	4 in. (100 mm)	2.0	1.12		✔	200	**1B200-4**
	6 in. (152 mm)	1.0	0.58	✔		500	**1B100F-6**
	6 in. (152 mm)	1.0	0.58			500	**1B100-6**
	6 in. (152 mm)	1.2	0.68	✔		350	**1B120F-6**
	6 in. (152 mm)	1.2	0.68			350	**1B120-6**
	6 in. (152 mm)	1.5	0.84	✔		225	**1B150F-6**
	6 in. (152 mm)	1.5	0.84			225	**1B150-6**
	6 in. (152 mm)	2.0	1.12	✔		125	**1B200F-6**
	6 in. (152 mm)	2.0	1.12			125	**1B200-6**
Thin-Wall Single-Barrel Standard	3 in. (76 mm)	1.0	0.75	✔		500	**TW100F-3**
	3 in. (76 mm)	1.0	0.75			500	**TW100-3**
	3 in. (76 mm)	1.2	0.90	✔	✔	400	**TW120F-3**
	3 in. (76 mm)	1.2	0.90			350	**TW120-3**
	3 in. (76 mm)	1.5	1.12	✔		225	**TW150F-3**
	3 in. (76 mm)	1.5	1.12		✔	300	**TW150-3**
	4 in. (100 mm)	1.0	0.75	✔		500	**TW100F-4**
	4 in. (100 mm)	1.0	0.75		✔	500	**TW100-4**
	4 in. (100 mm)	1.2	0.90	✔		350	**TW120F-4**
	4 in. (100 mm)	1.2	0.90			350	**TW120-4**
	4 in. (100 mm)	1.5	1.12	✔		225	**TW150F-4**
	4 in. (100 mm)	1.5	1.12		✔	300	**TW150-4**
	6 in. (152 mm)	1.0	0.75	✔		500	**TW100F-6**
	6 in. (152 mm)	1.0	0.75		✔	500	**TW100-6**
	6 in. (152 mm)	1.2	0.90	✔	✔	400	**TW120F-6**
	6 in. (152 mm)	1.2	0.90			350	**TW120-6**
	6 in. (152 mm)	1.5	1.12	✔		225	**TW150F-6**
	6 in. (152 mm)	1.5	1.12		✔	300	**TW150-6**

Single barrel glass is Kimble N51A. All thin wall glass is Schott Duran 8330. Tolerance ±10%

Borosilicate Glass Micropipettes

Eliminate the cost and trouble of making your own micropipettes

µTip™

Features

- Schott Duran borosilicate glass
- 0.5 µm and smaller ID micropipettes include internal glass fiber for easy filling
- Tip inner diameter tolerance ±20%
- Short taper yields high strength
- Nominal length ≈ 50 mm
- OD:ID = 1.33:1
- Standard capillary outer diameters are 1.0 mm (thin-wall) or 1.14 mm
- Every pipette individually tested and inspected
- Vacuum sealed packs of 10

Benefits

- Plain Shank or Luer Fittings

Applications

- Injection of dyes or proteins into cells, oocytes or other biomedical laboratory applications

WPI can quickly supply your need for consistently sized pre-pulled glass micropipettes.

Tip diameters (ID) range from 0.1 to 10 µm.

Silanized Tips (Luer Shank) are available. Silanization waterproofs the glass to retard water when inserting into cell. This will not let the outside fluid run down the pipette and get inside so easily.

ORDERING INFORMATION

Shank	Tip I.D.	Silanize Coating Length	Glass O.D.	Filament	Fire Polished	Catalog #	
PLAIN	0.1 µm	—	1.0 mm Thin-Wall	Yes	No	**TIP01TW1F**	
	0.2 µm	—	1.0 mm Thin-Wall	Yes	No	**TIP02TW1F**	
	0.3 µm	—	1.0 mm Thin-Wall	Yes	No	**TIP03TW1F**	
	0.4 µm	—	1.0 mm Thin-Wall	Yes	No	**TIP04TW1F**	
	0.5 µm	—	1.0 mm Thin-Wall	Yes	No	**TIP05TW1F**	
	1 µm	—	1.0 mm Thin-Wall	No	Yes	**TIP1TW1**	
	2 µm	—	1.0 mm Thin-Wall	No	Yes	**TIP2TW1**	
	5 µm	—	1.0 mm Thin-Wall	No	Yes	**TIP5TW1**	
	10 µm	—	1.0 mm Thin-Wall	No	Yes	**TIP10TW1**	
	10 µm	—	1.14 mm A203XV glass *	No	Yes	**TIP10XV119**	
	—	—	1.0 mm Thin-Wall	No	Yes	**TIP10LT**	Long Taper †
	—	—	1.0 mm Thin-Wall	Yes	Yes	**TIP10FLT**	Long Taper †
	—	—	1.5 mm Thin-Wall	No	Yes	**TIP15LT**	Long Taper †
	—	—	1.5 mm Thin-Wall	Yes	Yes	**TIP15FLT**	Long Taper †
	30 µm	—	1.0 mm Thin-Wall	No	Yes	**TIP30TW1**	
LUER	0.1 µm	—	1.0 mm Thin-Wall	Yes	—	**TIP01TW1F-L**	
	0.2 µm	—	1.0 mm Thin-Wall	Yes	—	**TIP02TW1F-L**	
	0.3 µm	—	1.0 mm Thin-Wall	Yes	—	**TIP03TW1F-L**	
	0.5 µm	—	1.0 mm Thin-Wall	Yes	—	**TIP05TW1F-L**	
	1 µm	—	1.0 mm Thin-Wall	No	—	**TIP1TW1-L**	
	2 µm	—	1.0 mm Thin-Wall	No	—	**TIP2TW1-L**	
	5 µm	—	1.0 mm Thin-Wall	No	—	**TIP5TW1-L**	
	10 µm	—	1.0 mm Thin-Wall	No	—	**TIP10TW1-L**	
	30 µm	—	1.0 mm Thin-Wall	No	—	**TIP30TW1-L**	
LUER/ SILANIZED	5 µm	1 inch	1.0 mm Thin-Wall	No	—	**TIP5TW1LS01**	
	5 µm	2 inch	1.0 mm Thin-Wall	No	—	**TIP5TW1LS02**	
	10 µm	1 inch	1.0 mm Thin-Wall	No	—	**TIP10TW1LS01**	
	10 µm	2 inch	1.0 mm Thin-Wall	No	—	**TIP10TW1LS02**	
	30 µm	1 inch	1.0 mm Thin-Wall	No	—	**TIP30TW1LS01**	
	30 µm	2 inch	1.0 mm Thin-Wall	No	—	**TIP30TW1LS02**	

* *10 µm (ID), 1.14 mm capillary pipettes are for use in WPI's* ***Nanoliter 2010****.*

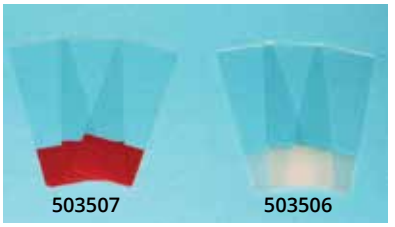
† *Long Taper micropipettes are pulled with a 12-15 mm taper which the customer cuts back to obtain the desired tip diameter.*

µTip Sampler Assortments

TIPMIX01-05	Two each, 0.1, 0.2, 0.3, 0.4, 0.5 µm ID, Plain Shank
TIPMIX05-10	Two each, 0.5, 1, 2, 5, 10 µm ID, Plain Shank
TIPMIX01-05-L	Two each, 0.1, 0.2, 0.3, 0.4, 0.5 µm ID, Luer
TIPMIX05-10-L	Two each, 0.5, 1, 2, 5, 10 µm ID, Luer

Slides

These clean glass microscope slides are 25 x 75 mm, 1.0~1.2 mm thick with 90° ground edges. They are available as frosted and red ended. The frosted end slides feature a fine 20 mm frosted area on both sides of one end for easy marking. The red frosted slides feature a 20 mm colored end useful for identifying hazardous materials.



ORDERING INFORMATION

503506	Frosted Glass Microscope Slides, Box of 144
503507	Red Frosted Glass Microscope Slides, Box of 144

Cover Slips

These cover slips (made of German glass) can be used for growing and culturing cells that normally have poor adhesion to plastic surfaces. They are small enough to be placed in the micro plate or other cell culture devices. The 5 mm size will fit inside the 96-well culture plate and leave enough room to pick it up from the bottom of the well with forceps. The 8mm size fits inside the 24-well plates.

ORDERING INFORMATION

Order #	Diameter	Thickness	Quantity
502040	5 mm	#1.5 (0.16 - 0.19 mm)	100
502041	8 mm	#1.5 (0.16 - 0.19 mm)	100
503508	25 mm	#1.5 (0.16 - 0.19 mm)	100

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Luer Valve Assortment Kit

Build your own liquid flow experiment

Features

- Over 300 assorted parts
- Luer fittings for quick and easy connect and disconnect

Benefits

- Sold individually or in kits

Applications

- Liquid flow experimental setups

A useful kit (right) for building your own liquid flow experiment. It provides the means to start, stop, add, divide and control a flow of liquid or gas. Included in the kit are ***over 200 assorted parts*** such as one-way and three-way stopcocks, manifolds, Y-connectors, injection sites, male and female luer caps, check valves, syringe-activated check valves, slide clamps, roller clamps, and pinch clamps. All (except clamps) have a luer fitting for quick and easy connecting and disconnecting. Includes assorted luer fittings for use with flexible tubing.

ORDERING INFORMATION	
14011	Luer Valve Assortment Kit

Luer-to-Tubing Coupler Assortment Kit

Quick connects in nylon and polypropylene

Features

- Over 250 assorted parts in each kit
- Valves are polycarbonate, and the valve handles are polyethylene. Do not autoclave those parts.

Benefits

- Polypropylene parts (**504954**) can be autoclaved repeatedly at 121°C/15PSI, 15 min. cycle
- Polypropylene fittings are chemically inert and resistant to most organic and inorganic solvents
- Nylon fittings are strong and can be bonded with adhesive.

Applications

- Liquid flow experimental setups

504954

504955

Assemble quick-disconnect luer fittings for use with flexible tubing with internal diameters of 1⁄16", 3⁄32" and 1⁄8". A variety of quick-disconnect connectors can be quickly made for connecting small diameter flexible tubing; 3-way connections can be made with the use of the 3-way luer tee; luer plugs, tees, connectors, bulk-head mounts, color coding rings, locking nuts, male and female luers—are all included to enhance the versatility of this kit. The kit has over 250 assorted parts and is offered in two different types of materials. Nylon parts are not autoclavable.

ORDERING INFORMATION	
504954	Luer-to-Tubing Coupler Assortment Kit (Polypropylene)
504955	Luer-to-Tubing Coupler Assortment Kit (Nylon)

Luer Valve Assortment Kit 14011 Parts

Kit parts are also available individually

14034-40
Injection Site
Male luer lock
Pack of 40

14039-10
Check Valve
Pack of 10

14044-5
Syringe
Activated Dual
Check Valve
Pack of 5

14045-20
Syringe
Slip Luer Valve
Activated Check
Pack of 20

13822-10
0.135"/3.4 mm
OD Tubing
Pack of 10

14041-60
Roller Clamp
3/16" Tubing
Pack of 60

7465-20
Pinch Clamp
Large Bore
Pack of 20

14040-50
Pinch Clamp for
7mm Tubing
Pack of 50

3742-20
Female T Luer
Pack of 20

14047-10
4-Port Infusion Y
Swivel Thread
Pack of 10

14048-20
3-Port Infusion Y
Swivel Thread
Pack of 20

14057-10
4-Way Stopcock,
Luer Lock
Pack of 10

14036-15
4-Way Luer
Stopcock
Pack of 15

14058-10
4-Way Stopcock,
Luer Lock
Pack of 10

14035-10
4-Way Stopcock,
Luer lock,
Pack of 10

14051-100
Pinch Clamp for 5
mm Tubing
Pack of 100

14038-10
1-Way Stopcock
Luer Lock,
Pack of 10

14054-10
1-Way Stopcock,
Luer Slip
Pack of 10

14055-2
4-Port Manifold (6 Female Ports)
Pack of 2

14059-2
3-Port Manifold (5 Female Ports)
Pack of 2

13156-100
Female Luer
Fitting for
1/16" ID Tubing
Pack of 100

13157-100
Female Luer
Fitting for
3/32" ID Tubing
Pack of 100

13158-100
Female Luer Fitting
for
1/8" ID Tubing
Pack of 100

13159-100
Female Luer
Fitting for
5/32" ID Tubing
Pack of 100

13160-100
Male Luer
Fitting for
1/16" ID Tubing
Pack of 100

13161-100
Male Luer
Fitting for
3/32" ID Tubing
Pack of 100

13162-100
Male Luer
Fitting for
1/8" ID Tubing
Pack of 100

13163-100
Male Luer
Fitting for
5/32" ID Tubing
Pack of 100

14061-60
Male/Female
Luer Plug
Pack of 60

14042-100
Slide Clamp
for 2.5 mm
O.D. Tubing
Pack of 100

Parts in kit may differ slightly in appearance from those pictured.

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BNC Cables & Connectors

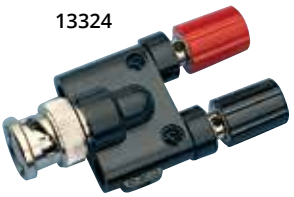
For wiring any laboratory setup

13451

5374

5375

13324



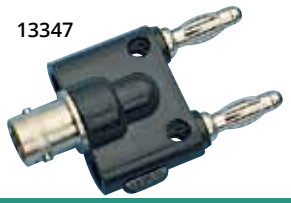
2851 (6 ft)
500184 (10 ft)
500257 (6 in.)
500258 (12 in.)
500259 (18 in.)

CBL102

14254

13854

13347



500256

ORDERING INFORMATION

PART #	APPLICATION/DESCRIPTION	CONNECTOR A	CONNECTOR B	CABLE LENGTH
2851	Standard BNC cable	BNC (male)	BNC (male)	6 ft (1.8 m)
5374	Low-noise cable for microelectrode holders	BNC (male)	2 mm gold pin	4 ft (1.2 m)
5375	Low-noise cable for microelectrode holders	BNC (male)	2 mm gold jack	4 ft (1.2 m)
13324	Adapter	Double-banana (female)	BNC (male)	none
13347	ISO2 (chart recorder adapter)	Double-banana (male)	BNC (female)	none
13451	Adapter: Iso-DAM, Iso-DAM8	BNC (female)	two 2 mm pins	6 in. (15 cm)
13854	BNC T-connector, male to:	BNC (female)	BNC (female)	none
14254	BNC Straight Adapter	BNC (female)	BNC (female)	none
500184	Standard BNC Cable	BNC (male)	BNC (male)	10 ft (3 m)
500256	BNC Right Angle Adapter	BNC (male)	BNC (female)	none
500257	Standard BNC Cable	BNC (male)	BNC (male)	6 in. (15 cm)
500258	Standard BNC Cable	BNC (male)	BNC (male)	12 in. (30 cm)
500259	Standard BNC Cable	BNC (male)	BNC (male)	18 in. (46 cm)
CBL102	DAM Series, PM Series	3.5 mmMiniPhone plug	BNC (male)	6 ft (1.8 m)

Micro Cannula

Quickly connect to existing experimental plumbing

Features

- 0.4 mm O.D., 0.2 mm I.D. tubing
- Autoclavable
- Biocompatible Perfluorocarbon tubing material

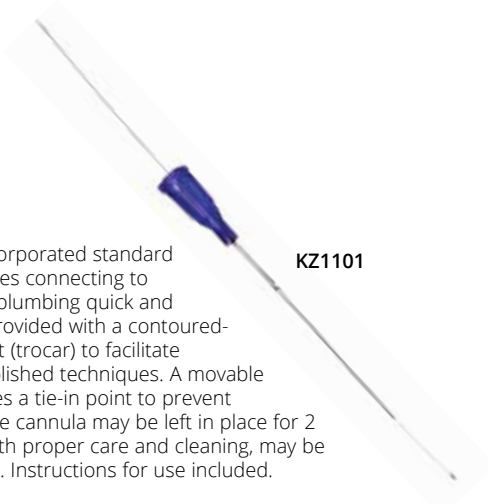
Benefits

- May be used with a pressure tranducer (BLPR2) or a micro syringe injection system (UMP3 or MMP)

Applications

- Cannula for carotid or femoral arteries of rodents and small animal blood vessels

This micro cannula is ideal for placement in the carotid or femoral artery of mice, rats, and other small animal blood vessels. It can be used with a pressure transducer (WPI'S **BLPR2**) for blood pressure measurement, or in conjunction with a micro-syringe injection system (like WPI's **UMPIII** or **MMP** pumps). The incorporated standard female luer fitting makes connecting to existing experimental plumbing quick and easy. The cannula is provided with a contoured-tip stainless steel stylet (trocar) to facilitate placement using established techniques. A movable "shoulder" ring provides a tie-in point to prevent accidental removal. The cannula may be left in place for 2 hours or more, and with proper care and cleaning, may be re-used multiple times. Instructions for use included.



KZ1101

ORDERING INFORMATION

KZ1101	Micro Cannula, 3-inch

Precious Metal and Specialty Wire

Bare and coated metal wire for most laboratory applications

Micro coaxial cables (**MAXxxxx**) are ideal for microelectrode fabrication and construction of similar research tools. The dual shielding eliminates electrical interference caused by radio frequencies (RF), electrostatic and microphonics (e.g., bending and vibration. Available with single or dual (twin) conductors.

Teflon-coated stainless steel (type 304) wire (**SSTxxxx**) is available in 25-ft and 50-ft lengths. The Teflon coating is 150 micro-in. thick (4 µm). The Teflon coating is designed to reduce surface friction, only. It is not insulation.

Carbon wire (**C3005**) is a single 30-micron fiber of electrochemically activated carbon. This fiber is especially useful in micro-electrochemical experiments.

Platinum/iridium wire — uncoated (**PTxxxx**) and Teflon-coated (**PTTxxxx**) — is an alloy of 90% platinum and 10% iridium, giving excellent tensile strength and corrosion resistance. Uncoated pure platinum wire (**PTPxxx**) is 99.95% pure.

Indium wire (IN1003) is 99.99% pure, with a melting point of 156.4°C.

Annealed silver wire (**AGWxxxx**), 99.99% pure, is available in five diameters; three of those sizes are also available with a Teflon coating (**AGTxxxx**).

Tungsten wire (**TGWxxxx**), available in three diameters, is 99.95% pure.

Gold wire (**AUWxxxx**) is 99.99% pure.

Stainless steel wire (**SSxxxxx**) is type 316.

ORDERING INFORMATION					
Catalog No.	Metal	Coating	AWG*	Diameter	Precut Length
AGT0510	Silver	Teflon	36	0.005 in. (0.125 mm)[1]	10 ft (3 m)
AGT0525	Silver	Teflon	36	0.005 in. (0.125 mm)[1]	25 ft (7.6 m)
AGT05100	Silver	Teflon	36	0.005 in. (0.125 mm)[1]	100 ft (30 m)
AGT1010	Silver	Teflon	30	0.010 in. (0.25 mm)[1]	10 ft (3 m)
AGT1025	Silver	Teflon	30	0.010 in. (0.25 mm)[1]	25 ft (7.6 m)
AGT10100	Silver	Teflon	30	0.010 in. (0.25 mm)[1]	100 ft (30 m)
AGT1510	Silver	Teflon	26-27	0.015 in. (0.38 mm)[1]	10 ft (3 m)
AGT1530	Silver	Teflon	26-27	0.015 in. (0.38 mm)[1]	30 ft (9.1 m)
AGW0510	Silver	—	36	0.005 in. (0.125 mm)	10 ft (3 m)
AGW0530	Silver	—	36	0.005 in. (0.125 mm)	30 ft (9.1 m)
AGW1010	Silver	—	30	0.010 in. (0.25 mm)	10 ft (3 m)
AGW1030	Silver	—	30	0.010 in. (0.25 mm)	30 ft (9.1 m)
AGW1510	Silver	—	26-27	0.015 in. (0.38 mm)	10 ft (3 m)
AGW1530	Silver	—	26-27	0.015 in. (0.38 mm)	30 ft (9.1 m)
AGW2010	Silver	—	24	0.020 in. (0.5 mm)	10 ft (3 m)
AGW2030	Silver	—	24	0.020 in. (0.5 mm)	30 ft (9.1 m)
AGW4010	Silver	—	18	0.040 in. (1.0 mm)	10 ft (3 m)
AUW0170	Gold	—	50	0.001 in. (0.025 mm)	70 ft (21 m)
AUW201	Gold	—	24	0.020 in. (0.5 mm)	1 ft (30 cm)
C3005	Carbon	—	49	0.0012 in. (30 µm)	5 ft (1.5 m)
PT1002	Platinum / Iridium	—	30	0.010 in. (0.25 mm)	2 ft (61 cm)
PT0402	Platinum / Iridium	—	38	0.004 in. (0.102 mm)	2 ft (61 cm)
PT0203	Platinum / Iridium	—	44	0.002 in. (0.051 mm)	3 ft (91 cm)
PT0110	Platinum / Iridium	—	50	0.001 in. (0.025 mm)	10 ft (3 m)
PTP101	Platinum	—	30	0.010 in. (0.25 mm)	1 ft (30 cm)
PTP201	Platinum	—	24	0.020 in. (0.5 mm)	1 ft (30 cm)
PTP401	Platinum	—	18	0.039 in. (1.0 mm)	1 ft (30 cm)
PTP406	Platinum	—	18	0.039 in. (1.0 mm)	0.5 ft (15.2 cm)
PTT0502	Platinum / Iridium	Teflon	36	0.005 in. (0.125 mm)[1]	2 ft (61 cm)
PTT0203	Platinum / Iridium	Teflon	44	0.002 in. (0.051 mm)[1]	3 ft (91 cm)
PTT0110	Platinum / Iridium	Teflon	50	0.001 in. (0.025 mm)[1]	10 ft (3 m)
SS31605	Stainless Steel	—	36	0.005 in. (0.125 mm)	50 ft (15.2 m)
SS31614	Stainless Steel	—	27	0.014 in. (0.36 mm)	30 ft (9.1 m)
SST30407-25	Stainless Steel	Teflon	33	0.007 in. (0.18 mm)[3]	25 ft (7.6 m)
SST30407-50	Stainless Steel	Teflon	33	0.007 in. (0.18 mm)[3]	50 ft (15.2 m)
TGW0325	Tungsten	—	40	0.003 in. (0.075 mm)	25 ft (7.6 m)
TGW0515	Tungsten	—	36	0.005 in. (0.125 mm)	15 ft (4.6 m)
TGW1510	Tungsten	—	26-27	0.015 in. (0.38 mm)	10 ft (3 m)
MICROCOAXIAL CABLES					
MAX3820	Tinned Cu Alloy	Coaxial		0.0173 in. (0.44 mm)	20 ft (6 m)[4]
MAX4020	Tinned Cu Alloy	Twin Coaxial		0.0158x0.024 in. (0.4x0.61 mm)	20 ft (6 m)[5]

*Brown & Sharpe
[1] Plus 0.002 in. for Teflon coating
[3] Teflon adds 0.00015 in. (4 µm) to diameter
[4] Impedance: 50 ohm; capacitance: 95 pF/m; resistance: 5 ohm/m
[5] Impedance: 100 ohm; capacitance: 54 pF/m; resistance: 1.9 ohm/m

Wire Cutters and Scissors

504749

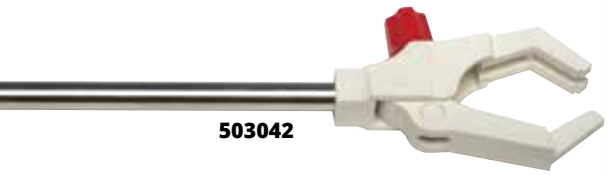
ORDERING INFORMATION	
504749	Ergonomic Micro-Shear Flush Cutters, 12.7 cm (5 in.) Micro-shear flush cutters for delicate wires
504750	Ergonomic Mini-Scissors, 12.7 cm (5 in.) For cutting fine or delicate items with a clean, square edge. Handle design is advantageous for users with arthritic hands.
504751	Ergonomic Micro-Shear Flush Cutters, 12.7 cm (5 in.) For delicate wires. ESD safe. Extra tough high carbon steel blades. Sized for smaller hands and maximum maneuverablity

FrameWorks

Non-Magnetic Bases,Stainless Steel Rods, & Clamps

These high quality components are made of stainless steel and polymer that resist organic solvents and corrosion. They can be easily assembled to make a stand-alone setup for student labs or to make a complicated frame for research labs.

503041



503042

503086

14073-4

503082-4

502193-4

503078-4

503079-4

503080-4

503084

503085

503081-4

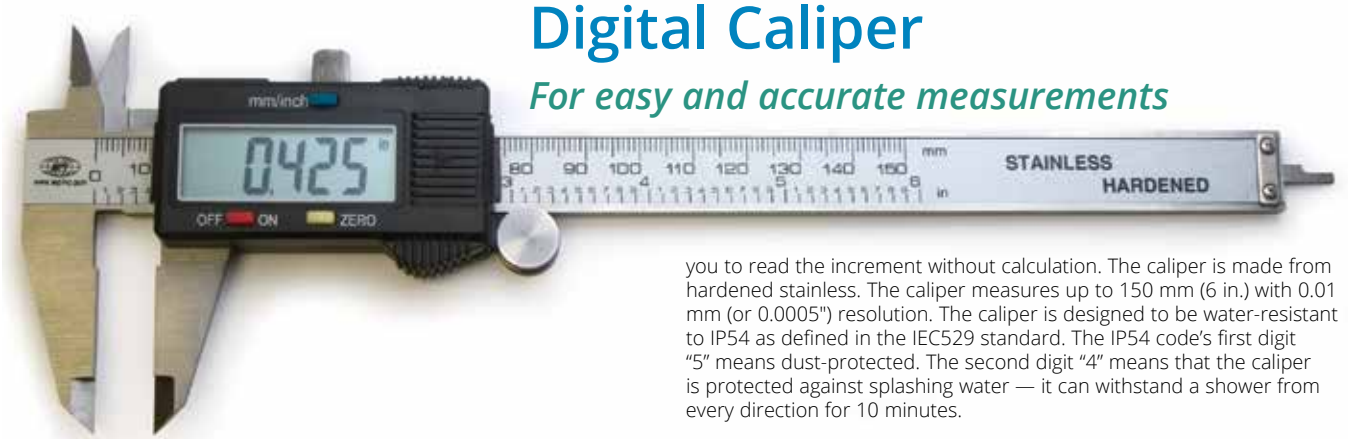
502190

ORDERING INFORMATION

503041	Large Clamp with Rod (157 mm), opens up to 85 mm
503042	Medium Clamp with Rod (157 mm), opens up to 45 mm
503086	Small Clamp with Rod (157 mm), opens up to 16 mm
14073-4	Open-sided Frame Clamp (pkg. of 4)
503082-4	Board Frame Clamp, opens to 8.5 mm (pkg. of 4)
503080-4	Frame Clamp with Parallel Surface Mount (includes mounting screws) (pkg. of 4)
502193-4	Parallel Frame Clamp (pkg. of 4)
503078-4	T-joint Frame Clamp (pkg. of 4)
503079-4	In-line Frame Clamp (pkg. of 4)
502190	Heavy Rectangular Base (with M8 Thread mount and thumbscrew mount), 23×15.6 cm, 4 lb.
503083	Light Rectangular Base (with M8 Thread mount and thumbscrew mount), 23×15.6 cm, 0.5 lb.
503085	Large 10-in. V-base with M8 Thread Mount
503084	Small 6-in. V-base with M8 Thread Mount
503081-4	Vertical Surface Mount, M8 Threaded (pkg. of 4)
503070	Polished Stainless Steel Post, 12 mm OD, 25 cm long, No Thread
503071	Polished Stainless Steel Post, 12 mm OD, 50 cm long, No Thread
503072	Polished Stainless Steel Post, 12 mm OD, 75 cm long, No Thread
503073	Polished Stainless Steel Post, 12 mm OD, 25 cm long, M8 Thread
502191	Polished Stainless Steel Post, 12 mm OD, 50 cm long, M8 Thread
503075	Polished Stainless Steel Post, 12 mm OD, 60 cm long, M8 Thread
503076	Polished Stainless Steel Post, 12 mm OD, 75 cm long, M8 Thread
503077	Polished Stainless Steel Post, 12 mm OD, 80 cm long, M8 Thread

Digital Caliper

For easy and accurate measurements



The high quality electronic digital caliper is a useful tool — no laboratory should be without one because it is more accurate and easier to use than the traditional analog devices. Measure in either inches or millimeters at the touch of a button. The floating zero feature allows you to read the increment without calculation. The caliper is made from hardened stainless. The caliper measures up to 150 mm (6 in.) with 0.01 mm (or 0.0005") resolution. The caliper is designed to be water-resistant to IP54 as defined in the IEC529 standard. The IP54 code's first digit "5" means dust-protected. The second digit "4" means that the caliper is protected against splashing water — it can withstand a shower from every direction for 10 minutes.

ORDERING INFORMATION	
501601	Digital Caliper
502157	Replacement Battery (package of 10)

Non-rotating Spindle Digital Micrometer Head

Build your own precision micro-positioning device

The new non-rotating spindle digital micrometer head allows you to create your own micro-positioning instrument. With micron-level accuracy, it gives higher precision than a normal micromanipulator. Since the spindle does not rotate as it advances, instruments can be directly attached without the need for a complicated decoupling device. The digital display eliminates the need to squint at the notational scale. Readings can be clearly seen in either inches or millimeters. You can read both absolute position and the increment relative to a previously chosen point.

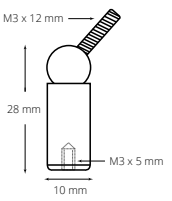
502102 SPECIFICATIONS	
TOTAL TRAVEL DISTANCE	25 mm
RESOLUTION	0.001 mm
ACCURACY	± 0.003 mm
SPINDLE	Ø 8 mm
MOUNTING	Ø 12 mm x 10 mm
TOTAL LENGTH	166 mm
MEASUREMENT MODE	Absolute and incremental
DIGITAL READOUT	mm or inch
ANALOG READOUT	mm
DATA OUTPUT	RS232
ENVIRONMENTAL PROTECTION	IP54
SHIPPING WEIGHT	0.51 kg (1.12 lb.)

ORDERING INFORMATION	
502102	Non-Rotating Spindle Micrometer Head

Powerful Ball Joint Rare Earth Magnet

Construct holding devices for small parts/equipment

- Small but very powerful: holds 2 kilograms (~5 pounds)!
- Steel ball rotates freely 360° on a 180° axis
- M3 mounting screw on ball for attachment to equipment
- Magnet base threaded (M3) for mounting onto a base or equipment



This novel magnetic ball joint has phenomenal holding power for up to 2kg of attached weight while permitting the ball a full 360° rotation on a 180° axis. You can freely orient your equipment to an infinite number of positions within this rotation. This is made possible by the combination of a steel ball (10 mm diameter) and a powerful rare earth magnet contained in the magnet cylinder (ϕ 10 x 20 mm). Convenient M3 attachment sites are provided on both the ball (male) and the magnet base (female). For use with micromanipulators for the positioning and holding of optical instruments including various lighting sources and lasers, pipettes and any small parts that would benefit from the flexibility offered by this new magnetic ball joint.

ORDERING INFORMATION	
500871	Magnetic Ball Joint

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Culture Dishes with Optical Glass Bottom

Cover-glass bottom for observing & growing cells for imaging

Back by popular demand:
Black Wall FluoroDish™

Features

- Optical quality glass bottom for better imaging quality (RI=1.525)
- Low sample volume for expensive chemicals
- Lowest access angle for micropipette
- Black wall available for low background fluorescent measurement

Benefits

- Multiple sizes and designs to suit your application
- Optional Poly-D-Lysine coating for neurons
- Dishes designed for low volumes or large growth areas

Applications

- High resolution image analysis
- Microinjection
- Electrophysical recording of fluorescent-tagged cells
- Black wall available for use with confocal microscopes

WPI's **FluoroDish™** tissue culture dishes provide exceptional imaging quality for many applications requiring the use of inverted microscopes such as high resolution image analysis, microinjection and electrophysical recording of fluorescent-tagged cells. Taking advantage of WPI's extensive experience with low toxicity adhesives, **FluoroDish™** uses a specially formulated adhesive that is optically clear, durable and with extremely low toxicity. Tests by an independent laboratory have shown that the 96-hour surviving rate of embryos is 100% when kept in **FluoroDish™**, substantially better than other brands. The bottom glass has superior UV transmission (30% transmission at 300 nm, compared to less than 7% for the most popular German glass). Stringent quality control ensures that glass thickness is 0.17 ±0.01 mm.

Conventional plastic dishes and chambers limit the use of the inverted scope, because the thick plastic bottom requires a long working distance objective available only in lower magnifications. Each WPI dish has a flat (0.17mm thick), optical quality glass bottom, allowing the use of a much shorter working distance, larger numerical aperture (NA) and higher magnification (up to 100X). The larger NA and higher magnification provide superior quality imaging for both classical and fluorescence microscopy. Higher effective NA yields brighter images for fluorescence and higher resolution in image analysis. The glass bottom permits the use of immersion objectives with media such as water, glycerin or oil for the highest magnification possible. To optimize heat-exchange, WPI's glass-bottom dish is designed to be flush (flat) with the microscope stage or heating unit, eliminating the air gap that exists with modified plastic dishes where a cover slip was inserted.

Multiple sizes

We have a 50 mm diameter dish and two types of 35 mm diameter dishes. An inner well is created within the dish by the glass bottom and the tissue culture grade polystyrene which forms the sides of the dish. They are individually packed and gamma sterilized.

The 35 mm dish has outside dimensions similar to that of a Corning 35 mm dish and has ø23.5 mm glass window (**FD35**) or ø10 mm glass window (**FD3510**). Most heaters and perfusion adapters designed for the Corning 35 mm dish also fit this dish.

Poly-D-Lysine coating or uncoated

The 23.5 mm glass dish is available uncoated or poly-D-lysine-coated. Some cell lines (e.g., PC3 and HEK) adhere well to the uncoated glass bottom dish. The poly-D-lysine coating reportedly improves the adhesion of neuron cells. You may also apply any special coating that is best for your cell line to uncoated dishes.

Low volume dishes or large growth areas

The 10 mm glass dish (**FD3510**) has low sidewalls for easy microelectrode access and low solution volume. The low microelectrode access angle is the lowest among all of 35 mm dishes on the market (very close to that of a 50 mm dish). The dish needs only about 115 µL to cover the bottom well, an important feature when using expensive drugs and chemicals.

The 50 mm dish (**FD50**) has a large growth area (35 mm well diameter), a low access angle for microelectrodes, and grips for easy handling.

References

Petros Batsios, Xiang Ren, Otto Baumann, Denis A. Larochelle, Ralph Gräf, Cells. 2016 Mar; 5(1): 13. Published online 2016 Mar 18. doi: 10.3390/cells5010013 PMCID: PMC4810098

P. Calcraft, A. Arredouani, M. Ruas, Z. Pan, X. Cheng, X. Hao, J. Tang, K. Rietdorf, L. Teboul, K. Chuang, P. Lin, R. Xiao, C. Wang, Y. Zhu, Y. Lin, C. Wyatt, J. Parrington, J. Ma, A. M. Evans, A. Galione, M. Zhu. Nature. 2009 May 28; 459(7246): 596–600. Published online 2009 April 22. doi: 10.1038/nature08030 PMCID: PMC2761823

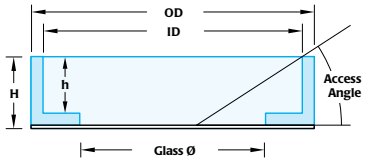
T Mitra-Ganguli, I. Vitko, E. Perez-Reyes, A. Rittenhouse. *J Gen Physiol.* 2009 November; 134(5): 385–396. doi: 10.1085/jgp.200910204 PMCID: PMC2768804 ArticlePubReaderPDF–3.0 m

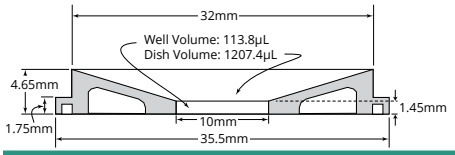
S. Khuon, L. Liang, R. Dettman, P. Sporn, R. Wysolmerski, T. Chew. *Cell Sci.* 2010 February 1; 123(3): 431–440. Published online 2010 January 12. doi: 10.1242/jcs.053793 PMCID: PMC2816188

SPECIFICATIONS

Style	ID (mm)	OD (mm)	Glass Ø (mm)	height (inside)	Height (outside)	Access Angle
FD35	33	35.5	23.5	7.8	9	29°
FD5040	47.5	49.82	35	7.25	7.4	17°

Standard FluoroDish™





FD3510

ORDERING INFORMATION

FD35-100	FluoroDish™ Sterile Culture Dish, clear wall, 35 mm, 23 mm well, box of 100
FD35B-100	FluoroDish™ Sterile Culture Dish, **black wall**, 35 mm, 23 mm well, box of 100
FD35PDL-100	FluoroDish™ Sterile Culture Dish, Poly-D-Lysine Coated, clear wall, 35 mm, 23 mm well, box of 100
FD3510-100	FluoroDish™ Sterile Culture Dish, clear wall, 35 mm, 10 mm well, low sidewall, box of 100
FD3510B-100	FluoroDish™ Sterile Culture Dish, **black wall**, 35 mm, 10 mm well, low sidewall, box of 100
FD5040-100	FluoroDish™ Sterile Culture Dish, clear wall, 50 mm, 35 mm well, box of 100
FD5040B-100	FluoroDish™ Sterile Culture Dish, **black wall**, 50 mm, 35 mm well, box of 100

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TERMS & CONDITIONS

WPI values its customers and will make every effort to maintain the highest professional and ethical standards. However, WPI regards as invalid any special terms and conditions set forth by any other party, including purchasing, quotations, warranties or other statements. WPI's response to a quotation, purchase order or inquiry shall not be construed as acceptance of any conditions stated therein.

Credit Terms

Net 30 days from date of invoice to customers with satisfactory credit references.

Standard Equipment & Accessories

To insure against misunderstandings or delays, always include model number, name, and significant specifications of systems and accessories when ordering. Also specify any options desired. WPI retains the right to change specifications or discontinue products without prior notice and without responsibility for incorporating such changes into equipment previously sold. Please state the desired operating line voltage and frequency.

Warranty

WPI strives to maintain the highest quality standards in all products. We warranty these products against defects in workmanship or materials, and all WPI products retain a warranty that is stated in the product's manual. (Typically, one year for parts and labor except for consumable items such as electrodes, glass, etc., for which warranty varies from 30 days to six months, or as otherwise specified.) However, WPI hereby specifies that no use or application of any product may be suitable or successful for a specific application and therefore waives all liability in that regard. It is the sole responsibility of the buyer/user to apply the product in a manner consistent with its intended use.

WPI products are not approved for human use unless specifically stated in writing with accompanying FDA (or applicable) documents. WPI assumes no liability or legal, moral, ethical, or fiduciary responsibility for a use of any product in the WPI catalog in treating or studying humans.

Prices

WPI maintains competitive world wide pricing. Prices listed for standard items as described are net and subject to change without notice. Prices (in U.S. dollars) do not include shipping charges. Formal quotations are valid for a period of 30 days unless otherwise specified. Purchases may be charged to your VISA, MasterCard, or American Express account.

Taxes

We reserve the right to add any taxes required by local law or ordinance. Institutions operating under tax-free conditions must state applicable license or contract number and be prepared to furnish necessary exemption certificate.

Packaging and Shipping

Equipment is shipped in adequate commercial packing. All packages should be checked thoroughly before being discarded. Shipping and handling expenses, including adequate insurance coverage, are paid by the customer.

Claims and Returns

Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within ten (10) days after receipt of shipment. Claims for lost shipments must be made within thirty (30) days of receipt of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim is settled. In some instances, photographic documentation may be required. Some items are time-sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container

Do not return any goods to us without obtaining prior approval and instructions from our Returns Department. Goods returned unauthorized or by collect freight may be refused. Goods accepted for restocking will be exchanged or credited to your WPI account and are subject to a restock fee of up to 25%. Goods returned which were ordered by customers in error are subject to a 25% restock fee. Equipment which was built as a special order cannot be returned.

Repairs

Contact our Returns Department for assistance in the repair of apparatus. Do not return goods until instructions have been received. Returned items must be securely packed to prevent further damage in transit. The Customer is responsible for paying shipping expenses, including adequate insurance on all items returned for repairs. Identification of the item(s) by model number, name, serial number and proof of purchase (packing slip number or invoice number) as well as complete description of the difficulties experienced should be written on the RMA request form and a copy of the form must be included with the item.

ORDERING INFORMATION

Orders from **North America** should be directed to WPI's main office:

World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota, Florida 34240-9258

Telephone: (941) 371-1003 (collect calls not accepted). Facsimile copies of purchase orders, inquiries or other correspondence may be transmitted to WPI's Fax number: (941) 377-5428. When sending written purchase orders to confirm a telephone order, please clearly mark "CONFIRMING" on the order to avoid it being shipped a second time. Our Sales Department's e–mail address is: sales@wpiinc.com

North American customers may also order many products online through WPI's Web site — www.wpiinc.com. All customers may use the online Quote Request Form and online Purchase Order Form.

Orders from **Belgium**, **Denmark**, **Eire**, **Finland**, **Luxembourg**, **Norway**, **Portugal**, **Spain**, **Sweden**, **Switzerland** (FR) and the **United Kingdom** should be directed to

WPI UK: 1 Hunting Gate
Hitchin, Hertfordshire SG4 0TJ England
Tel: +44 (0)1462 424700 Fax: +44 (0)1462 424701
E-mail: wpiuk@wpi-europe.com

Customers in **France** may call +33 (0)970 44 9000 or
E-mail: wpifr@wpi-europe.com

Orders from **Austria, Germany, Greece, Italy, Malta, Netherlands, Russian States, Switzerland** (DE) and **Turkey** should be directed to

WPI Germany: Saarstrasse 23
D-61169 Friedberg, Germany
Tel: +49 (0)6031 1602171 Fax: +49 (0)6031 1602180
E-mail: wpide@wpi-europe.com

Orders from **China**, **Hong Kong** and **Taiwan** should be directed to

WPI China: WPI Shanghai Trading Co., Ltd.
Rm 25e, No8 Dong Fang Rd., Lu Jia Zui Financial District
Shanghai PRC
Tel: + 86 688 85517
Email: chinasales@china.wpiinc.com

Orders from **Brazil** should be directed to

WPI Brazil: Av: Conselheiro Nebias, 756 sala 2611
Santos - Sao Paulo - Brasil
CEP: 11045-002
Email: Info@brazil.wpiinc.com

Orders from the countries listed below should be directed to the appropriate WPI distributors. All other international orders should be directed to WPI's main office and factory in Sarasota, Florida.

To expedite shipment of orders outside North America (other than to areas served by the international offices above), payment must be made in advance via wire transfer, check payable in U.S. dollars, or charged to a credit card. Proforma Invoices will gladly be furnished upon request. Please specify proper electrical current for your order.

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