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Laboratory Equipment, Instruments and Supplies

2016 International Catalog





WORLD PRECISION INSTRUMENTS, INC.

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Dear Valued Customer,

First and foremost, thank you for your continued patronage. Our core values are driven by a desire to empower you to actualize your scientific ideas with cost-effective, quality instruments. We always strive to provide you more for less.

This year, we have once again renewed our commitment to quality and value, which is reflected in our new look. We have implemented measures (like our ISO-9001:2008 certification) throughout our home office and production facility to improve our efficiency and ensure quality for the benefit of our customers. We strive to operate with the highest standards of integrity and efficiency.

Since our earliest days, WPI has designed laboratory equipment for researchers. Our founder Harry Fein began developing electrophysiology equipment for Yale University researchers in the seventies. Nearly 50 years ago (1967) WPI was born out of Harry's passion for the advancement of science. Since then, we have worked hand-in-hand with researchers to create the equipment needed to facilitate modern science and advance biomedical research. We continue to offer the instruments that empower your scientific ideas.

Now, we are a multi-national company with offices in four countries and distributors all over the world. Originally, we specialized in electrophysiology, and now we are in several areas of study, the core being in tissue and cell biology, animal physiology and electrophysiology. Additionally, we offer a full range of quality surgical instruments, general laboratory equipment and supplies, such as microscopes and pipettes.

We look forward to serving you for many years to come. If you have questions or need assistance ordering, our customer service team is ready to help.



Best regards,

A handwritten signature in blue ink, appearing to read 'Cliff Bredenberg'.

Cliff Bredenberg
WPI President and CEO

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Cell Tester System

The **SI-CTS200** system is a revolutionary new research tool for studying single living cells. This 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 using an innovative experimental paradigm. The Cell Tester provides researchers with the comprehensive ability to investigate and characterize the physiological, biomechanical and biophysical properties of single isolated living cells, and to extend these findings to both the sub-cellular and multi-cellular levels. The **SI-CTS200** systems can be used on single living cells, small multi-cellular preparations or skinned muscle fibers and strips without modification. 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.

The Cell Tester is an integrated system of components needed to maintain and handle single living cells, stimulate and perform perturbations of the cells, and detect, amplify, and record signals, like contractile force, from the cells.

- Optical transducer for measuring force with nN sensitivity and integrated vacuum attachment system for cell attachment. Lifetime warranty on optical heads.
- Equipped with a nanomotor for stretching and relaxing cell with nm resolution.
- A rotating cuvette system for easy alignment of cells increases productivity. Interchangeable

bath inserts provide a range of options for the handling of live cells.

- Signal conditioning amplifier system includes a force transducer amplifier with multiple gains, a position controller for moving the nanomotor used to stretch and relax cells and to open and close the microtweezers, a 2-channel temperature controller, and an anti-oscillation unit for eliminating the resonance frequency of the transducer and its mounting support.
- **Lab-Trax-8/16** data acquisition system with **MDAC** software records force signals, motor positions and other data through four analog inputs. It is designed for controlling the stimulator and the position of the linear motor through two analog outputs and other devices through two digital outputs.

New Stretch Dependent Signaling Pathway Discovered in Cardiac Ventricular Myocytes termed "X-ROS"



The manipulators tilt up and fold back to facilitate system setup. There are two programmable memory positions (home and target) for easy exchange of the 35mm dishes, providing access to the bath so you can add the live cells. The combination of these features enables high experimental throughput.



The **SI-CTS200** system utilizes a unique rotating bath to dramatically improve experimental throughput. It is designed to orient cells in the XY plane so that no physical manipulation of the position of the cell itself is required prior to capture by the grabbing devices attached to the force sensor and linear actuator.

This bath has two interchangeable inserts. The first holds any 35mm glass bottom dish (WPI #FD35-100). The second is a native cuvette insert containing the live cells.

Signal Conditioning Amplifier System with CTS200 Electronics



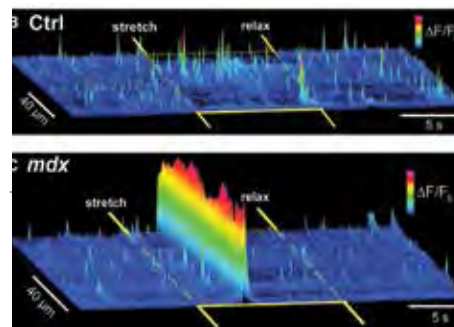
SI-BAM21-LCB Optical Transducer Amplifier
 SI-CISB Position Control Module
 SI-AOSUB Anti Oscillation Unit
 SI-TCM2B Temperature Control Module
 Expansion Slots
 Power Switch

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); MyoTak Bio-adhesive kit (5-week supply)

SI-CTS200B Cell Tester, Non-Rotating, No Micromanipulators

SI-CTS200A Cell Tester, Manual Platform, No Micromanipulators



A confocal microscope in linescan mode is used to record calcium spikes. The healthy cell in the top image shows a marked increase in number and intensity of calcium sparks over the duration of the stretch. The diseased muscle in the bottom image shows fewer sparks when at rest and a profound increase in sparks of short duration during the stretch.

Introduction

- Control of cardiac Ca²⁺ release is critical for the regulation of contraction and maintenance of electrical activity.
- A new signaling pathway was discovered: X-ROS signaling.
- It regulates normal Ca²⁺ release in healthy heart cells and may drive pathologic Ca²⁺ release in diseased cells.

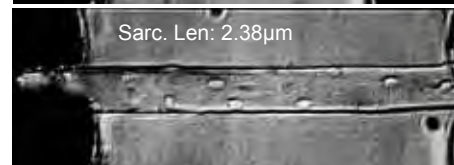
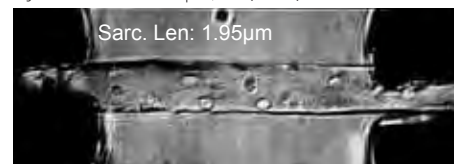
Results

- Stretch triggers the generation of ROS by NOX2
- Stretch-dependent process activates NOX2 production of ROS which reversibly oxidizes nearby RyR2 ryanodine receptors.
- X-ROS oxidation tunes the sensitivity of the RyR2s, increasing the Ca²⁺ spark rate and enhancement of Ca²⁺ signaling.
- During a sustained stretch of a cardiomyocyte in a Cell Tester, a rapid elevation of ROS production subsides over the duration of stretch.
- During a repetitive cyclical stretch, a new level of steady-state ROS production is maintained.

Conclusion

The level of steady state ROS generation in the cell may be graded by diastolic length or pre-load.

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



A single skeletal muscle cell is held with micro-tweezers. The top image shows the unstretched cell, and the bottom shows the stretched cell.

Muscle Research System

MUSCLE PHYSIOLOGY

The **SI-MKB** is the next research platform in the progression of studying living systems from the cellular level to whole organisms. It is the standard muscle research system, which can be configured to study skinned and intact muscle fibers, muscle strips and small whole muscles. The modular design of the **SI-MKB Muscle Research Platform** allows it 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 **Horizontal Tissue Bath** systems, the **SI-MKB** uses **SI-KG** optical force transducers and is constructed with corrosion-free materials (stainless steel, anodized aluminum and plastic).



Can be configured with specific components, like a linear motor or a stimulator, for measuring:

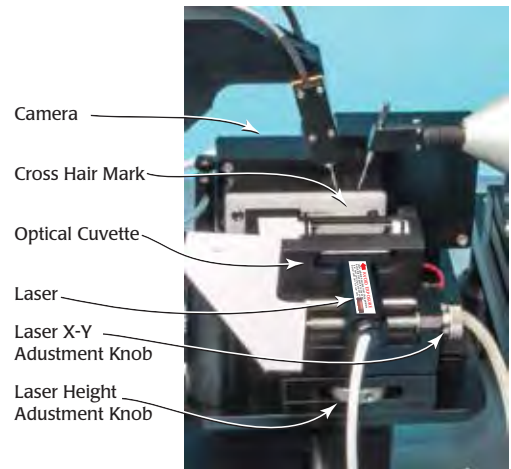
- Responses to electrical stimulation, including tetany
- Mechanical properties of contracting and relaxing muscle strips
- Isotonic force and the effects of constant load
- Twitch amplitude and kinetics, like contraction and relaxation times and velocities
- Slack, quick stretch-release, constant velocity and eccentric contraction tests
- Vibrational studies that simulate unloaded muscle shortening
- Quick temperature-change effects on skinned and intact muscle fibers

Can be equipped with components, like a laser diode or a photometer, for measuring:

- Sarcomere length/spacing by laser diffraction at the same time muscle force is measured
- Intracellular calcium concentration/distribution in intact muscle fibers as muscle force is measured
- ATPase activity in skinned muscle fibers as muscle force is measured

Supplied with a Labtrax 8/16 data acquisition system and MDAC software for:

- Recording signals from the force transducer and the motor position monitor, through four analog inputs
- Controlling the stimulator, or an external stimulus isolator, through an analog output
- Controlling the position of the linear motor through a second analog output
- Controlling other devices through two digital



The Sarcomere Spacing Assembly has the optical cuvette, laser diode array and camera in one unit. It also includes the electronic control module. See page 10.

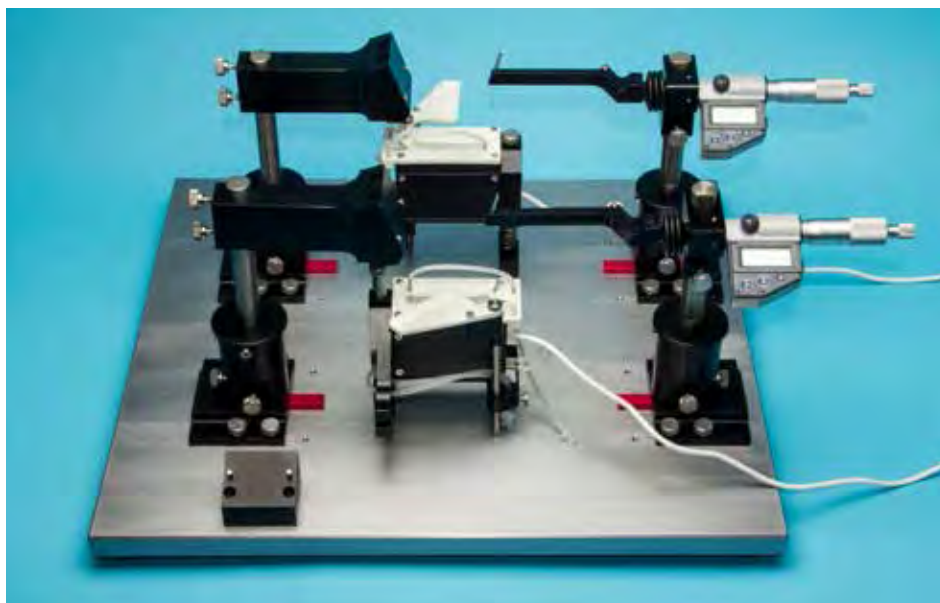
SOME SYSTEMS AVAILABLE FOR INTACT MUSCLE FIBERS INCLUDE:

SI-MKBM	System with a 5cm heated cuvette and a linear motor
SI-MKB	System with a 5cm heated cuvette and a 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), **Lab-Trax 8/16** data acquisition system with MDAC software for recording force and position signals and for controlling stimulation and the movement of the linear motor.

Horizontal Tissue Bath

Research system for higher throughput of complex pharmacological/physiological assays



The new 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.

- 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 μ L–10mL
- Modular, space-saving, blade-style electronics (Control up to 4 channels with the electronics in one chassis)
- Large variety of force transducers covering mN–N forces, all with lifetime warranty
- Can be combined with automated fluid control systems
- Add a linear motor and controller (**SI-MOT**) to perform mechanical, electrophysiological and optical techniques, including isometric (standard), isotonic, eccentric and auxotonic
- Add an electrometer like the WPI **Duo773** or **Electro705**
- Add the multi-purpose Biofluorimeter (**SI-BF-100**) for tissue fluorescence (calcium, NO_x, ROS). See page 6.

Multiple Bath Options

The **SI-HTB** system breaks through the (large) volume limitations of the traditional organ bath, allowing volumes as low as 500 μ L 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 complement this freedom 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

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, auxotonic 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 a length change solution (software/hardware) like WPI's **MDAC** package.

Future is Now

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 Biofluorimeter allows for tissue fluorescence measurements (calcium, NO, ROS) 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.

Options

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

SI-HTB2	Horizontal Tissue Bath, 2-Channel System
2-Channel SI-HTB platform for isometric force (1)	SI-KGX Force Transducers (2)
SI-BAM21LCB Optical Force Transducer Amplifiers (2)	SI-TCM2B 2-Channel Temperature Controller (1)
Signal Conditioning Amplifier System Chassis (1)	
SI-HTB4	Horizontal Tissue Bath, 4-Channel System
2-Channel SI-HTB platform for isometric force (2)	SI-KGX Force Transducers (4)
SI-BAM21LCB Optical Force Transducer Amplifiers (4)	SI-TCM2B 2-Channel Temperature Controller (2)
Signal Conditioning Amplifier System Chassis (1)	
SI-HTB2M	Horizontal Tissue Bath, 2-Channel Motorized System
2-Channel SI-HTB platform for isometric force (1)	SI-KGX Force Transducers (2)
SI-BAM21LCB Optical Force Transducer Amplifiers (2)	SI-TCM2B 2-Channel Temperature Controller (1)
SI-MOT Linear motor with controllers (SI-MOTDB) (2)	SI-AOSUB Anti-oscillation Unit (2)
Signal Conditioning Amplifier System Chassis (1)	MDAC Data Acquisition software (1)
SI-HTB4M	Horizontal Tissue Bath, 4-Channel Motorized System
2-Channel SI-HTB platform for isometric force (2)	SI-KGX Force Transducers (4)
SI-BAM21LCB Optical Force Transducer Amplifiers (4)	SI-TCM2B 2-Channel Temperature Controller (2)
SI-MOT Linear motor with controllers (SI-MOTDB) (4)	SI-AOSUB Anti-oscillation Unit (4)
Signal Conditioning Amplifier System Chassis (2)	MDAC Data Acquisition software (1)



Biofluorometer

Now even more reliable, simplified and affordable



MUSCLE PHYSIOLOGY

The new **SI-BF-100** is an LED-based fluorometer for life science applications. It is ideally suited for ratiometric calcium detection (FURA-2) and ATPase detection (via NADH fluorescence). With up to seven LED modules (wavelengths), the **SI-BF-100** covers many fluorometric applications in neuroscience and cell biology.

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 380nm and produce more light in those spectra. This technology significantly cuts the cost of photometric calcium imaging without sacrificing resolution or quality.

- LED light sources require less power, give off less heat and are more compact and affordable
- Sampling rates up to 1kHz (1,000 ratios/second maximum). At lower speeds, signal averaging is used for noise reduction.
- Two auto ranging photomultiplier inputs allow you to monitor multiple wavelengths from a single emission output that can be comprised of any wavelength of light for which an LED module is available
- Using a separate reference channel, ultra-stable, continuous ratio calculations automatically compensate for LED intensity drift. This ensures less noise and produces more accurate measurements.
- Application-specific probes are available for existing tissue baths and cuvette systems.
- Ratio noise is <0.05 peak to peak, drift is less than 0.1 unit/hour
- The warm up time of less than one minute is a dramatic improvement over the common 20–60 minutes required by xenon or mercury light sources
- Replace the emission filter easily or change the LED modules to transform the **SI-BF-100** into a general purpose fluorometer for many other applications

How it Works

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 designs.

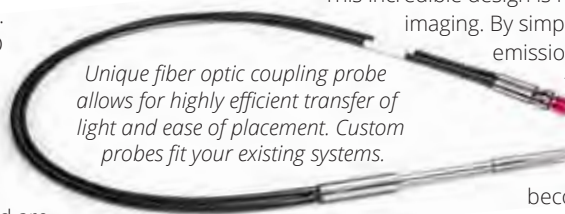
Monochromatic LED light sources using WPI patented technology eliminate the need for complex and expensive white light sources and filter wheels. Because the LED modules can be pulsed, sampling frequencies up to 1,000 cycles per second are possible.

The LED light source emits specific excitation frequencies which travel through the probe. The excitation light can be comprised of any wavelength of light for which an LED module is available. The probe returns a single emission

output to one or two photomultiplier inputs on the front of the **SI-BF-100**, which are independently filtered for specific wavelengths. This design allows you to monitor multiple wavelengths from a single emission output.

The LED light source in the WPI design makes this ratiometric fluorometer more compact, energy efficient and affordable. As added benefits, the low-power light source produces much less heat, and it warms up in less than one minute!

This incredible design is not limited to calcium imaging. By simply replacing the emission filters in front of the photomultipliers with the desired wavelength filters, your **SI-BF-100** becomes a general purpose fluorometer for any application you can imagine. Changing a filter involves removing the two screws that hold the filter carriage on the face of the **SI-BF-100**, swapping the filter and reinstalling the integral SMA/filter carriage.



Unique fiber optic coupling probe allows for highly efficient transfer of light and ease of placement. Custom probes fit your existing systems.

SI-BF-100 Biofluorometer

OPTIONAL COMPONENTS

M3301R	Manual Manipulator, right-handed
M3301L	Manual Manipulator, left-handed
M10	Magnetic Base

SI-BF-100 SPECIFICATIONS

CALL FOR APPLICATION

FIBER OPTIC LIGHT INPUT/OUTPUT	.....SMA terminated
BANDWIDTH	.....1000 ratios/second
RATIO NOISE	.....< 0.1 peak to peak
ANALOG OUTPUT RANGE	.....0–10V (continuous, equivalent to a ratio 0–10)
ANALOG OUTPUT IMPEDANCE	.....100 Ω
POWER	.....12VDC, 0.5A, (universal power supply, 110/240VAC)
WARM UP TIME	.....<1 minute
DIMENSIONS	.....3.5"H x 17"W x 13"D (88 x 431 x 330 mm)

In-Vivo Applications of SI-BF-100 Using Voltage Sensitive Dyes

- Monitor electrical activity over large areas of intact brain without the limitations of microelectrode arrays
- Simultaneously monitor electrical activity and calcium concentration
- Genetically-encoded fluorescent probes make it possible to monitor neurotransmitter behavior over entire regions of intact tissue
- Integration with miniature fiber optic arrays or micro-scale endoscopes allow for measurements on animals while conscious and mobile

The new **SI-BF-100** is an LED-based fluorometer for life science applications. With up to seven LED modules (wavelengths), the **SI-BF-100** covers many fluorometric applications in both Neuroscience and Cell Biology. This technology significantly cuts the cost of fluorescent imaging without sacrificing resolution or quality.

Using the **SI-BF-100** Biofluorometer equipped with high intensity LED modules

and an appropriate fiber-optic probe, a researcher can perform many different types of analysis on intact tissue *in vivo*. Some potential applications include simultaneous measurement of membrane potential and calcium concentrations. With the use of genetically-encoded fluorescence probes,



WPI's **SI-BF-100** Biofluorometer probes include both the excitation and emission light fibers. See page 199.

the applications are limited only by the imagination of the researcher.

The use of a probe allows for the measurement of entire areas of the intact brain without the limitations presented by the placement of arrays of microelectrodes. By removing these limitations, the researcher is able to collect data over larger groups of neurons without placing a single electrode.

Miniature fiber-optic arrays and microscale endoscopes have already been developed for use in Neuroscience. Coupling this technology with the **SI-BF-100** allows the research to be conducted on conscious and mobile animals. By not requiring the animal to be attached to a traditional light source, more accurate results can be obtained.

The **SI-BF-100** eliminates the need for expensive and complicated arrays of microelectrodes to conduct studies *in vivo*. Larger areas can now be completely analyzed at a fraction of the cost with a significant reduction in experimental complexity.

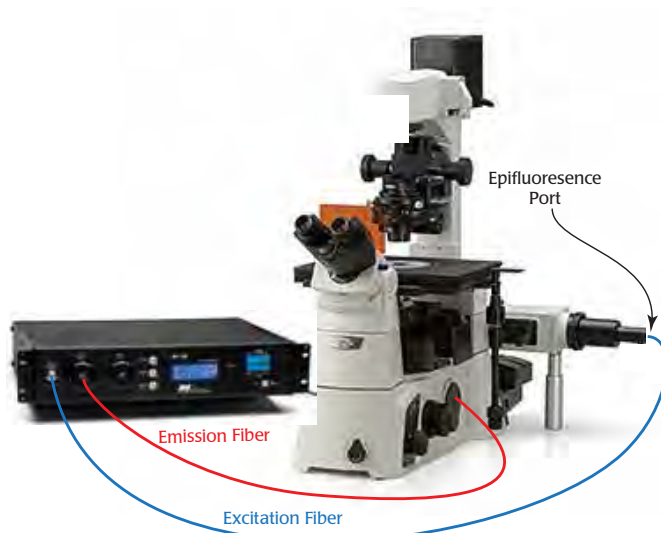
Microscopic Imaging Applications Using Voltage Sensitive Dyes

- Monitor membrane potential over small networks in cell culture
- Monitor surface membrane potential in a single cell
- Simultaneously monitor electrical activity and calcium concentration
- Integration of fluorescence microscopy onto existing patch-clamp setups
- Genetically-encoded fluorescence probes make it possible to monitor neurotransmitter behavior between cells in cell culture samples
- With the addition of a CCD, traditional spatial imaging can be conducted

The new **SI-BF-100** Biofluorometer is an LED-based fluorometer for life science applications. With up to seven LED wavelength modules (three when using the high power Biofluorometer), the **SI-BF-100** covers many fluorometric applications in both Neuroscience and Cell Biology. This technology significantly cuts the cost of fluorescence imaging without sacrificing resolution or quality.

Using the **SI-BF-100** Biofluorometer equipped with high intensity LED modules and coupling to an inverted microscope, a researcher can perform many different types of analysis on both single cells and small cell cultures. Some potential applications include simultaneous measurement of membrane potential and calcium concentration. With the use of genetically-encoded fluorescence probes, the applications are limited only by the imagination of the researcher.

The **SI-BF-100** uses LED technology, eliminating the need for expensive secondary external light sources and project-specific filter cubes. With the potential for seven different LED modules inside every Biofluorometer, more fluorophores can be analyzed simultaneously, without the need for expensive filter wheels and external timing devices.



The Biofluorometer can connect to the epifluorescence port of a microscope, and its high intensity LED light source is used for the illumination.

Signal Conditioning Amplifier System

Choose the amplifier modules you need to measure nearly anything!

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

Signal conditioning in the last decade has increasingly moved in the direction of the computer, because 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 and the outputs from electrochemical free radical sensors. 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.

The system consists of an 8-channel frame that 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.

When the system is ordered with **SI-MKB** (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-PF100** Programmable Filter Module, the **SI-SARCAM** Sarcomere Spacing Module and the **SI-COLUB** Constant Load Unit. The Temperature Control Module, Linear Motor Controller and Sarcomere Spacing Module require two slots each on the chassis backplane.

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.

Modules currently available include:

- **SI-BAM21-LCB** Optical Transducer Amplifier
- **SI-PF100** Programmable Filter Module
- **SI-SARCAM** Sarcomere Spacing Module
- **SI-MOTDB** Linear Motor Control Module
- **SI-TCM2B** Temperature Control Module
- **SI-COLUB** Constant Load Module



SI-BMFA Power Frame Enclosure



Optical Transducer Amp

The **SI-BAM21-LCB** KG Optical Force Transducer Amplifier 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 KG optical force transducers to:

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

Features

- Rapid Auto Zeroing function with fine offset adjustment
- Offset indicator LED's
- Multiple gain ranges with adjustable fine tuning for precise calibration

- Digital interface for optional Anti-Oscillation module for use in isotonic studies

Also available in a single standalone 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 X10 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 -10V to +10V 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-MKB** Muscle Tester system, the signal is routed internally from the **SI-BAM21-LCB** module to the **SI-AOSUB** module.



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

ACCESSORIES

2851	BNC Cable
SI-KG2	0-2N Force Transducer
SI-KG2B	0-0.2N Force Transducer
SI-KG4	0-50mN Force Transducer
SI-KGxx	contact us for specialty transducers with different ranges

See Optical Force Transducers on page 13.

SI-BAM21-LCB	Optical Transducer Amplifier
SI-BAM21-LC	Standalone Optical Force Transducer Amplifier

SI-BAM21-LCB SPECIFICATIONS

Input Configuration	Current to voltage converter
Gain	1x, 2x, 5x, 10x
Optional factory setting:	10x, 20x, 50x, 100x
Input Offset Adjustment	± 2.0 VDC
Output Impedance	470 Ω
Power	12 VDC provided by chassis
Output Range	± 10 VDC

Signal Conditioning Amplifier System

Sarcomere Spacing Module

The **SI-SARCAM** Sarcomere Spacing Module was designed for the **SI-MKB** and **SI-HTB** systems. It consists of a linear diode array detector coupled with a calibrated controller (shown below). Together with the laser diode system, it facilitates the calibrated measurement of sarcomere length in striated muscle samples. The **SI-SARCAM** can be combined with mechanical intact muscle parameter measurements with the **SI-MKB** and **SI-HTB** systems. It can be combined with calcium measurements and myomechanics in intact and skinned muscle fibers when you are using the **SI-MKB** system. The **SI-SARCAM**

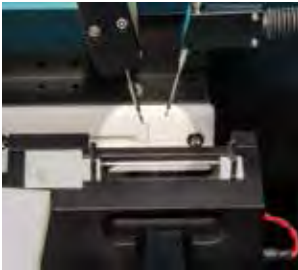
module requires two of the eight module positions in the chassis.

How It Works

A red laser diode ($\lambda=650\text{nm}$) is used. A one-dimensional (linear) CCD camera with a time resolution of 1ms scans the light intensity of the diffraction pattern beginning 6.8mm from the center beam. The camera scans only half the diffraction pattern, assuming that the pattern is symmetrical with respect to the center beam. When the scan arrives at the part of the CCD chip which is hit by the first order diffraction of the pattern, the output voltage increases to a peak level, and the first order of diffraction is captured. Then, the intensity signal decreases again. The sarcomere length is calculated from the first order diffraction distance. See the full article at

www.wpiinc.com/sarcam.

A cross hair mark used for aligning the laser is etched on the front of the camera, which is mounted just behind the optical cuvette.



SI-SARCAM
Sarcomere Length Control Module

Temperature Control

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.

- Controls two cuvettes simultaneously
- Uses PID control to maintain a constant temperature with $\pm 0.1^\circ\text{C}$ tolerance
- Has both high and low alarm warnings which can be user defined
- Easy to control with simple interface
- Also available as a stand-alone device — call for details and price.

SI-TCM2B
2-Channel Temperature Control Module
SI-TCM2
2-Channel Temperature Control Standalone



SI-SARCAM SPECIFICATIONS

INPUT CONFIGURATION	Current to voltage converter
LASER	Red laser diode
LASER WAVELENGTH	650 nm
CAMERA	Linear CCD Camera
POWER REQUIREMENTS	12V DC provided by the chassis
MAXIMUM POWER CONSUMPTION	1.3A AT 115V 50/60HZ, 1.8A AT 230V 50/60HZ

SI-TCM2 SPECIFICATIONS

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

See the Sarcomere Spacing Assembly on page 4.



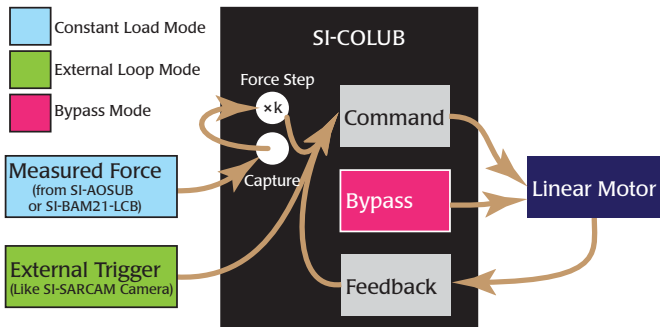
Constant Load

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 **SI-COLUB 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 isometric contraction. 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.

- Offers three modes including Constant Load, Eternal Loop and Bypass
- Can be configured using MDAC software and Lab-Trax 8/16 data acquisition system



SI-COLUB Constant Load Module

SI-COLUB SPECIFICATIONS

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

SI-PF100 Programmable Filter Module

When you use a motor, an **SI-PF100** 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-PF100** Programmable Filter, the signal is routed internally from the amplifier (**SI-BAM21-LCB** module) to the **SI-PF100**. 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.

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



SI-PF100 Programmable Filter Module

SI-PF100 SPECIFICATIONS

POWER	12 VDC provided by chassis
INPUT	± 10 VDC
CUTOFF FREQUENCY RANGE	5–1000Hz
FILTER TYPES	Bessel, Butterworth

Signal Conditioning Amplifier System

Linear Motor Control

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 for measuring mechanical muscle properties such as slack-test, isotonic release, constant velocity release, stretch release, vibration studies, 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 (**Lab-Trax 8/16**). The data acquisition analog output signal is set to define the waveform and timing pattern of force to be applied to the sample.

The Linear Motor Controller has been designed with an automatic shutoff feature. That means that the voltage driving the motor automatically shuts off if the motor draws too much current. After less than a second, the motor cycles back on again. If the setup still draws too much current, it repeats the power down cycle. This could happen if too much force is being applied to the sample. The system continues to cycle the motor off and on until the force on the motor is reduced. If this happens, the motor hums as if it is trying to work, but the motor produces no force output. If an auto-shutdown occurs, adjust the experiment and force tension on the motor.

The motor is setup and calibrated to the Linear Motor Controller that is shipped with it. The motor and controller have a maximum range of motion of ± 3.5 mm from the center of travel.

The *Position In* BNC interface provides for an external position command input. The input range is ± 10 VDC. The signal presented at the input will affect the length of motor travel. The motor/controller combination are calibrated for travel of 1.0mm/2.0VDC. For example, +7VDC translates to +3.5mm of travel from the center, and -7VDC equals -3.5mm of travel from the center. This input could come from the **Lab-Trax-8/16** Data Acquisition system or an **SI-COLUB** Constant Load Module.

NOTE: Use of a linear motor with a muscle testing platform creates vibration which excites the sensor's resonant frequency and requires an Programmable Filter module (**SI-PF100**) for best results.

- 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 **Lab-Trax-8/16**) to allow the programming to control the waveform and timing of the motor control



The SI-MOT motor can be used with any SI-HTB Horizontal Tissue Bath or SI-MKB Muscle Research System.



- Input range of ± 10 VDC
- Over current protection that automatically shuts down when the supply voltage dips below the reference value
- Linear motor position is determined by a DC value applied from the Position In port

SI-MOT-MT Linear Motor for SI-HTBM system

SI-MOT-MKB Linear Motor for SI-MKB

SI-MOTDB Linear Motor Controller

SI-MOTDB SPECIFICATIONS

POWER REQUIREMENTS	12V 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)

KG Optical Force Transducers



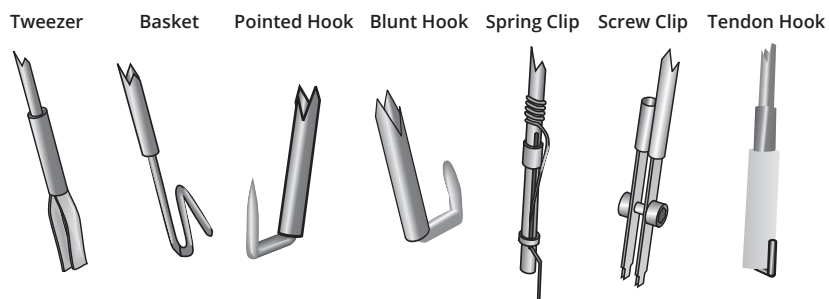
- Different models to accommodate a wide range of forces and sensitivities
- Nearly insensitive to changes in temperature and ambient light
- Extremely high level of linearity
- Virtually indestructible with normal use
- Lifetime warranty

- Simple calibration
- KG transducers are required for use with **SI-BAM21**-type amplifiers

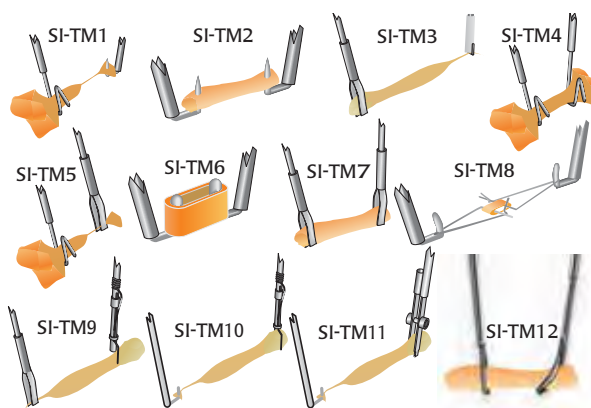
Tissue Mounting Hooks

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.



*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.



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

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-MKB** or **SI-HTB** system.

Ordering

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

TRANSDUCER SPECIFICATIONS					
Unloaded transducer without tissue mounting support					
	Force Range	Range	Noise	Compliance (nm/mN)	Resonance Frequency
SI-KG2	0-2 N	0-200 g	250 μ N	150	1.3 kHz
SI-KG2B	0-0.2 N	0-20 g	80 μ N		590 Hz
SI-KG4	0-50 mN	0-5 g	15 μ N	0.5	1.2 kHz
SI-KGxx	contact us for specialty transducers with different ranges.				

	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

BioTester

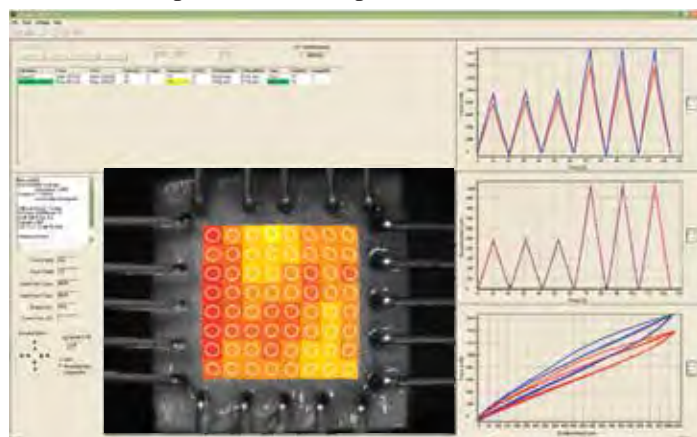
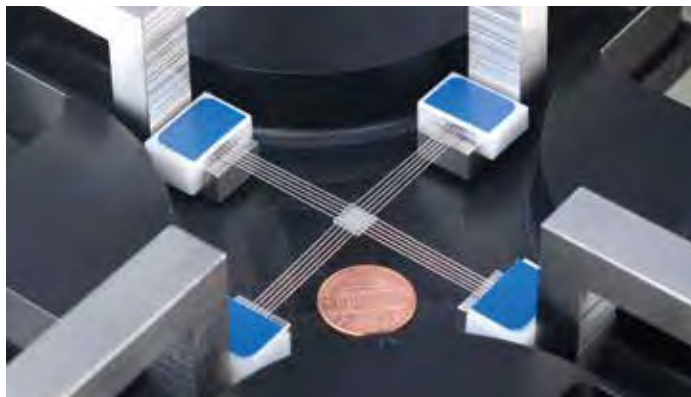
Biaxial Test System For Biomaterials

The BioTester offers you a complete system for examining any planar biological or replacement tissue—skin, ligaments, blood vessels, heart valves, sclera, membranes and scaffolds! Powerful image tracking and analysis software delivers synchronized data, image and video management.

- Quick and easy sample mounting
 - High Resolution (integrated) CCD camera provides synchronized video tracking for live images (up to 15 frames/sec) and real-time analysis
 - Image tracking and analysis software offers real-time data graphing and imaging to confirm the quality of the data collected
 - Precision measurement of small samples (3mm-15mm square)
 - Uniaxial or biaxial tension tests of planar tissues
 - Multi-modal cyclic, simple and relaxation testing
- Export data to spreadsheets or other scientific modeling software
Synchronized data, image and video management



The unique tungsten BioRakes easily pierce the toughest and most delicate soft tissue samples and provide distributed attachment sites across the geometry of the sample for uniform attachment and deformation across the edge of the sample. The sharp rakes will not damage fragile samples.



The software features live data graphing and imaging and offers a virtually limitless number of test stages and duration combinations. Previously used tests and templates can be easily edited.

CS-BIOTESTER

Biaxial Biomaterial Tester

For information on these tissue testers, see www.wpiinc.com/stretch

Uniaxial Tissue Tester

- **Quality testing**
- **Cost-effective**
- **Multiple attachment options**
- **Available imaging and temperature controlled fluid bath**

The **CS-USTRETCH** makes it possible to carry out dependable, mechanical testing of soft materials for a reasonable price.

Applications

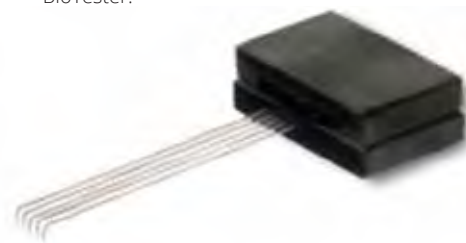
Typical applications include hydrogels, skin, muscle, blood vessels, heart valves, ligaments, sclera and scaffolds.

Specifications

Test specimen as small as 3x3mm and as large as 20x100mm. Elongation rates can be as high as

50mm/s and applied forces can be monitored at 100Hz. Load control is also possible, and simple or complex protocols can be specified. A variety of load cells are available, with force resolutions as low as 1mN and capacities as high as 100N.

Includes imaging software similar to the BioTester.



Mount a specimen quickly and precisely using the patented BioRake attachment system.

CS-USTRETCH

Uniaxial Biomaterial Tester

Check the WPI website for complete details and specifications.

World Precision Instruments

www.wpiinc.com

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US: Tel: 941-371-1003 • sales@wpiinc.com

MicroSquisher

Micro-Scale Compression System



The MicroSquisher is designed to perform compression testing on specimens between 50 μm and 2 mm with force resolutions as small as 50 nN. Forces are determined from the deflection of a flexible cantilever beam to which one compression plate is attached. Displacement control is achieved by manipulating the base of that beam using a motorized piezo stage.

The specimen can be tested in ambient air or in a temperature-controlled fluid bath. An integrated camera system allows synchronized imaging at up to 5Hz.

Micro-Scale Material Characterization

The MicroSquisher can be used to determine the compressive stress-strain properties of a variety of materials (hydrogel microspheres, small tissue samples, scaffolds and cell aggregates) with peak forces ranging from 1 μN to 1mN.

The device can perform displacement-controlled compression and stress relaxation testing.

Example Application

The interface tensions that exist play an important role in the organization of cells within aggregates. These properties can be determined by analyzing the force-time curve and test images from a parallel plate compression test.

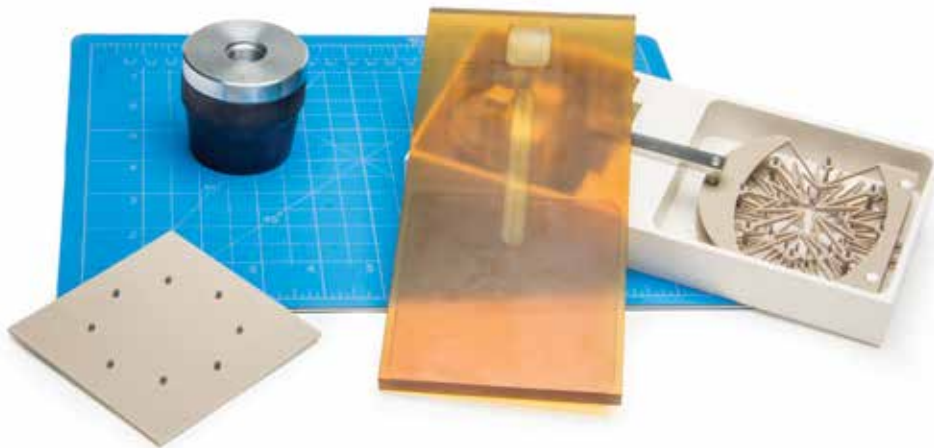
The MicroSquisher image analysis module quantifies the aggregate profile, allowing cell-cell and cell-medium interface tensions to be calculated.



CS-MICROSQUISHER Micro-Scale Compression System

MechanoCulture

Mechanotransduction cell culture system



MechanoCulture allows researchers to culture cells on a deformable substrate or as part of a 3D matrix to understand how mechanical environment affects cell differentiation, mitosis and signalling.

Easy to use software

The **MechanoCulture** software is used to specify test parameters. The test sequence can then be downloaded to the instrument. A run/pause

button is used to initiate, pause and stop the test. An LED display indicates the state of the unit, including the number of cycles remaining in the original protocol. The base unit can be stopped and disconnected from its power source without losing track of its position in the protocol.

- *Uniaxial, equibiaxial, or non-equibiaxial strains*
- *0 - 15% strain*
- *User downloaded test protocol*
- *Monolayer cells on substrate or 3D constructs*
- *Autoclavable*
- *Affordable and expandable system*
- *VHS videocassette-sized units fit easily in standard incubator*

Other Systems Available

The MechanoCulture FX can uniaxially stretch 24 wells while capturing images on an inverted microscope. The sterile single-use silicone plates have a thin transparent bottom that has similar optical properties to a glass coverslip.

The MechanoCulture T6 can uniaxially stretch up to 6 clamp-mounted specimens from 5-80mm in length. For stimulation in tendon, ligament, and bone tissue engineering work, it can deliver up to 250N of thrust. For cardiovascular research, the system can stimulate at up to 5Hz.

CS-MECHANO-SYS	Strainable Substrate for Culturing Cells
CS-MECHANO-FX	24 Well Mechanical Stimulation for Culturing Cells
CS-MECHANO-T6	6 Channel Mechanical Stimulation for Tissues

World Precision Instruments www.wpiinc.com

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Surgical Instruments

The instruments shown in this section are a sampling of the most popular tools from WPI. For a complete look at the hundreds of other items available, call today for the complete catalog.



Made in Switzerland

When we listen to our customers, we build a bridge of understanding and rapport. In that understanding, we discover the true needs of the customer. We have had numerous requests from you for affordable and good quality instruments and we are listening. World Precision Instruments is proud to introduce our own line of Swiss-made

forceps and scissors. We worked diligently with our manufacturer to make sure our products meet your expectations. With over 45 years experience, World Precision Instruments provides innovative instruments to the biomedical research community. We look forward to continuing to expand our product line to better serve your evolving needs.

WPI Swiss Tweezers

stainless steel, 11.5cm
504502
acid-resistant, antimagnetic, 11.5cm
504503



Tips: 0.18 x 0.2 mm

1:1

WPI Swiss Tweezers

stainless steel, 11.5cm
504504
acid-resistant, antimagnetic, 11.5cm
504505



Tips: 0.18 x 0.2 mm

1:1

WPI Swiss Tweezers

stainless steel, 11cm, 0.1 x 0.06mm tips
504506
acid-resistant, antimagnetic, 11cm
504507



Tips: 0.01 x 0.07 mm

1:1

WPI Swiss Tweezers

stainless steel, 11cm, 45° tips
504512
acid-resistant, antimagnetic, 11cm, 45° tips
504513



Tips: 0.06 x 0.07 mm

1:1

WPI Swiss Tweezers

stainless steel, 11cm
504510
acid-resistant, antimagnetic, 11cm
504511



Tips: 0.06 x 0.07 mm

1:1

WPI Swiss Tweezers

stainless steel, 10.5cm, extra fine 90° tips
504508
acid-resistant, antimagnetic, 10.5cm, extra fine 90° tips
504509



Tips: 0.06 x 0.02 mm

1:1

Forceps by Dumont

For material information and instrument purchase guidance visit www.wpiinc.com

Dumont #3

Material: Stainless steel
 Length: 12 cm (4.75 in.)
 Tips: 0.20 x 0.12 mm tips

503235



1:1

Dumont #5

Material: Dumostar, non-magnetic, non-corrosive stainless steel
 Length: 11 cm long (4.75 in.)
 Tips: 0.025 x 0.015 mm

500085

Tip Profile: ▲



1:1

Dumont #5

Material: Stainless steel
 Length: 11 cm (4.3 in.)
 Tips: 0.025 x 0.005 mm

501985



1:1

Dumont #5

Material: Dumostar, non-magnetic, non-corrosive
 Length: 11 cm (4.3 in.)
 Tips: 0.1 x 0.06 mm Tips

500233

Tip Profile: ▲



1:1

Dumont #5

Material: Dumoxel, non-magnetic stainless steel
 Length: 11 cm (4.3 in.)
 Tips: 0.1 x 0.06 mm tips

14098

Tip Profile: ▲



1:1

Dumont #5

Material: Stainless steel
 Length: 11 cm (4.3 in.)
 Tips: 0.10 x 0.06 mm

500342

Tip Profile: ▲



1:1

Dumont #5

Material: Stainless steel, Biology
 Length: 11 cm (4.3 in.)
 Tips: 0.05 x 0.01 mm tips

500341

Tip Profile: ▲



1:1

Dumont #5

Material: Stainless steel, Medical Biology
 Length: 11 cm (4.3 in.)
 Tips: 0.05 x 0.01 mm

14095

Tip Profile: ▲



1:1

Dumont #5B

Material: Stainless steel, Biology, bent at 45°
 Length: 11 cm (4.3 in.)
 Tips: 0.05 x 0.01 mm

500234

Tip Profile: ▲



1:1

Dumont #7

Material: Stainless steel
 Length: 12 cm (4.75 in.)
 Tips: 0.17 x 0.1 mm

14097

Tip Profile: ▲



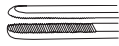
1:1

Forceps

Iris Forceps, serrated

Stainless steel
10 cm (4 in.) long, straight 0.8 mm tips

Tip Profile:



1:1

Standard

German

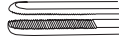
15914

15914-G

Iris Forceps, serrated

Stainless steel
10 cm (4 in.) long, curved 0.8 mm tips

Tip Profile:



1:1

Standard

German

15915

15915-G

Adson Forceps, serrated

Stainless steel
12 cm (4.75 in.) long

Tip Profile:



1:1

Standard

14226

German

14226-G



Tip Profile:



1:1

Tip Profile:



Hartman Mosquito Hemostatic Forceps

Stainless steel

Standard

German

15920

12.5 cm (5 in.) long, straight

15920-G

15921

12.5 cm (5 in.) long, curved

15921-G

501705

9 cm (3.5 in.) long, straight

501705-G

501291

9 cm (3.5 in.) long, curved

501291-G

Kelly Hemostatic Forceps

Stainless steel

Standard

German

501241

Straight, 14 cm (5.5 in.) long

501241-G

501288

Curved, 14 cm (5.5 in.) long

501288-G

501714

Straight, 15.5 cm (6 in.) long

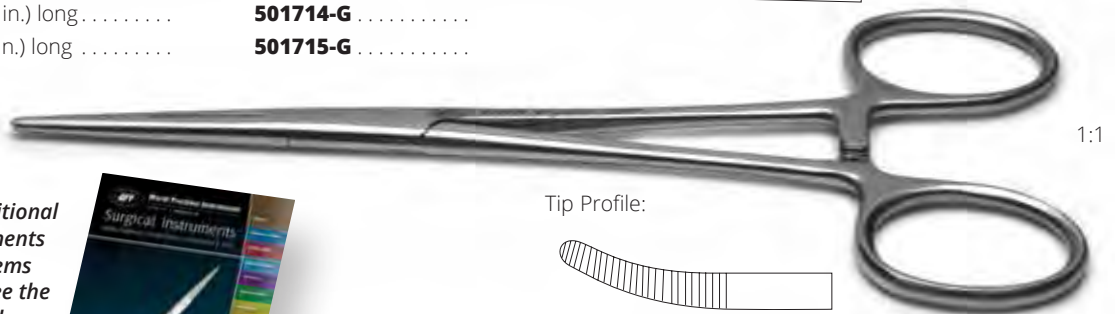
501714-G

501715

Curved, 15.5 cm (6 in.) long

501715-G

Tip Profile:



1:1

Tip Profile:



Hundreds of additional surgical instruments and related items are available. See the complete catalog.



Titanium Forceps

- 100% non-corrosive (great for seawater procedures)
- 100% non-magnetic (MRI compatible)
- 40% lighter than stainless steel (reduces hand fatigue)
- Forcep tips coated with tungsten carbide for increased gripping power
- Anodized, non-glare blue finish

Straight Forceps

Length: 11.5 cm (4.5 in.)
 Tips: 1 x 2, 0.12 mm teeth, 5 mm tying platform

Titanium 555047FT.....



Straight Forceps

Length: 11.5 cm (4.5 in.)
 Tips: 3 mm, 6 mm tying platform

Titanium 555007FT.....



Calibri Tying Forceps

Length: 11.5 cm (4.5 in.)
 Tips: 3 mm, 4 mm tying platform

Titanium 555008FT.....



Kelman-McPherson Forceps

Length: 8.5 cm (3.3 in.)
 Tips: 45° angle, 7.5 mm smooth jaw

Titanium 555190FT.....



Kelman-McPherson Forceps

Length: 11.5 cm (4.5 in.)
 Tips: 45° angle, 7.5 mm smooth jaw

Titanium 555191FT.....



McPherson Forceps

Length: 11.5 cm (4.5 in.)
 Tips: 45° angle, 6 mm tying platform

Titanium 555009FT.....



McPherson Forceps

Length: 8.5 cm (3.3 in.)
 Tips: angled, 4.5 mm tying platforms

Titanium 555005FT.....



Forceps

Length: 8.5 cm (3.3 in.)
 Tips: 12 mm, straight, 4.5 mm tying platforms

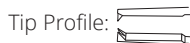
Titanium 555001FT.....



Forceps

Length: 8.5 cm (3.3 in.)
 Tips: straight, 0.12 mm teeth (1x2), 5 mm tying platform

Titanium 555041FT.....



Spring Scissors

These squeeze-handle micro scissors can be used ambidextrously.

Vannas Scissors, Super Fine, stainless steel

Length: 8 cm
Blades: straight 3 mm **501778**
Tips: 0.015 x 0.015 mm

Length: 8 cm
Blades: curved 3 mm **501839**
Tips: 0.015 x 0.015 mm

Tip Profile:



1:1

Vannas Scissors, stainless steel

Length: 8.5 cm (3.3 in.)
Blades: straight 7mm **500086**
Tips: 0.025 x 0.015 mm

Length: 8.5 cm (3.3 in.)
Blades: curved 7mm **501232**
Tips: 0.025 x 0.015 mm

Tip Profile:



1:1

Vannas Scissors

Length: 8 cm (3 in.)
Blades: straight 5 mm
Tips: 0.1 mm tips

Standard *German*
14003 **14003-G**

Tip Profile:



1:1

Vannas Scissors

Length: 8 cm (3 in.)
Blades: curved, 5 mm
Tips: 0.1 mm tips

Standard *German*
14122 **14122-G**

Tip Profile:



1:1

Vannas Scissors

Length: 8 cm (3 in.)
Blades: 45° angled to side, 5 mm
Tips: 0.1 mm tips

Standard *German*
500260 **500260-G**

Tip Profile:



1:1

McPherson-Vannas Scissors

Length: 8 cm (3 in.) *Standard* *German*
Blades: straight 5 mm **14124** **14124-G**
Tips: 0.1mm

Length: 8 cm (3 in.) **501234** **501234-G**
Blades: curved 5 mm
Tips: 0.1mm

Tip Profile:



1:1

Spring Scissors

Length: 12 cm (4.75 in.)
Blades: straight 12 mm extra fine and long

Standard **14125**

German **14125-G**

Length: 12 cm (4.75 in.)
Blades: curved 12 mm extra fine and long

14126

Tip Profile:



1:1

Iris Scissors

Length: 9 cm (3.5 in.)
 Tips: sharp, 11 mm straight

Titanium 555560S



1:1

Vannas Scissors

Length: 9.5 cm (3.7 in.)
 Tips: angled sharp, 10.5 mm

Titanium 555584S



1:1

Vannas Capsulotomy Scissors

Length: 9.5 cm (3.7 in.)
 Tips: curved, sharp, 12.5 mm

Titanium 555583S

Length: 10.5 cm (4.1 in.)
 Tips: curved, sharp, 12.5 mm

Titanium 555582S



1:1

Castroviejo Straight Scissors

Length: 10.5 cm (4.1 in.)
 Tips: 11 mm

Titanium 555530S



1:1

Castroviejo Curved Scissors

Length: 10.5 cm (4.1 in.)
 Tips: small

Titanium 555524S



1:1

Mcpherson-Westcott Stitch Scissors

Length: 11.5 cm (4.5 in.)
 Tips: 10.5 mm

Titanium 555540S



1:1

Mcpherson-Westcott Conjunctiva Scissors

Length: 10.5 cm (4.1 in.)
 Tips: curved, blunt

Titanium 555500S



1:1

Iris Scissors

Length: 10.5 cm (4.1 in.)
 Tips: sharp, 11 mm curved

Titanium 555562S



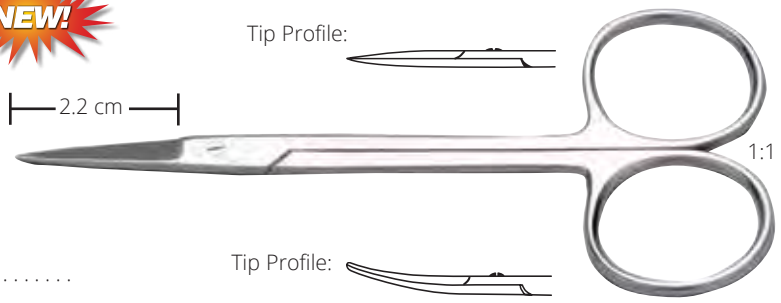
1:1

Mini-Dissecting Scissors, stainless steel

- 503666** 8.5 cm (3.3 in.) curved, sharp tips
- 503667** 8.5 cm (3.3 in.) straight, sharp tips.
- 503668** 8.5 cm (3.3 in.) curved, blunt tips.
- 503669** 8.5 cm (3.3 in.) straight, blunt tips



2.2 cm



1:1

Dissecting Scissors

Standard

- 14393** 10 cm (4 in.) straight.
- 14394** 10 cm (4 in.) curved
- 15922** 12.5 cm (5 in.) straight.
- 15923** 12.5 cm (5 in.) curved.

German

- 14393-G**
- 14394-G**
- 15922-G**
- 15923-G**



Iris Scissors, stainless steel

Length: 11.5 cm (4.5 in.)
Blades: straight, Tungsten Carbide

Standard

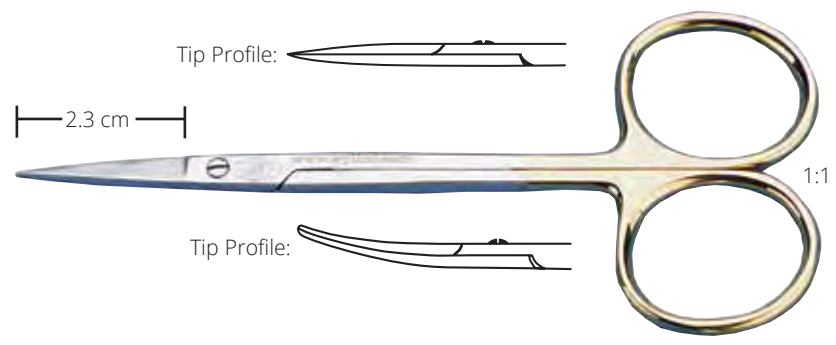
- 500216** **500216-G**

Length: 11.5 cm (4.5 in.)
Blades: curved, Tungsten Carbide

- 500217** **500217-G**



2.3 cm



1:1



Iris Scissors, stainless steel

Length: 11 cm (4.3 in.) Blades: straight

Standard

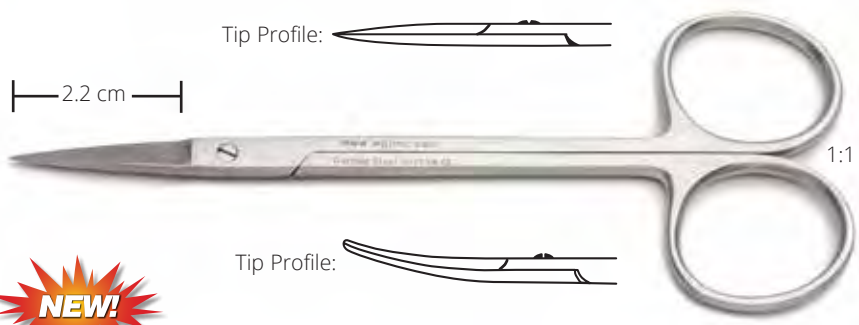
- 501758** **501758-G**

Length: 11 cm (4.3 in.) Blades: curved

- 501759** **501759-G**



2.2 cm



1:1



Mini-Iris Scissors

- 503670** 8 cm (3.1 in.) straight, sharp tips.
- 503671** 8 cm (3.1 in.) curved, sharp tips



Iris Scissors, SuperCut, stainless steel

one edge micro serrated, one edge honed to the sharpness of a knife edge

10 cm (4 in.)

Standard

German

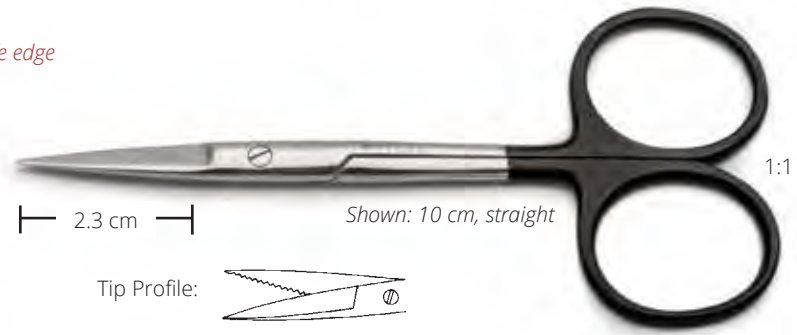
- Straight **14218** **14218-G**

- Curved **14219** **14219-G**

11.5 cm (4.5 in.)

- Straight **503259**

- Curved **503260**



1:1

2.3 cm

Shown: 10 cm, straight



- 504519** WPI Swiss Scissor, Stainless Steel, 9cm, Blade Extra Fine

- 504520** WPI Swiss Scissor, Stainless Steel, 9cm, Blade Fine Sharp

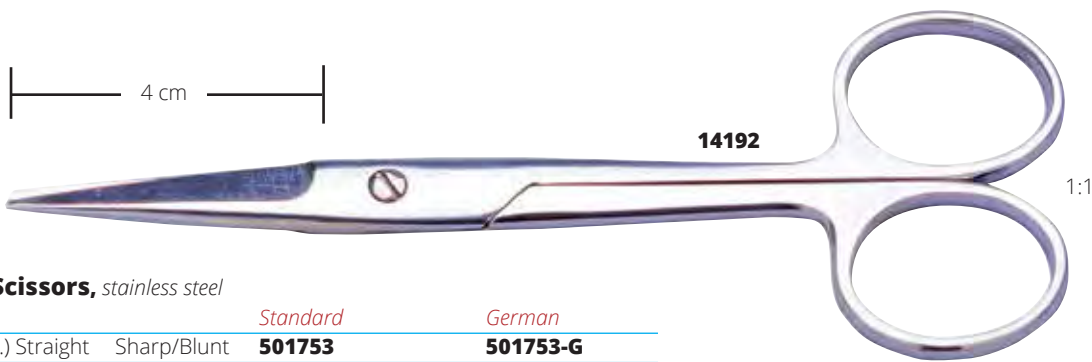
- 504521** Wpi Swiss Scissor, Stainless Steel, 9cm, Heavy Duty, Rounded

- 504522** WPI Swiss Scissor, Stainless Steel, 9cm



1:1

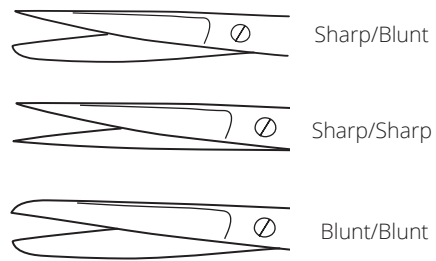
504519



Operating Scissors, stainless steel

		Standard	German
11.5 cm (4.5 in.) Straight	Sharp/Blunt	501753	501753-G
	Sharp/Sharp	501754	501754-G
	Blunt/Blunt	501743	501743-G
11.5 cm (4.5 in.) Curved	Sharp/Sharp	501755	501755-G
	Sharp/Blunt	501756	501756-G
	Blunt/Blunt	501757	501757-G
14 cm (5.5 in.) Curved	Sharp/Sharp	501220	501220-G
	Sharp/Blunt	501221	501221-G
	Blunt/Blunt	501222	501222-G
14 cm (5.5 in.) Straight	Sharp/Blunt	14192	14192-G
	Sharp/Sharp	501218	501218-G
	Blunt/Blunt	501219	501219-G

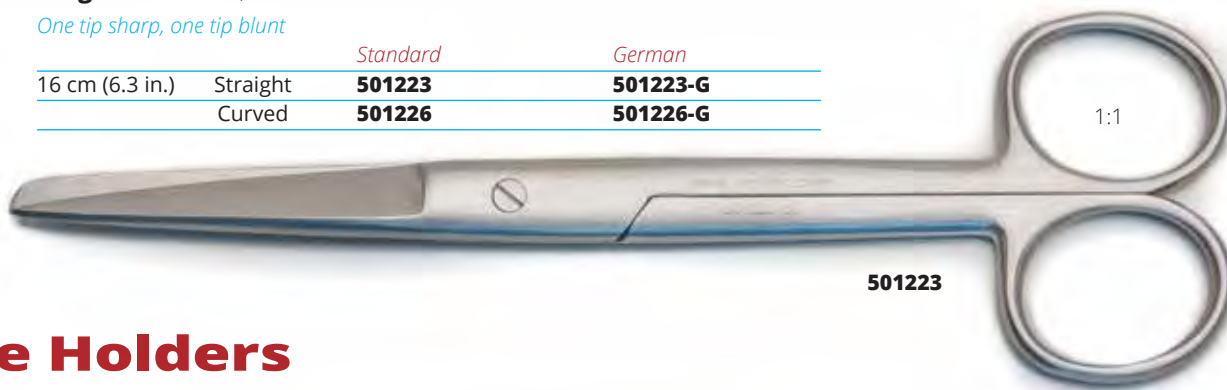
Tip Profiles:



Surgical Scissors, stainless steel

One tip sharp, one tip blunt

		Standard	German
16 cm (6.3 in.)	Straight	501223	501223-G
	Curved	501226	501226-G



Needle Holders

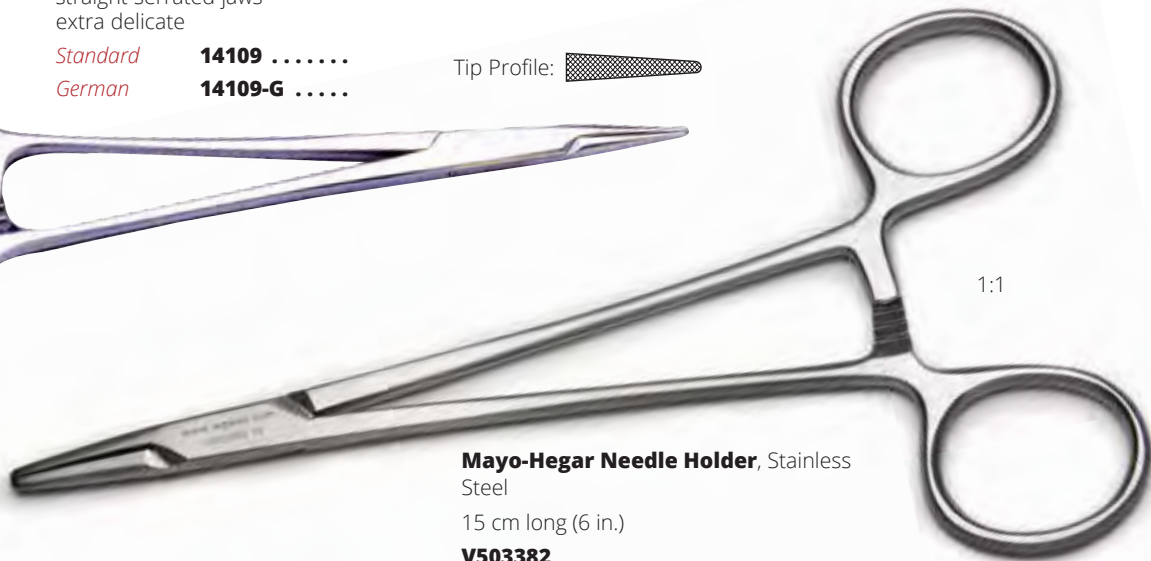
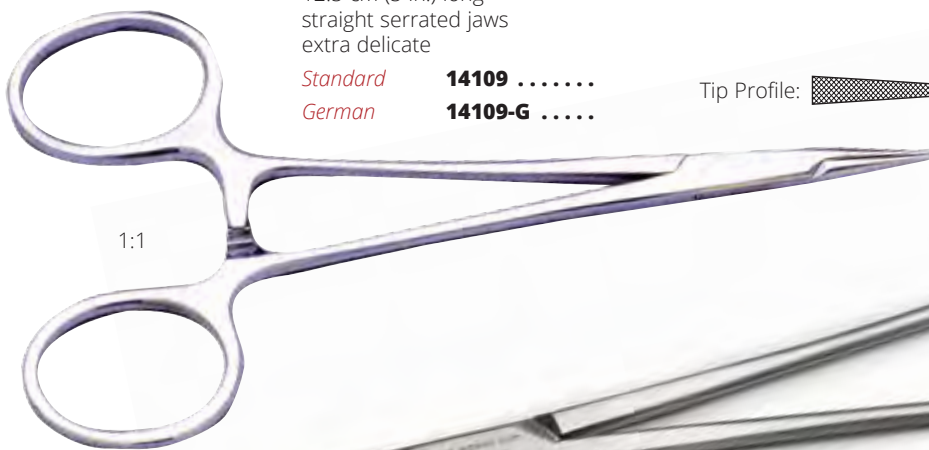
Needle Holder

12.5 cm (5 in.) long
straight serrated jaws
extra delicate

Standard **14109**

German **14109-G**

Tip Profile: 



Mayo-Hegar Needle Holder, Stainless Steel

15 cm long (6 in.)

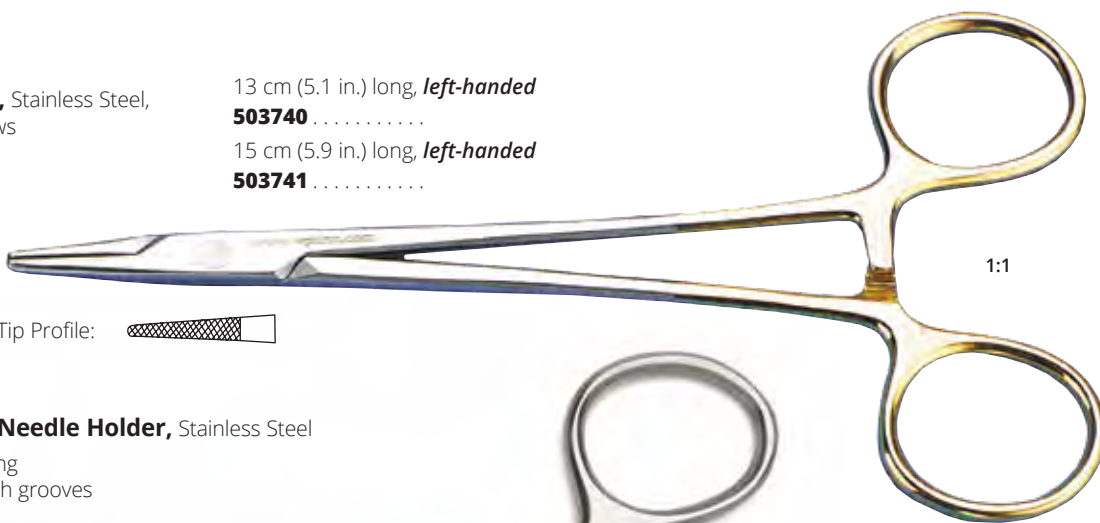
V503382.....

Crile-Wood Needle Holder, Stainless Steel,
serrated **Tungsten Carbide** jaws
14.5 cm (5.75 in.) long

Standard 500224
German 500224-G

13 cm (5.1 in.) long, *left-handed*
503740
15 cm (5.9 in.) long, *left-handed*
503741

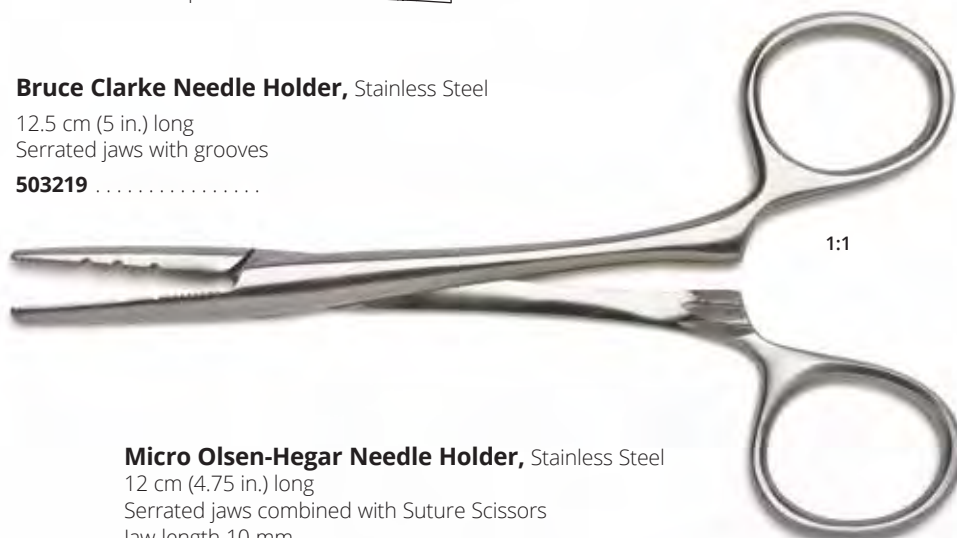
Tip Profile: 



Bruce Clarke Needle Holder, Stainless Steel

12.5 cm (5 in.) long
Serrated jaws with grooves

503219



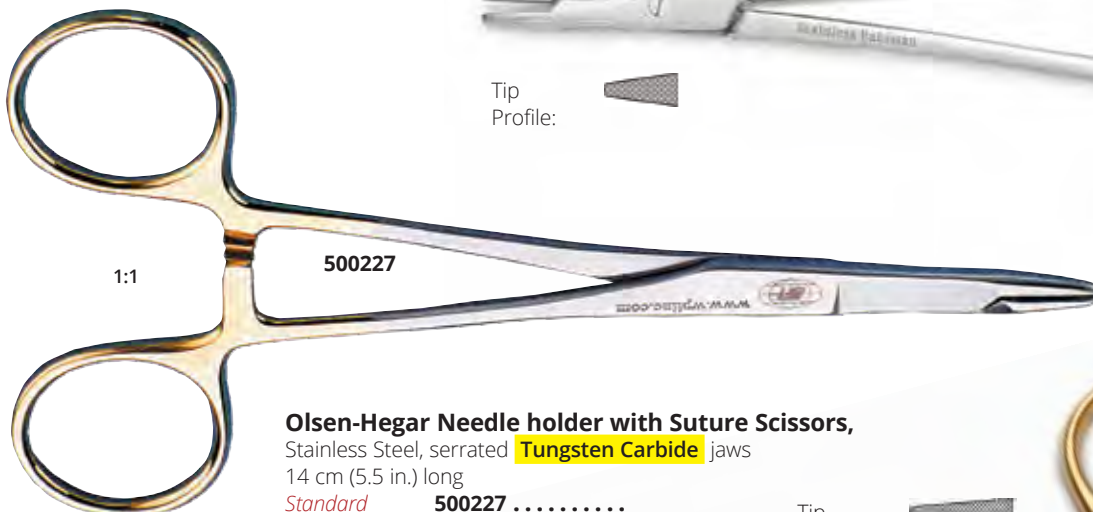
Micro Olsen-Hegar Needle Holder, Stainless Steel

12 cm (4.75 in.) long
Serrated jaws combined with Suture Scissors
Jaw length 10 mm
Tip width 2 mm

501989



Tip Profile: 



Olsen-Hegar Needle holder with Suture Scissors,

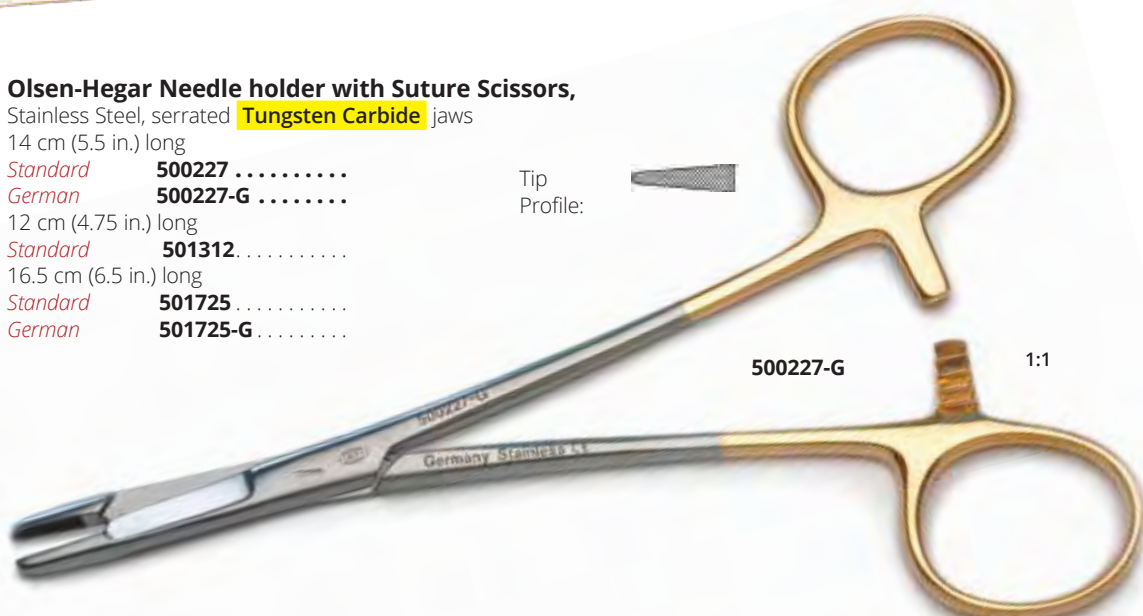
Stainless Steel, serrated **Tungsten Carbide** jaws
14 cm (5.5 in.) long

Standard 500227
German 500227-G

12 cm (4.75 in.) long
Standard 501312

16.5 cm (6.5 in.) long
Standard 501725
German 501725-G

Tip Profile: 





Olsen-Hegar Needle Holder, Stainless Steel

14cm (5.5 in.) long
Serrated jaws combined with Suture Scissors

- 500023**
- 500023-G**

Tip Profile:



NOT
ACTUAL
SIZE



Mayo-Hegar Needle Holder, Stainless Steel

15 cm long (6 in.)

- V503382**

NOT
ACTUAL
SIZE

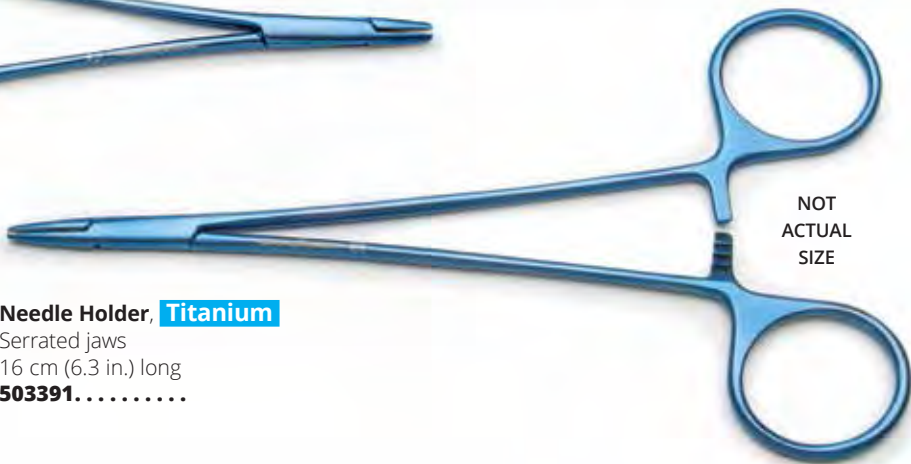


Needle Holder, Titanium

Serrated jaws
13 cm (5.1 in.) long

- 503390**

NOT
ACTUAL
SIZE



Needle Holder, Titanium

Serrated jaws
16 cm (6.3 in.) long

- 503391**

NOT
ACTUAL
SIZE



Barraquer Needle Holder, Titanium

11.5 cm long (4.5 in.)
Delicate, 9mm gently curved jaws, sharp tips

- | | |
|-----------------|----------------------|
| 555402NT | without lock |
| 555403NT | with lock (pictured) |

1:1

Troutman Needle Holder, Curved, Titanium

11.5 cm long (4.5 in.)
10mm gently curved jaws, blunt tips

- | | |
|-----------------|-------------------------|
| 555406NT | without lock (pictured) |
| 555407NT | with lock |



1:1



Curved Needle Holder, Titanium

11 cm long (4.3 in.)
Curved, 6mm delicate jaws

- | | |
|-----------------|--------------|
| 555408NT | without lock |
|-----------------|--------------|

1:1

Needle Holder, Titanium

14 cm long (5.5 in.)
Curved, Smooth Jaws

- 501923**



1:1

Ear Punches and Ear Tags

Ear Punch

5 cm (2 in.) long, 2 mm diameter

500075



1:1



Ear Punch

10 cm (4 in.) long

2 mm diameter

500077

1 mm diameter

500076

Physiology Kit I

SuperCut Tenotomy Scissors curved (#14396)

Rongeur 3mm jaw (#14091)

Utility Scissors (#501322)

Operating Scissors straight Sharp/Blunt (#14192)

Dumont Tweezer #5 (#14098)

Flat Jaw Tweezers (#501303)

Probe 1.0 mm diameter, blunt (#501313)

KIT-PHYSIO-I Physiology Kit I

Mouse Kit

Dumont #5 (#14098)

Vannas Scissors (#14003)

Iris Forceps, curved, serrated (#15915)

Dissecting Scissors, straight 10cm (#14393)

Wire Retractor (#14130)

Needle Holder (#14109)

Blunt Probe, 1.0 mm diameter (#501313)

MOUSEKIT Mouse Kit

Physiology Kit II

Vannas Scissors (#14003)

SuperCut Iris Scissors straight (#14218)

Rongeur 1.3mm jaw (#14292)

Utility Scissors (#501322)

Probe 1.0 mm diameter, blunt (#501313)

Operating Scissors straight Sharp/Blunt (#14192)

Dumont Tweezer #5 (#14098)

Stevenson Retractor (#14131)

Iris Forceps curved (#15915)

Adson Forceps 1x2 teeth (#500092)

Olsen-Hegar Needle holder (#500227)

PHYSIO-II Physiology Kit II

Rat Kit

Dumont #5 (#14098)

Vannas Scissors (#14124)

Iris Forceps, serrated (#15915)

SuperCut Iris Scissors, straight 10cm (#14218)

Alm Retractor (#14240)

Needle Holder (#14110)

Blunt Probe, 1.0 mm diameter (#501313)

RATKIT Rat Kit

Student Dissecting Kit

Includes:

Dissecting Scissors, 4.5"

Dissecting Scissors, 4"

Dressing Forceps, 5.5"

Micro Dressing Forceps, 4"

#4 Knife Handle

Straight Teasing Needle

Angled Teasing Needle

#22 Surgical Blade

Canvas Roll-up



501336

501838 Canvas Roll-up only

Clips and Clamps

Reflex Clip Applier

11 cm (4.3 in.) long
for 7 mm clips only
500343



Reflex Clip Applier

11 cm (4.3 in.) long
for 9 mm clips only
500345

Reflex Clip 7 mm

for use with #500343
100/box, Stainless Steel, non-sterile
500344



Reflex Clip 9 mm

for use with #500345
100/box, Stainless Steel, non-sterile
500346

Micro Bulldog Clamps



14119-G

Curved serrated jaws

Standard **14119**

32mm long, 12mm jaw



14119

German **14119-G**

38mm long, 9mm jaw

Retractors

Agricola Retractor

Length: 4 cm (1.6 in.)
Blades: 3 x 3 sharp prongs

Small, self-retaining retractor perfect
for small animal surgery and dissection.
Maximum spread, 2.5 cm.

501846



1:1

Scalpels, Knives, Blades and Handles

Scalpel Handle #3

13 cm (5 in.) long, stainless steel

Standard **500236**

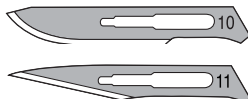
German **500236-G**



For Blades #10 ~ #15

Sterile stainless steel blades

All stainless steel scalpel blades are made by Feather®, using a precise beveling technique to create the edge's micron sharpness. *They are the finest blades available.*



500239 Scalpel Blades #10, stainless steel, sterile (100 / box)

500240 Scalpel Blades #11, stainless steel, sterile (100 / box)

Animal Lancets



504539	Animal Lancet, 3mm, Mice, 1-2 drops, 200/box
504540	Animal Lancet, 4mm, Mice under 2 mo, 200/box
504550	Animal Lancet, 5mm, Mice 2-6 mo, 200/box
504551	Animal Lancet, 5.5mm, Mice over 6 mo, 200/box
504552	Animal Lancet, 5mm, Rats under 3 mo, 200/box
504553	Animal Lancet, 6mm, Rats under 3mo, 200/box
504554	Animal Lancet, 7mm, Rats 3-4mo, 200/box
504555	Animal Lancet, 3mm, Primates, 200/box
504556	Tattoo Identification Lancet, 3mm, 200/box

Disposable Scalpels



500348	Disposable Scalpel, No. 10, sterile (10/box)
500349	Disposable Scalpel, No. 11, sterile (10/box)
500350	Disposable Scalpel, No. 12, sterile (10/box)
500351	Disposable Scalpel, No. 15, sterile (10/box)
500352	Disposable Scalpel, No. 20, sterile (10/box)
500353	Disposable Scalpel, No. 21, sterile (10/box)
500354	Disposable Scalpel, No. 22, sterile (10/box)
500355	Disposable Scalpel, No. 23, sterile (10/box)
500356	Disposable Scalpel, No. 24, sterile (10/box)

Rodent Guillotine



- **Large, stable base**
- **Hardened blades for long service**
- **Ambidextrous configuration**

The small animal guillotine has been completely redesigned for ease of use and extra added safety features. The blades are drawn together by magnetic force to ensure a clean and precise cut through very strong bones and skin. 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

DCAP	Guillotine for Rodents and other small animals (opening 1.5 x 1.5 in.)
DCAP-M	Guillotine for large rodents and other medium animals (opening 2.5 x 2.5 in.)
DCAP-L	Guillotine for larger animals (opening 4" x 4")

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.

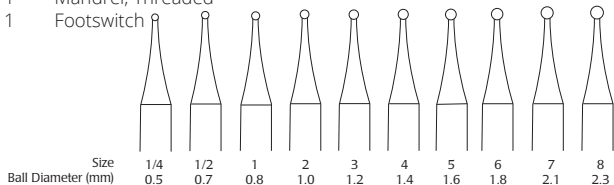
OmniDrill35

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 the user. 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 2.33 mm bur shanks. Unlike battery-powered drills, this unit will maintain consistent power for the duration of use. The wide range of speeds allows the user to control the amount of heat generation.



The following accessories are included with the Micro Drill System:

Qty	Description
4	Abrading Tip, Rubber
1	Abrading Tip, Stone
1	Accessory Stand
1	Ball Mill, Carbide, #1, .031" Diameter
1	Ball Mill, Carbide, #2, .039" Diameter
1	Ball Mill, Carbide, #3, .047" Diameter
1	Ball Mill, Carbide, #4, .055" Diameter
1	Ball Mill, Carbide, #5, .063" Diameter
1	Ball Mill, Carbide, #6, .071" Diameter
1	Ball Mill, Carbide, #7, .083" Diameter
1	Ball Mill, Carbide, #1/4, .019" Diameter
1	Ball Mill, Carbide, #1/2, .027" Diameter
4	Cutoff Disk
1	Mandrel, Screw
1	Mandrel, Threaded
1	Footswitch



503598	OmniDrill35 Micro Drill System, 110 V
503599	OmniDrill35 Micro Drill System, 220 V

REPLACEMENT ACCESSORIES

501850	Abrading Tip, Rubber, pk of 20
501851	Abrading Tip, Stone, pk of 5
501852	Accessory Stand
501853	Ball Mill, Carbide, #1, .031" Diameter, pk of 5
501854	Ball Mill, Carbide, #2, .039" Diameter, pk of 5
501855	Ball Mill, Carbide, #3, .047" Diameter, pk of 5
501856	Ball Mill, Carbide, #4, .055" Diameter, pk of 5
501857	Ball Mill, Carbide, #5, .063" Diameter, pk of 5
501858	Ball Mill, Carbide, #6, .071" Diameter, pk of 5
501842	Ball Mill, Carbide, #7, .083" Diameter, pk of 5
501860	Ball Mill, Carbide, #1/4, .019" Diameter, pk of 5
501861	Ball Mill, Carbide, #1/2, .027" Diameter, pk of 5
501862	Cutoff Disk, pk of 20
501863	Mandrel, Screw, pk of 5
501864	Mandrel, Threaded, pk of 5
504459	Footswitch
502237	Stereotaxic Holder for OmniDrill35 Microdrill

OMNIDRILL35 SPECIFICATIONS

INPUT	110V, 50/60 Hz
OUTPUT	0-32 Vdc
FUSE	1 amp
OPERATING SPEED RANGE	0-35,000RPM
DIMENSIONS	178 x 114 x 89mm (7 x 4.5 x 3.5in.)
WEIGHT	1.7kg (3.75lbs)

BioClave Mini Research Autoclave

- Fully automatic—just press **START**
- Rapid, complete sterilization
- Extremely compact
- Built in water tank does not require connection to an external water supply
- Benchtop model

The BioClave Mini comes pre-programmed for basic sterilization. Choose either the 120°C or 134°C temperature mode, and the cycle time is fixed. This is the perfect autoclave for small spaces.

The stainless steel sterilization chamber accommodates a variety of liquids, media,



BIOCLAVE MINI SPECIFICATIONS

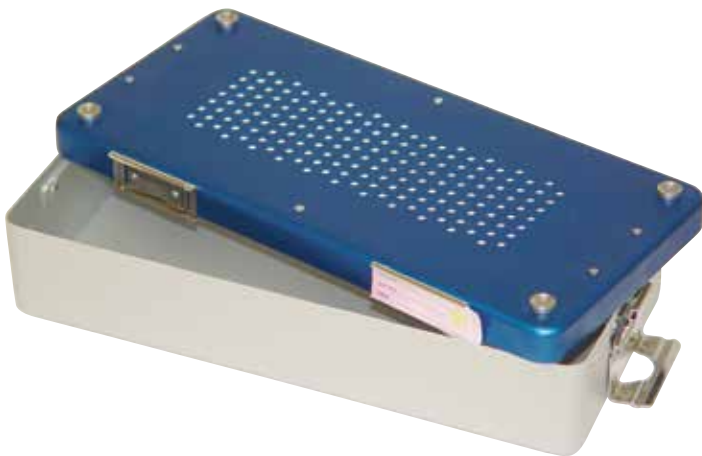
CHAMBER VOLUME.....	8L
MAX. PRESSURE.....	29 PSI/2 Bar
CHAMBER DIMENSIONS.....	6.7 x 12.5"/17 x 31cm
TRAY DIMENSIONS.....	4.75 x 9.75"/12 x 24.8cm
EXTERIOR DIMENSIONS.....	20 x 13.5 x 12.9"/51 x 24 x 33cm
WEIGHT.....	74 Lb. (33kg)
ELECTRICAL.....	115 or 230V, 50–60Hz, 950W

instruments, glassware and plasticware. A mechanical and electrical safety interlock prevents the door from being opened until the pressure is released (0 PSI).

Simply press the Start button, and the entire sequence runs—fill, sterilize, exhaust and dry.

504187	BioClave Mini (115 V)
504188	BioClave Mini (230 V)

Aluminum Sterilizing Trays



These sterilization containers are made of hard anodized aluminum and can withstand autoclaving and ethylene oxide sterilizing. The non-perforated base has two locking clasps that secure the lid in place. The perforated lid with disposable filter allows steam and gas to move freely in and out of the container during sterilization. A silicone mat may be purchased separately and cut to fit the base of the tray.

501913	Small Aluminum Tray, 300 x 140 x 40 mm
501914	Large Aluminum Tray, 300 x 140 x 70 mm
501915	Single-use Filters, 100 per package
500255	Silicone Mat, 38 x 25.5 cm

Dry Sterilizer

Sterilize your microdissecting and tissue culture instruments, thoroughly and conveniently, in seconds. No chemicals. No flames. No risk of burns. No disinfectant fluids. Glass beads heated to 260°C kills all viruses, aerobic and anaerobic bacteria, yeasts and spores. (1.5 mm lead-free glass beads included.)



GERMINATOR SPECIFICATIONS

O.D.....	17.1 x 13.3 x 12.9 cm (6/4 x 5/4 x 5/16 in.)
I.D.....	5.1 x 10.2 cm (2 x 4 in.)
WEIGHT.....	2.3 kg (5 lb.)

14404	Dry Sterilizer (110 V)
500121	Dry Sterilizer (220 V)
14405	Extra Glass Beads, 300 g (11 oz)

SweepZone®

Ultrasonic Cleaning System

SweepZone operates with a special cleaning wave of ± 2 KHz energy that literally sweeps back and forth throughout the ultrasonic tank. Pulse Width Modulation (PWM) enables the device to sense cleaning loads, solution levels and voltage fluctuations.

It automatically adjusts to different conditions in order to create more uniform cleaning power by eliminating hot spots and weak areas in the tank. This results in unsurpassed cleaning performance with every application.

User-friendly digital touch pad controls make it easy and convenient to set any of the five preset timer settings from a range of six to sixty minutes. Durable stainless steel housing and tank are corrosion resistant and long lasting. Includes timer, drain and stainless steel cover

Dimensions: 32.2 x 1.75 x 22.2 cm (12.68 x 6.88 x 8.75 in.)

Shipping Weight: 5.4 kg (12 lb)

Tank Capacity: 4.0 L (1.06 gal.)

Tank Internal Dimensions: 29.8 x 15.2 x 10.2 cm (11.75 x 6 x 4 in.)



CE

504217 SweepZone Ultrasonic Cleaning System

Quantrex®

Ultrasonic Cleaning Systems

Provides super-strength cleaning every time. Versatile enough for a variety of cleaning applications. 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.

60 Minute Timer.

Constructed with vinyl-clad steel and stainless steel.

Fourteen quality inspection steps for strength and durability.

Stainless steel drain with multi-positional outlet for easy removal of solution.

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.)

Includes Timer, Drain and Cover. Heater Optional.



CE

504216 Quantrex Ultrasonic Cleaning System

Ultrasonic Cleaner

Half liter stainless steel tank. Durable and compact, robust all-metal construction allows for continuous duty. Includes lid.



CE

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 1/4 x 3 1/8 x 2 1/8 in.)
TANK O.D.	13.7 x 10.5 x 12.1 cm (5 1/8 x 4 1/8 x 4 1/4 in.)
SHIPPING WEIGHT	1.8 kg (4 lb.)



504766

504767

504768



503737



14342

UBATH-Y Ultrasonic Cleaner (110 V)

UBATH-Z Ultrasonic Cleaner (220 V, Euro plug)

UBATH-B Ultrasonic Cleaner (220 V, UK plug)

Specify line voltage

13740 Ultrasonic Detergent (4 lb)

14342 Ultrasonic Detergent (1 gal)

503737 Mesh Draining Basket

503738 Bur Sterilizing Tray

503739 Positioning Cover

504766 Sterilization mesh cassette 40x40x20mm

504767 Sterilization mesh cassette.80x80x34mm

504768 Sterilization mesh cassette.105x70x25mm

Micro-Cautery

For surgery at the micro level, such as Xenopus Capping



The PI-MC2010 is a micro-cauterizing unit that embraces thermodynamic technology to perform micro-surgical tasks with efficiency and cleanliness. Cells just beyond the cutting line are left healthy and functional.

How It Works

A current passes through the platinum cutting wire and super-heats it at a preprogrammed rate for the span of a few microseconds, then abruptly stops. A thin, gaseous-tube of solution surrounding the wire is created because the rate of heating is much faster than the velocity of the solution molecules due to their average thermal energy at room temperature. This creates an intense but finite shockwave as the superheated tube of vapor expands from the wire inducing turbulence. The quick heating and cooling of the platinum wire causes a flushing effect as cool water rushes in after the brief shockwave and turbulence. Debris from the lysed cells directly adjacent to the wire is flushed away immediately. Cellular debris does not stick to the wire and, even at the highest power settings, only an extremely small quantity of heat is generated and then quickly cooled so as not to increase the temperature of the surrounding environment.

Features

- 13 & 18 micron diameter cautery tips with 1 & 1.5mm loop
- 15 Power settings
- Light weight pencil handle
- Foot switch activated
- Simple operation

PI-MC2010 Micro-Cautery Instrument

Comes with foot switch, pencil, tip, holder, power cord, operation manual, and choice of one box of tips.

MICRO-CAUTERY ELECTRODE TIPS

504045	18 micron wire tip cautery electrode, red-black cover, 10mm loop, 5/pkg
504046	18 micron wire tip cautery electrode, red cover, 1mm loop, 5/pkg
504047	18 micron wire tip cautery electrode, red cover, 1.5mm loop, 5/pkg
504048	13 micron wire tip cautery electrode, yellow, 1mm loop, 5/pkg
504049	13 micron wire tip cautery electrode, yellow, 1.5mm loop, 5/pkg

Economy Electrosurgical Unit

Electrosurgery utilizes alternating current at radio frequencies to cut and coagulate. Using this method, the current enters the patient's body and the patient becomes part of the electrical circuit. This requires the use of a return, or indifference 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, indifference plate, footswitch, 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	115V ± 10% - 50/60Hz 1.8A, 210VA 230V ± 10% - 50/60Hz 0.9A, 210VA
OUTPUT POWER	70 WATTS ± 5%
WORKING FREQUENCY	1.5-1.7 MHz ± 5%
DIMENSIONS	24cm x 22cm x 8.5cm (lwxhx)
SHIPPING WEIGHT	10 lb (4.5kg)



501274	Electrosurgical Unit, 110V
501285	Electrosurgical Unit, 220V
501273	Handpiece for electrodes, Ø 1.6mm shaft
501275	Indifference Plate
501277	Footswitch
501278	Diamond Shape Loop Electrode, Ø 1.6mm shaft
501279	Small Loop electrode, Ø 1.6mm shaft
501280	Large Loop Electrode, Ø 1.6mm shaft
501281	Fine Wire electrode, Ø 1.6mm shaft
501282	Wire Electrode, Ø 1.6mm shaft
501283	Small Oval Loop Electrode, Ø 1.6mm shaft
501284	Ball Electrode, Ø 1.6mm shaft
501286	Set of 7 Electrodes

SMALL ANIMAL ANESTHESIA



Components may not be as pictured.

EZ-7000 Classic System

Features

- Integrated turnkey solution for small animal anesthesia
- Safe for surgical personnel, 90% below OSHA Isoflurane limit
- Designed by veterinarians
- Compact and portable
- Time efficient and cost effective
- Virtually stress-free for the animals
- Easy to setup and use, simplifying the training of new staff and reducing the threat of human error
- Speedy recovery time

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 can be moved to the heated surgical water bed and positioned properly in the snugly fitted nosecone. A highly sensitive valve regulated by the animal's breathing works with the nosecone to ensure non-rebreathing efficiency, and allow safe anesthesia for up to several hours.

The breathing device also includes an air filter that releases safe, filtered air back into the room.

EZ Systems include all necessary hardware components and connections. 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
- One Induction Chamber (standard **EZ-178**)
- One Breathing Device (standard **EZ-103**)
- Case of charcoal filters

Other available options include:

- Heated Beds and Heating Pump
- Additional Breathing Devices

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-FF9000 Fixed Flow System

EZ-7000 Classic System

The Classic System is the upgraded version of our original EZ-Anesthesia system. The new version has a reconfigured flow meter that is more user-friendly. The system offers five gas outlets that can supply a single induction chamber and four breather circuits simultaneously.

The upgraded 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-7000 Classic System

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.

EZ-B800 Basic System

**For the full line of anesthesia products, see
www.wpiinc.com/anesthesia**

EZ-1130 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.

EZ-1130 Connection Kit

EZ-830 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.

EZ-830 Ventilator Connection Kit



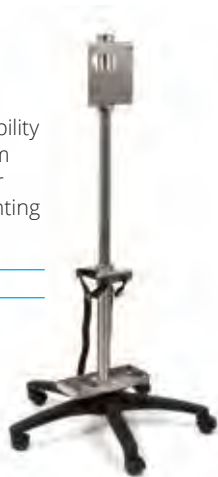
Euthanex Lids

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.

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.

E-28000 Vaporizer Pole Mount



Rodent Isoflurane Facemask Kit

Mouse and rat facemasks, medical grade PVC tubing (12 feet), 1/4-inch adapters (2), 3/8-inch adapters (2).



OC-SFM-KIT	Small Rodent Facemask Kit (one mask, tubing, adapters)
OC-MFM-KIT	Medium Rodent Facemask Kit (one mask, tubing, adapters)
OC-LFM-KIT	Large Rodent Facemask Kit (one mask, tubing, adapters)
OC-XLFM-KIT	XLarge Rodent Facemask Kit (one mask, tubing, adapters)
OC-MOUSE-KIT	Mouse Facemask Kit (sm & med masks, tubing, adapters)
OC-RAT-KIT	Rat Facemask Kit (lg & xlg masks, tubing, adapters)
OC-ALLFM-KIT	Complete Rodent Facemask Kit (sm, med, lg & xlg masks, tubing, adapters)

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. It 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.

EZ-E25000	Mobile Workstation, 42" x 24" Top
EZ-E27000	Mobile Workstation, 22" x 21" Top



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
EZ-212	Mouse/Rat Standard Heated Waterbed

Analgesia

Electronic von Frey Anesthesiometer

- **Plug up to three probes into a single unit**
- **LCD readout (Floating or last maximum/minimum)**
- **Rigid tips up to 800 gm**
- **“Supertips™” 15 up to 65 gm**
- **1,000 gm probe available**
- **Independence from temperature**
- **Optional analog output cable for chart recorder**
- **Pipette tips can be customized to any specification**
- **Microprocessor electronics 0.1 gm plug-in probes**



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 calibrated. 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.

II-2390	Electronic von Frey Anesthesiometer, rigid tips, 90 gram range
II-2391	Electronic von Frey Anesthesiometer, rigid tips, 800 gram range
II-2392	Electronic von Frey Anesthesiometer, rigid & 15 super tips, 90 gram range
II-2393	Electronic von Frey Anesthesiometer, rigid & 15 super tips, 800 gram range
II-23931	Electronic von Frey Anesthesiometer, custom rigid tips, 1000 gram range
II-2394	von Frey Probe, 90 gram range
II-2395	von Frey Probe, 800 gram range
II-2396	von Frey Probe, 1000 gram range
II-2397	MRI Probe Option (add to price of probe above)
II-2400	Analog Output Cable

Trio

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.

II-2888 Trio 3-in-1 System



Quattro

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.

II-2889 Quattro 4-in-1 System



Plethysmometer (Paw Volume) Meter



- **No wetting solution needed**
- **One calibration/year**
- **Battery-operated or line powered controller**
- **One-year warranty**

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. 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. The acrylic stand offers full visibility of the subject throughout the testing.

II-520MR Paw Volume Meter for Mouse & Rat

Randall Selitto Paw Pressure Meter

- **Hands free operation with footswitch**
- **Visible force limit indicator**
- **Portable electronic display**
- **Battery-operated or line powered controller**
- **3-oz. handheld probe with accuracy of 0.5%**
- **No calibration required**



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 Randall Selitto Paw Pressure Meter, 800 g pressure applicator

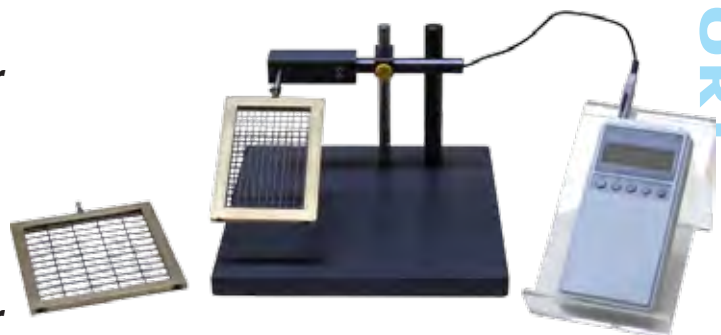
Grip Strength Meter

- **Mouse and rat wire mesh grid plates included**
- **Maximum force range is 2,000 gm (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**
- **Battery-operated or line powered controller**
- **One year warranty**

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.

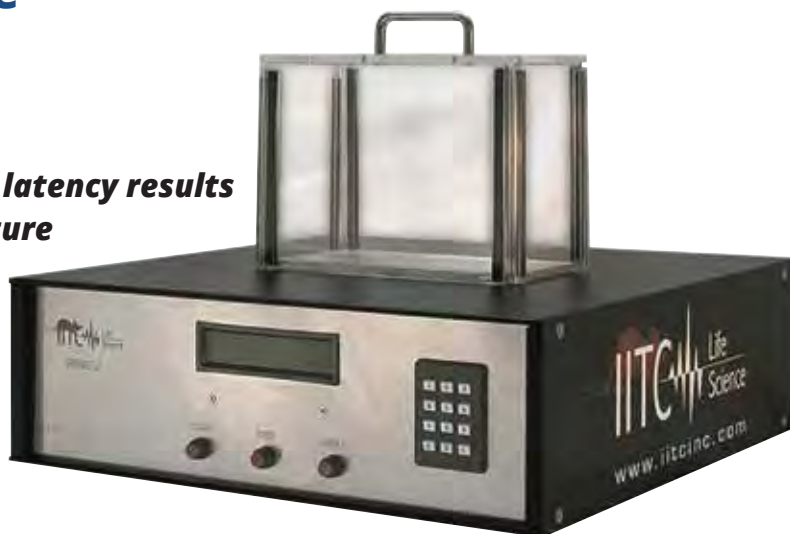


II-2200 Grip Strength Meter for Mouse & Rat

Analgesia

Incremental Hot Cold Plate Analgesia Meter

- **Heat or cool, from 0-70 °C**
- **Ramping temperatures for threshold & latency results**
- **Rapid increase or decrease in temperature**
- **Precise programmable digital control**
- **Printout of data**
- **Temperature stability is 0.1 °C**
- **Includes clear animal enclosure**
- **Plate size 4 x 8"**
- **Two-year warranty**



This safe, humane device for rats and mice is used for latency and threshold-based nociception, 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.

II-PE34 Incremental Hot Cold Plate Analgesia Meter for Mouse & Rat

Incapacitance Meter for Mouse & Rat

- **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 key-pad**
- **Two-year warranty**



Test pain and inflammation in the hind limbs of mice, rats or birds with the Incapacitance Meter. It 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

II-600MR Incapacitance Meter for Mouse & Rat

Hot Plate Analgesia Meter

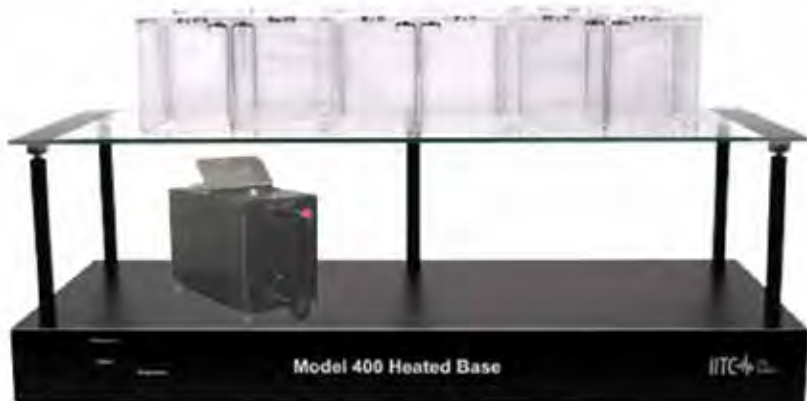
- **Includes both mouse and rat enclosure**
- **Temperature indicated in 0.1 °C increments**
- **Holding accuracy is +/- 0.1 °C**
- **Digitally controlled**
- **Two-year warranty**

Use the Hot Plate Analgesia meters for latency testing in rats and mice. Simply place the animals on a 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 setpoint (up to 75 °C). The plate maintains a consistent temperature throughout the test.



II-39 Hot Plate Analgesia Meter for Mouse & Rat

Plantar Test Apparatus/Tail Flick Test Analgesia Meter



- **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 key-pad**
- **Heated glass option**
- **Tail temperature monitor option (for use with the Tail Flick meter)**

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.

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



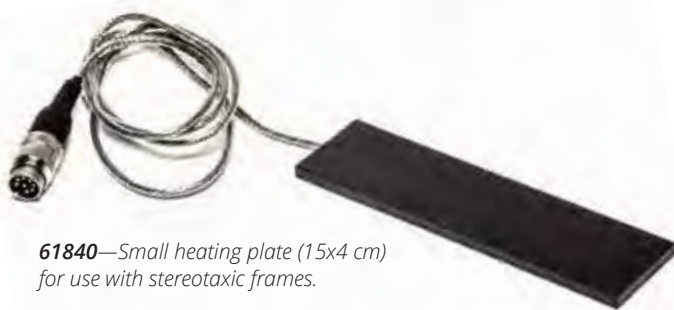
Animal Temperature Controller

ATC2000 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, and derivative (PID) technology in adjusting the DC voltage output. 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.

The controller 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.)



61840—Small heating plate (15x4 cm) for use with stereotaxic frames.



- **Low Noise DC Heater**
- **Adaptive mode—auto adjust PID regardless of animal size**
- **PID control for maximum temperature stability**
- **Three temperature inputs—RTD, TC, plate**
- **Automatic shutdown if the plate reaches 45°C**

- The heater plate also has an internal temperature sensor. The ATC2000 monitors this sensor to prevent the localized hot spots under animal.

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 the normal mode, depending on the sampling rate used.

- Shutdown is a fail safe mode used if the plate temperature ever exceeds 45°C.

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 6-ft ultra-flexible, shielded cable and an RTD sensor.

The metal heating plates (available separately) have built-in temperature sensors. Compatible with stereotaxic systems, the rigid, flat surface fits under the U-frame. Plates are washable with water and detergent.

ATC2000 SPECIFICATIONS

TEMPERATURE RANGE	..... up to 45°C
RESOLUTION	..... 0.1°C
ACCURACY	..... ± 0.3°C
RAT SENSOR	..... RTD, OD 2.0mm tube with 3.5mm ball head (Optional mouse sensor is available)
MAXIMUM DC OUTPUT	..... 10V, 3A
POWER	..... Universal AC Adapter 90–264V Input, 12V@4.5A maximum output
DIMENSIONS	..... 8.9 x 20.8 x 27.6 cm (3.5 x 8.2 x 10.8 in.)
WEIGHT	..... .5 kg (11 lb)

ATC2000 Animal Temperature Controller

REQUIRED 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 for stereotaxic frame, 15x4 cm

REPLACEMENTS

61824	RTD Rectal Temp Probe, 1.25 mm shaft diam., 2.5mm ball tip
RET-2	TC Rat Rectal Temp Probe, 1 mm shaft diam., 3.2mm ball tip
RET-3	TC Mouse Rectal Temp Probe, 1 mm shaft diam., 1.6mm ball tip
503573	Silicone Pad for ATC2000 (10 x 15 cm)

NEEDLE MICROPROBES (see page 49 for details)

MT-29/1	29 ga 1 cm Needle Microprobe, 5-ft cable
MT-23/3	23 ga 3 cm Needle Microprobe, 5-ft cable
MT-D	Needle Microprobe, 5-ft cable

FLEXIBLE IMPLANTABLE PROBES (see page 49 for details)

IT-18	0.025-inch diam Flexible Implantable Probe, 3-ft cable
IT-23	0.009-inch diam Flexible Implantable Probe, 3-ft cable
IT-1E	0.025-inch diam Flexible Implantable Probe, 3-ft cable

300443	RTD Extension Cable, 3 m
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Blood Pressure Measurement for Rats and Mice

Unique environmental control system and single tail cuff allows tail movement, minimizing stress in the animal subjects



- *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*

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.

- *Highly sensitive photoelectric sensor for blood pressure detection*
- *Monitor, record, store or export real time 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.

In addition to the standard one-year warranty on the system, tail cuff sensors have a lifetime warranty..

Includes all accessories necessary to run system.

II-MRBP-M	Mouse Blood Pressure System
II-MRBP-R	Rat Blood Pressure System

Call for pricing on multiple channels.

Blood Pressure Monitor and Transducer



- **Monitors animal arterial or venous blood pressure**
- **Displays systolic, diastolic or average blood pressure**

BP1 accepts WPI's BLPR 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 185), the user may calibrate the display to read mm Hg. Recorder output connector allows direct connection to a pen recorder, oscilloscope or computer via a data acquisition system.

BLPR2 can be used for the direct arterial and venous pressure measurement in animal blood vessels. Supplied sterile, BLPR2 is accurate, linear and stable with temperature. May be sterilized cold with Cidex or a similar bactericide.

BLPR2 is equipped with a twelve-foot cable and connector compatible with WPI's four-channel signal conditioning unit, **TBM4M** Transbridge, and the single-channel **BP1** blood pressure monitor. Cable has moisture-resistant locking connector. A continuous, uniform lumen



- **0.4mm O.D., 0.2mm I.D. tubing**
- **Autoclavable**
- **Biocompatible Perfluorocarbon tubing material**

**Micro Cannula
KZ1101**

See description on page 120.

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.

SYS-BP1 Pressure Monitor (transducer & cable not included)

Specify line voltage

ACCESSORIES

BLPR2 NEW Blood Pressure Transducer & Cable

BPCABLE2 NEW 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.

BP1 SPECIFICATIONS

AMPLIFICATION	x1, x10, x100, variable (x5 to x1000)
OUTPUT VOLTAGE SWING	± 5 volts
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

Motorized Stereotaxic Frame



When precision and repeatability of motion are critical, the **MTM-3** Motorized Stereotaxic Frame outperforms manual models, and it greatly reduces human error. The motorized axis of the MTM-3 provide 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 supplied with WPI stereotaxic frames is also compatible with standard stereotaxic frames and can be adapted to existing frames of other manufacturers. Single and dual manipulator arm motorized systems are available.

NEW!

MTM-3 Features

Increased Precision and Repeatability of motion over traditional manual Stereotaxic frames

- Accurate microstepping motor drive for high resolution placement
- Set the "final approach" speed between 2mm/sec and .02mm/sec

Increased Convenience, decreased error measurement

- No more error resulting from reading Vernier scales
- Brain atlas coordinates can be input into the controller, no computer required
- Coordinate distances are automatically calculated
- Touch screen for ease of control
- Graphic controller display for instant operational feedback

MTM-3 Operation

Manual mode

- Move the actuator using the touch panel or the intuitive manual 3 axis wheel controller
- Individual axes may be easily disabled/enabled to ensure motion on only the desired axis
- Controller allows for three different speed sensitivity levels

Coordinates mode

- Specify retracted position
- Store three origin definitions (references)
- Probe position may be displayed with respect to any of the references, as well as absolute coordinates

- Position plot cursor graphically represents the actuator arm position with respect to any of the stored references
- All functions are accomplished without the use of a computer (computer interface available, if desired)

Optional Computer Control

- Remote computer control through a USB port
- Wireless Bluetooth computer control for the MTM-3 models equipped with a wireless option
- Text based command set provided
- Use a terminal program to create simple scripts for repetitive operations



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.

MTM-3	3-Axis Stereotaxic Controller (Left or Right)
MTM-3B	3-Axis Stereotaxic Controller with Bluetooth (L or R)
MTM-6	6-Axis Stereotaxic Controller (Left and Right)
MTM-6B	6-Axis Stereotaxic Controller with Bluetooth
MTM	3-Axis Stereotaxic Arm and Controller only (L or R)
MTMB	3-Axis Stereotaxic Arm and Controller only, Bluetooth

Precision Stereotaxic Instruments for Small Animals

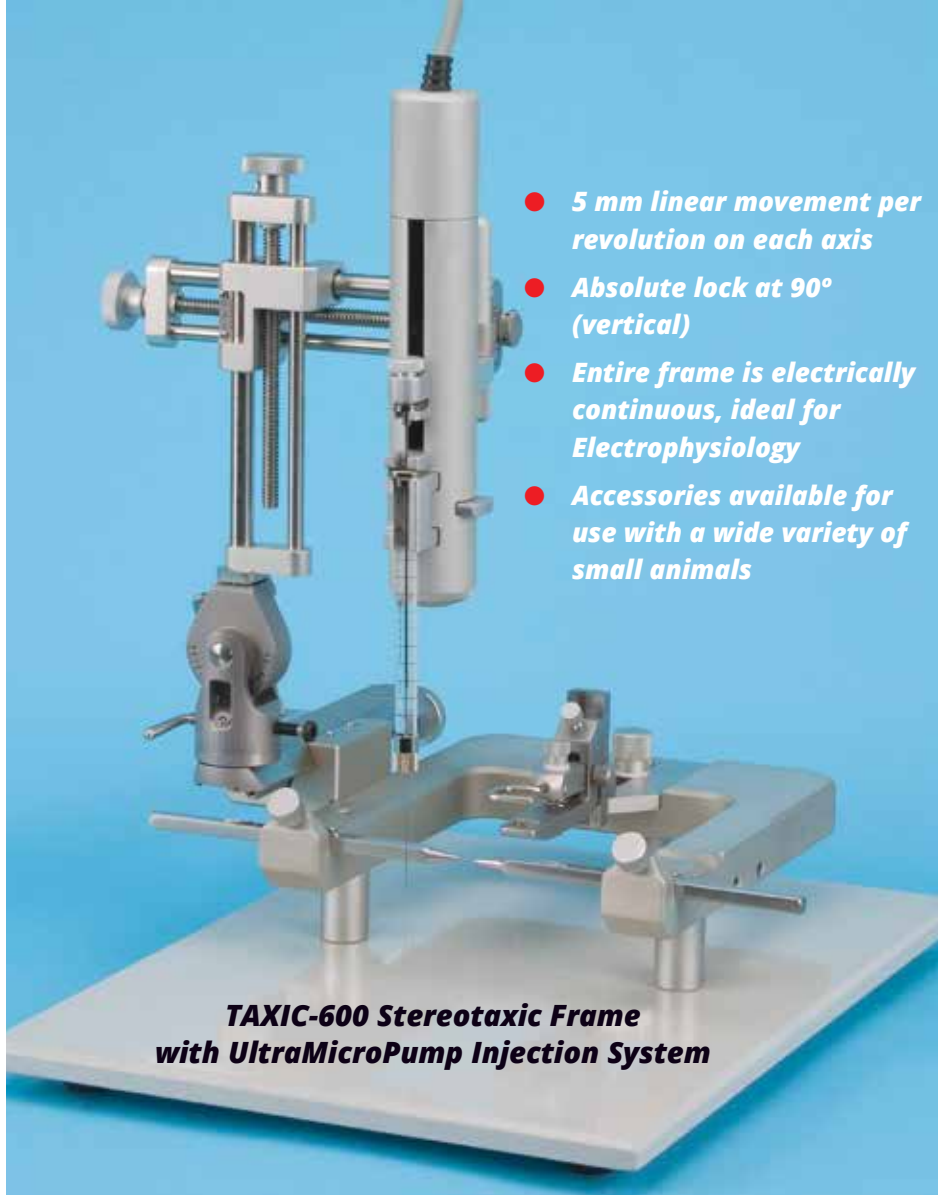
WPI's Precision Stereotaxic Instrument is built around the time-proven U-frame design concept, providing stability, and adaptability to most species. Precision alignment ensures accurate placement of electrodes, micropipettes, and other devices. It is ideal for researchers in need of a versatile, reliable instrument for stereotaxic procedures with small animals

Versatility of positioning

The manipulator arm controls medio-lateral 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 antero-posterior 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 antero-posterior or medio-lateral planes. The locking mechanism will hold any angle position without drift or creep. It also provides an absolute lock at 90° vertical.



Above: **502600** Precision Stereotaxic Frame.
At right: **502603** Dual Manipulator Stereotaxic Frame.



TAXIC-600 Stereotaxic Frame with UltraMicroPump Injection System

- **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 use with a wide variety of small animals**



Easily read scales

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.

Convenient for electrophysiology

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	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
TAXIC-600	Stereotaxic Frame with 18° Ear Bars plus UMP3-1 System
TAXIC-650	Stereotaxic Frame with 45° Ear Bars plus UMP3-1 System
TAXIC-603	Dual Manipulator Stereotaxic Frame with 18° Ear Bars plus UMP3-1 System
TAXIC-653	Dual Manipulator Stereotaxic Frame with 45° Ear Bars plus UMP3-1 System

Precision Stereotaxic Instruments for Mice and Neonatal Rats



502610
Stereotaxic Frame for Mouse, Portable, Single Manipulator



502612
Stereotaxic Frame for Rat, Portable, Single Manipulator, 18° Ear Bars



502614
Stereotaxic Frame for Rat, Rail-mounted, Single Manipulator, 18° Ear Bars



502257
MRI Rat Adaptor



502258
Neonatal Rat Gas Anesthesia Head Holder



502261
Rat Gas Anesthesia Head Holder



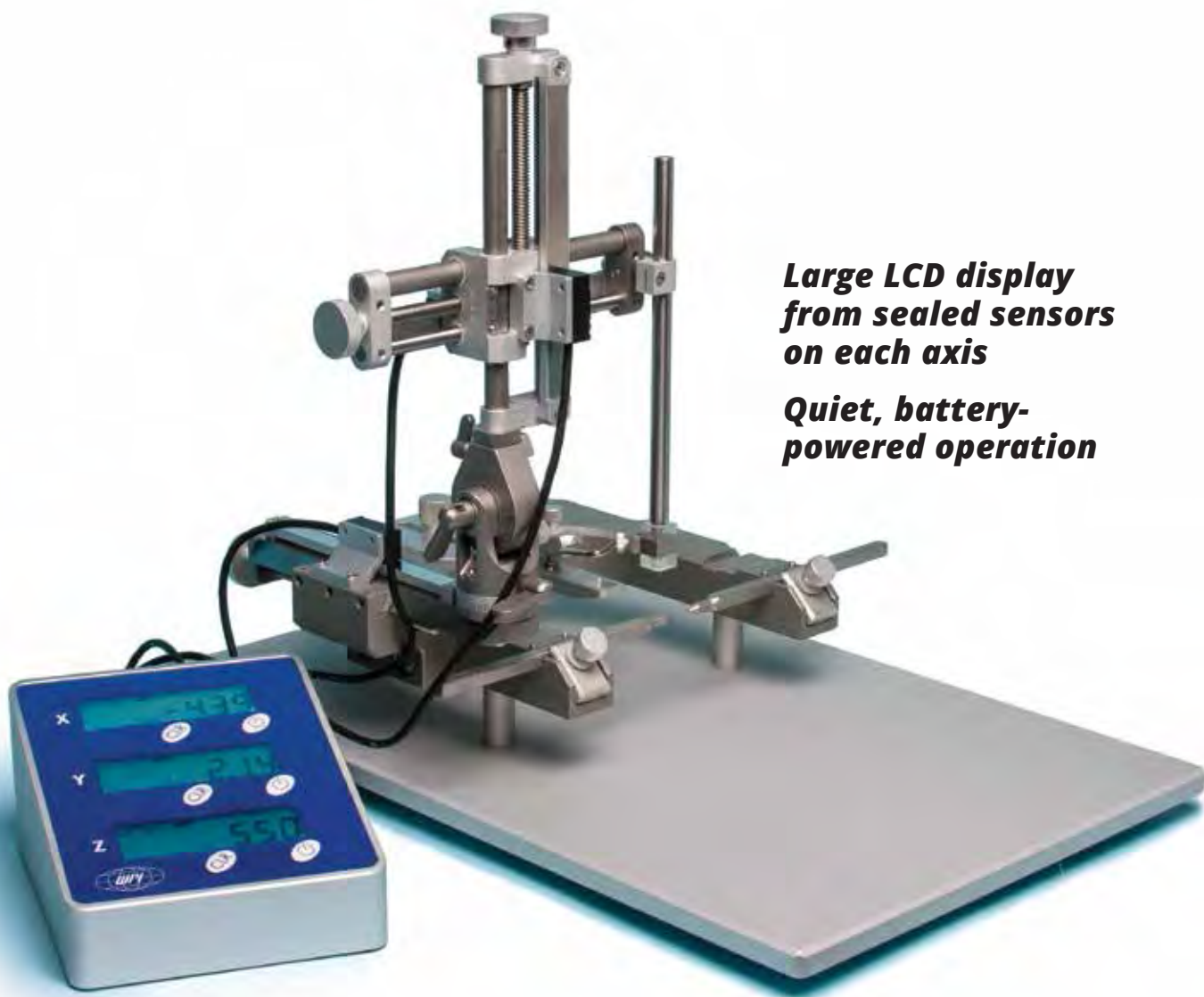
502262
Mouse Gas Anesthesia Head Holder



502616
MRI Stereotaxic Instrument for Dogs and Monkeys

502257	MRI Rat Adaptor
502258	Neonatal Rat Gas Anesthesia Head Holder
502259	Rat Spinal Adaptor
502261	Rat Gas Anesthesia Head Holder
502262	Mouse Gas Anesthesia Head Holder
502610	Stereotaxic Frame, Single Manipulator, for Mouse
502612	Stereotaxic Frame, Single Manipulator, for Rat, 18° Ear Bars
502614	Stereotaxic Frame, Single Manipulator, Rail Mounted, for Rat, 18° Ear Bars
502616	MRI Stereotaxic Frame, for Dogs and Monkeys

Digital Stereotaxic Frame with LCD Display



**Large LCD display
from sealed sensors
on each axis**

**Quiet, battery-
powered operation**

This new Digital Stereotaxic Frame features sealed electronic sensors and an easy-to-read LCD display with 10-micron resolution in all three axes. A zeroing function aids in targeting specific coordinates. The battery-powered display is electronically quiet, making it useful in electrophysiology experiments as well as keeping the workbench tidy.

Features

- 360° rotation and lock at any level angle
 - Syringe pump, microcamera and drill can be attached directly
 - Dual-lead screws provide stable and accurate movement
 - Maintains accuracy and flexibility under different temperatures
 - Zeroing function for targeting specific coordinates
 - 10µm precision of manipulator in all directions
 - Desktop display is separate from sensors, making it easy to read
 - Battery-powered sensors, without electronic noise, are suitable for electrophysiology experiment
 - Extended base plate 400mmX255mm suitable for various animals
 - Vertical lock and fixing knob are separated to ensure accurate position at any angle
 - The precisely-designed rotary knob and U frame allow sufficient space for the anterior-posterior operation
 - Laser engraved scales and darkened rod make numerals easy to read
 - Curved design of nose clamp fixes the head of the animals more securely
- Adaptors available for use with rats, mice, birds, cats, geckos, guinea pigs and other species
 - 80 mm of vertical, lateral and anterior-posterior travel
 - 180° rotation and lock at any vertical angle

502300	Digital Stereotaxic Frame with 18° Ear Bars
502350	Digital Stereotaxic Frame with 45° Ear Bars
502303	Dual Manipulator Digital Stereotaxic Frame with 18° Ear Bars
502353	Dual Manipulator Digital Stereotaxic Frame with 45° Ear Bars
TAXIC-300	Digital Stereotaxic Frame with 18° Ear Bars and UMP3-1
TAXIC-350	Digital Stereotaxic Frame with 45° Ear Bars with UMP3-1

**Also available
with UMP3-1
UltraMicroPump —
special pricing!**

Parallel Rail Stereotaxic Instrument for Large Animals

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 adopt up to four manipulators with 100-micron resolution on each axis. Each manipulator can smoothly moved to and locked at any location on both parallel rails in an arrange of 20 cm. Parallel Rail Stereotaxic Frame system for large animals include the Parallel Rail Frame, base plate, manipulator(s), Cat/Monkey or Dog adaptor, and swivel mount.

502227	Stereotaxic Frame System with one manipulator for Cat and Monkey
502228	Stereotaxic Frame System with two manipulators for Cat and Monkey
502229	Stereotaxic Frame System with three manipulators for Cat and Monkey
502230	Stereotaxic Frame System with four manipulators for Cat and Monkey
502231	Stereotaxic Frame System with one manipulator for Dog
502232	Stereotaxic Frame System with two manipulators for Dog
502233	Stereotaxic Frame System with three manipulators for Dog
502234	Stereotaxic Frame System with four manipulators for Dog

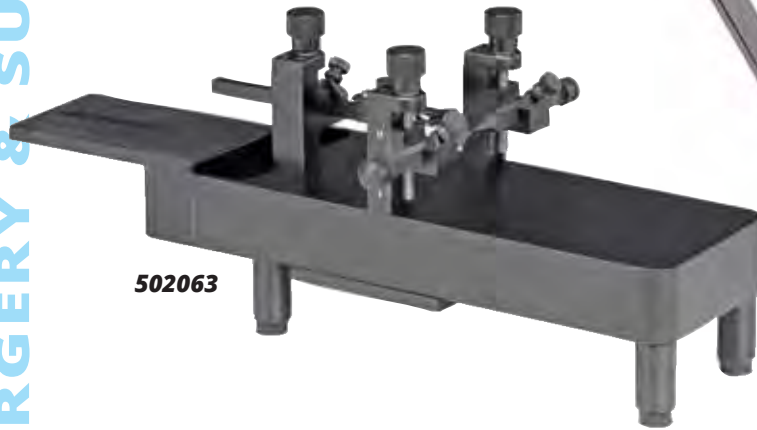
For more options and accessories, visit the website — www.wpiinc.com

Stereotaxic Accessories

ADAPTORS

502063	Mouse and Neonatal Rat Adaptor
502213	Platform, Gas Anesthesia, with mouse Mask (<i>use with 502063</i>)
502062	Mouse Adaptor
502204	Rat Adaptor with a pair of ear bars, 18°
502226	Cat/Monkey Adaptor for 502600 series
502238	Spinal Adaptor for Rat
502060	Guinea Pig Adaptor for 502600 series
502241	Dog/Monkey Adaptor for Parallel Rail Stereotaxic instruments, with a pair of ear bars, 18°

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.



502063



502241



502213



502054

502053



502062



502204

ANIMAL SURGERY & SUPPORT



502237

OmniDrill35 not included — see page 25.



502245

Guide Cannula (see page 48)



502256

502070

502068

502244

PROBE HOLDERS

502210	Probe Holder with corner clamp, 0.3-1.5mm opening
502067	Probe Holder with side clamp, 0.3-3.5mm opening
502070	Cannula Holder, metal tip, opens to 3.4mm (see cannulas, page 52)
502256	Cannula Holder, plastic tip, opens to 3.4mm (see cannulas, page 52)
502068	Large Probe Holder, 6.5-13mm opening
502237	Extra Large Holder for OmniDrill35 Microdrill
502236	Microdialysis Probe Holder, 1.5mm hole
502244	Micrometer Adjustable Electrode Holder, 10µ resolution, 25mm travel, 0.3-1.5mm opening
502245	Manual Microsyringe Injection Holder, 10µ resolution, 25mm travel



502235 502056 502225 502242

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. 1.5mm hole for auditory stimulation



502259—Spinal Adaptor for Rat

OTHER ACCESSORIES

502053	Mask, Gas Anesthesia, Mouse
502054	Mask, Gas Anesthesia, Rat
502201	V-Clamp, 10/32 screw
504608	V-Clamp screw
502213	Platform, Gas Anesthesia, with mouse Mask (use with 502063)
502243	Adjustable Stage Platform for 502600 series, 2cm high
503598	Micro-Drill, 35K rpm, 110/220VAC, w/ a set of bits
503599	Micro-Drill, 35K rpm, 240VAC, w/ a set of bits
61840	Heating Plate for 502063, 4X15cm, 5mm thick (use with ATC2000)

Microprobe Thermometers



BAT-12

Stand sold separately

- **Super Accuracy** ● **Fast Response**
- **Analog output signal** ● **Multiple inputs**
- **Differential Temperature Measurement**



BAT-10

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.

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

EXT-6	Probe Extension Lead, 180 cm long
501608	Tripod Stand for BAT-12

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°C Range: 1°C ± 1 least significant digit 0.1°C Range: 0.1°C ± 1 least significant digit Diff. Range: 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

Temperature Probes

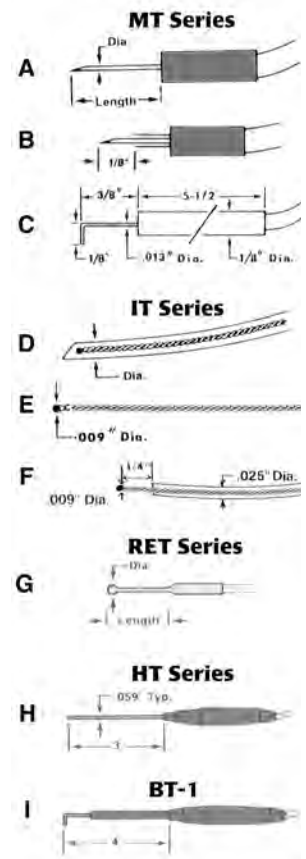
- **Flexible Teflon microprobes are used for implantation in tissue, in spectrophotometer cuvettes, rectally in neonatal mice, in water baths, PCR thermal cyclers, etc.**
- **Animal rectal temperatures during surgical procedures and pyrogen testing.**
- **Skin temperature measurement during exercise physiology studies.**

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.



Probe Type	Size	Style	Time Constant	Isolated	Max. Temp.	Lead Length	Description
NEEDLE MICROPROBES							
Fast-response needle probes for instant readings in tissue, semisolids, liquids, very small specimens, powders and materials.							Needle tip is sealed to ensure only stainless steel contacts specimen.
MT-29/1	29 ga / 1 cm	A	0.125 sec	No	200°C	5 ft	29 gauge approximately 0.013-in
MT-29/2	29 ga / 2 cm	A	0.125 sec	No	200°C	5 ft	-
MT-29/3	29 ga / 3 cm	A	0.125 sec	No	200°C	5 ft	-
MT-29/5	29 ga / 5 cm	A	0.125 sec	No	200°C	5 ft	-
MT-26/2	26 ga / 2 cm	A	0.1 sec	No	200°C	5 ft	26 gauge approximately 0.018-in
MT-26/4	26 ga / 4 cm	A	0.1 sec	No	200°C	5 ft	-
MT-26/6	26 ga / 6 cm	A	0.1 sec	No	200°C	5 ft	-
MT-23/3	23 ga / 3 cm	A	0.15 sec	No	200°C	5 ft	23 gauge approximately 0.125-in
MT-23/5	23 ga / 5 cm	A	0.15 sec	No	200°C	5 ft	-
MT-23/8	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							
Designed for high accuracy on extremely small specimens such as insects, seeds, etc. Maximum insertion depth 1/8". Totally sheathed in chemical resistant Teflon.							
Sensor Lead Diameter							
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 239A. 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 response of IT-23 with sheath strength of IT-18.
RECTAL PROBES							
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. 0.063-in. and shaft 3/4-in. long (0.028-in. diam.)
GENERAL PURPOSE							
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.
BT-1	-	I	0.15 sec	No	240°C	5 ft	Plastic handle with welded stainless steel, immersible shaft used for surface temperatures of solids, liquids, gases and semisolids. Tip is 0.02-in. diam., at right angle to probe to facilitate surface measurement.



These probes may also be used with WPI's new **ATC2000** Animal Temperature Controller.
See page 36

Neuroscience Cannulas

For in vivo investigation of rodents



Cannula assembly: fixing screw, internal cannula with attached tubing, and guide cannula.



Internal cannula secured with fixing screw.

ANIMAL SURGERY & SUPPORT

Exceptional Quality
Best Prices
Rapid Order Response

This cannula system for neuroscience study and pre-clinical research includes an entire range of cannula options. The three primary components include the Guide Cannula, the Internal Cannula and the Dummy Cannula (cap)

- WPI cannulas are beveled inside and out and then polished to remove any burrs and ensure that the inside diameter is perfectly cylindrical. This limits undesired trauma to tissue and ensures smooth operation.
- WPI offers exceptional quality at the best prices.
- Quantities of each item are kept in stock so you can order as needed.

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



The Internal Cannula is inserted into the Guide Cannula to sample or inject fluid.

Dummy Cannula



The Dummy Cannula has a stainless steel wire

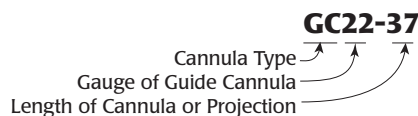
core, and it is placed in the Guide Cannula when the Internal Cannula is removed. It seals the opening and prevents tissue from entering the bottom of the Guide Cannula. The Dummy Cannula is threaded to securely tighten it so that the animal will not unscrew it while grooming.

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

Gauge—Choose the gauge of the Guide Cannula that will be used, even if you are specifying an

Internal or Dummy Cannula. Choices include 22, 24 and 26 gauge.

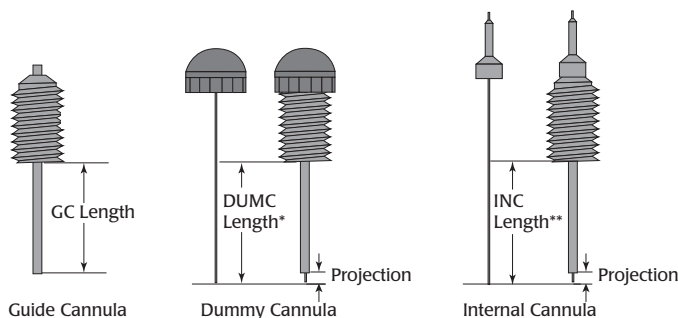
Length—Guide Cannulas can be ordered in a range of lengths from 1.0–9.9mm. Length can be specified to 0.1mm, with a tolerance of ± 0.07 mm. For example, a **GC24-60** is a 24ga. cannula that is 6.0mm long.

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 1.0mm.

$$DUMC \text{ Length} = GC \text{ Length} + \text{Projection}$$

$$INC \text{ Length} = GC \text{ Length} + \text{Projection}$$

For example, for a Dummy Cannula flush with the end of a 26ga Guide Cannula that is 6.0mm long, order a **DUMC26-60**. For an internal cannula that projects 0.5mm beyond the 6.0mm Guide Cannula (6.5mm), order an **INC26-65**.



* DUMC Length = GC Length + Projection. If the cap is screwed on too tightly, the projection will be longer than expected.
** INC Length = GC Length + Projection. Internal cannula mounts flush and does not screw into place.

Cannulas

		Qty 1-9	Qty 10-19	Qty 20-49	Qty 50-99	Qty 100+
GC22-X	Guide Cannula, 22 Gauge, X.0mm					
INC22-X	Internal Cannula, 22 Gauge, X.0mm					
DUMC22-X	Dummy Cap Cannula, 22 Gauge, X.0mm					
GC24-X	Guide Cannula, 24 Gauge, X.0mm					
INC24-X	Internal Cannula, 24 Gauge, X.0mm					
GC26-X	Guide Cannula, 26 Gauge, X.0mm					
INC26-X	Internal Cannula, 26 Gauge, X.0mm					
DUMC26-X	Dummy Cap Cannula, 26 Gauge, X.0mm					

Flexible PE Tubing

		Qty 1-9	Qty 10-19	Qty 20-49	Qty 50-99	Qty 100+
504278	0.25mm ID, 0.5mm OD, 1m long					
504279	0.42mm ID, 0.85mm OD, 1m long					
504280	0.6 mm ID, 1.1mm OD, 1m long					

Flexible PE tubing are 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

Misc. Accessories

		Qty 1-9	Qty 10-19	Qty 20-49	Qty 50-99	Qty 100+
504281	Fixing Screw for connection of INC & GC					
504282	Instant Cyanoacrylate Adhesive, 3g					
504283	Instant Cyanoacrylate Adhesive, 20g					

World Precision Instruments

www.wpiinc.com

Sensors

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
Price					
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	10nM to 10µM	1 NM to 40µM*	< 100nM to 100µM	0.1%-100%	< 5nM-100µM
Sensitivity	~0.5 pA/nM	≤ 2 pA/nM	8 pA/µM	0.3-0.6nA/%	2 pA/nM
Drift	<1pA/min	<1pA/min	0.1pA/min	< 1%/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	Nitric Oxide										H ₂ O ₂	H ₂ S	
	ISO-NOPF200	ISO-NOPF200-Lxx ³	ISO-NOPF100	ISO-NOPF100-L ³	ISO-NOP70Lxx ³	ISO-NOPF500-Cxx	ISO-NOP3005	ISO-NOP3020	ISO-NOP30L ³	ISO-NOP007	ISO-NOPNM	ISO-HPO-100	ISO-H2S-100
Price	(pkg of 2)	(pkg of 3)	(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 3)	(pkg of 2)
Fiber Diameter (µm)	200	200	100	70	500	30	30	30	7	7 Conical tip: 100nm	100	100	
Tip Length ² (mm)	1-5 ¹	1-10 ¹	1-5 ¹	3	5-10	0.5	2	3	2	2	1-4 ¹	2-5 ¹	
Response Time (sec.)	< 5	< 5	< 5	< 3	< 10	< 3	< 3	< 3	< 3	< 3	< 5	~5	
Lowest Detection Limit/Range (nM)	0.2	0.2	0.2	1	0.2	1	1	1	0.5	0.5	1	<5	
Nominal Sensitivity-New Sensor ² (pA/nM)	≥20	≥50	≥10	≥10	≥20	≥1	≥1.5	≥1	≥1	≥0.5	≥1	1-4	
Baseline Drift (pA/min)	none	none	none	none	none	none	none	none	none	none	<2.0	<2	

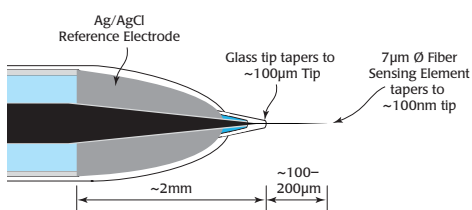
¹Sensor available in 1mm length increments (for example, 1mm, 2mm, 3mm...).

²Sensor sensitivity varies with length and diameter.

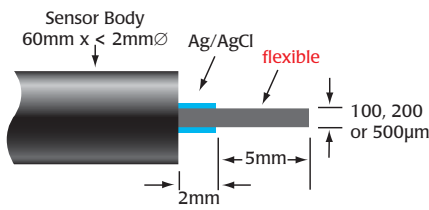
Any 100µm sensor can be purchased with a hypodermic sheath. Add a -H to the end of the part number (for example, ISO-HPO-100-H).

³L-shaped sensor for use with a tissue bath.

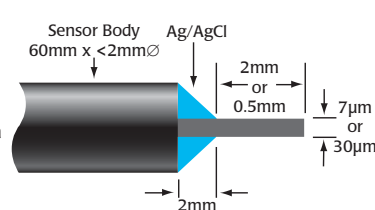
Some nitric oxide sensors are available in custom lengths. When ordering custom lengths, use the part numbers **ISO-NOPF100-Cxx** or **ISO-NOPF200-Cxx** and replace the **xx** with the desired length. For example, for a 1mm flexible sensor tip, the part number should be **ISO-NOPF200-C01**. Sensors can be ordered in the following custom lengths: 1mm, 2mm, 3mm, 4mm or 5mm.



NOPNM



ISO-NOPF



ISO-NOP007, ISO-NOP30

Nitric Oxide Sensor Guide

All WPI NO sensors are 100% compatible with ISO-NO Mark II (NOMK2), APOLLO 4000, APOLLO 1000, and TBR4100 Free Radical Analyzer.

APPLICATIONS	in vivo	Cell Cultures, NO ₂ , NO ₃	Tissue Bath	Tissue Bath	Microvessels	Microvessels	Single Cell
SENSOR	ISO-NOPF	ISO-NOP	ISO-NOP30L	ISO-NOP70L	ISO-NOP30	ISO-NOP007	ISO-NOPNM
SENSOR DIAMETER	100, 200, or 500 µm	2 mm	30 micron	70 micron	30 micron	7 micron	100 nm
RESPONSE TIME (with NOMK2)	< 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	some	yes	yes	yes	yes	yes	some
DRIFT	none	none	none	none	none	none	none
SENSITIVITY	10 pA/nM	2 pA/nM	1.4 pA/nM	1.4 pA/nM	1.4 pA/nM	1 pA/nM	0.5 pA/nM
PHYSIOLOGICAL INTERFERENCE	none	none	none	none	none	none	none

Selectivity of WPI's NO sensors

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 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, absorbic acid, hydrogen peroxide, catecholamines, and much more.

ISO-NOP – The original nitric oxide probe – ideal for cell cultures, cell suspensions and many other applications

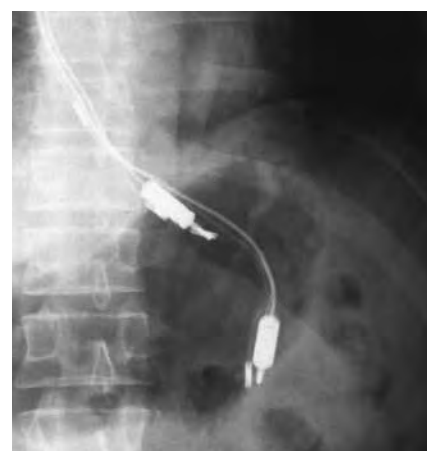


The ISO-NOP is a popular, robust and high performance sensor encased within a 2 mm diameter disposable stainless steel protective sleeve. The tip of the sleeve is covered with a NO-selective membrane. Replacement membrane sleeves can be purchased separately (WPI #5436) and require an internal electrolyte (WPI #7325).

NO₂ and NO₃ Detection

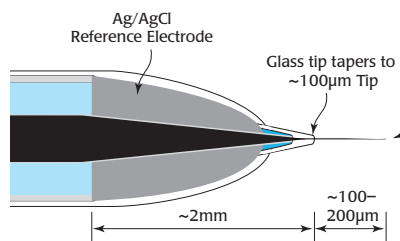
A simple change in experimental protocol will enable the ISO-NOP to be conveniently used for indirect rapid accurate determination of nitrite (NO₂) and nitrate (NO₃) concentration in samples. Using this method a detection limit for NO₂ or NO₃ as low as 1 nM is routinely possible.

Abdominal X-ray showing the apparatus 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.



- ISO-NOP** Replacement 2 mm shielded sensor and cable
- 5435** ISONOP Startup Kit (**recommended with first purchase**)
- 5436** Replacement Sleeve Kit for 2 mm 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 (100mL)

ISO-NOPNM – The world's smallest nitric oxide NanoSensor, designed for measurement of NO at the cellular level.

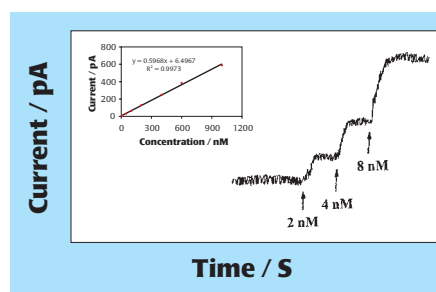


Schematic drawing of the new integrated NO nanosensor. (US Patent Pending)

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 nanofibre 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 seconds.

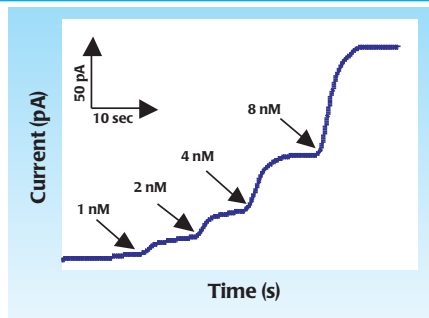


Amperometric response of the NO nanosensor (ISO-NOPNM) to the successive additions of 2nM, 4 nM, 8 nM NO into 0.1 M PBS (pH=7.4).

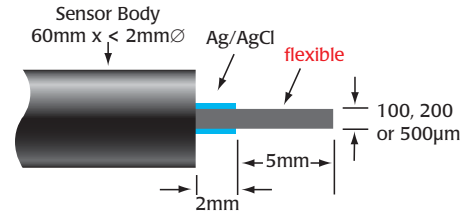
- ISO-NOPNM** 100 nm NanoSensor, pkg of 3 (requires cable #91580)
- 91580** Microsensor Adapter Cable
- SNAP50** SNAP, 50 mg vial

ISO-NOPF – unique flexible NO sensor! Designed for arteries, microvessels, in vivo applications, and similar applications.

ISO-NOPF electrodes are the newest addition to WPI's nitric oxide sensor family and 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.



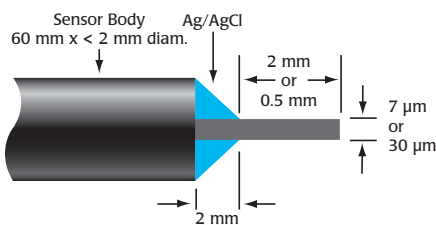
Schematic drawing of ISO-NOPF.

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
91580	Microsensor Adapter Cable
SNAP50	SNAP, 50 mg vial

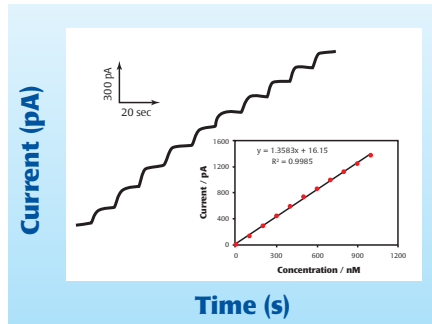
ISO-NOP007
ISO-NOP30 – 7 and 30 micron sensors with exceptional performance — ideal for tissues and microvessels

The ISO-NOP007 and ISO-NOP30 have recently been improved in design and performance. The ISO-NOP007 has a tip diameter of just 7 microns and a length of 2 mm. The ISO-NOP30 has a tip diameter

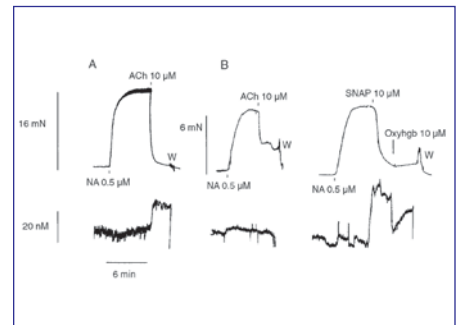
of 30 microns and is available in two different tip lengths (i.e., ISO-NOP3020 has tip length of 2 mm, ISO-NO3005 has tip length of 0.5 mm). The response of the ISO-NOP007 and ISO-NOP30 is linear over a wide dynamic concentration range of NO. The design of both electrodes is based on a single carbon 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.



Schematic drawing of ISO-NOP007 and ISO-NOP30.



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.



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. 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-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)
91580	Microsensor Adapter Cable
SNAP50	SNAP, 50 mg vial

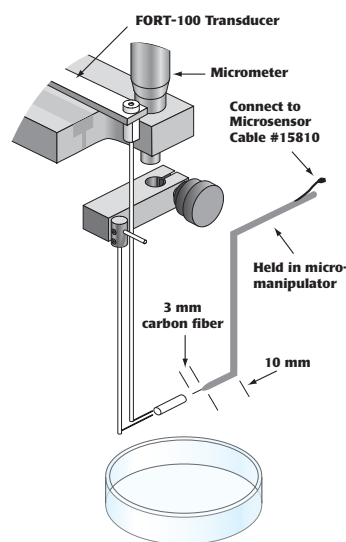
ISO-NOP30L
ISO-NOP70L
ISO-HPO-100-L
ISO-NOPF200-L10

L-shaped sensors for tissue bath & cell culture studies

The ISO-NOP30-L is a unique L-shaped nitric oxide sensor designed specifically for use in tissue bath studies and similar applications (e.g., see WPI's MYOBATH). 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-NOP70-L is similar in construction to the ISO-NOP30 but with the advantage of having a flexible tip (70 µm diameter). The ISO-NOPF200-L10 is designed specifically for cell culture studies.

ISO-NOP30-L	NO Sensor, L-Shaped 30-micron (pkg of 3)
ISO-NOP-70-L	NO Sensor, L-Shaped 70-micron (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-micron (pkg of 2)
91580	Microsensor Adapter Cable



HYDROGEN PEROXIDE & OXYGEN SENSOR GUIDE

	ISO-HPO-2	ISO-HPO-100	ISO-HPO-100H	ISO-HPO-100-L	ISO-OXY-2
APPLICATION	Cell Cultures, etc.	Tissue/ Microvessels	Hypodermic Sheath	Tissue Bath	Cell Cultures, etc.
SENSOR DIAMETER	2.0 mm	100 micron	100 micron	100 micron	2.0 mm
RESPONSE TIME	<5 SEC (90%)	<5 SEC (90%)	<5 SEC (90%)	<5 SEC (90%)	<10 SEC (90%)
DETECTION LIMIT	<100 nM to 100 mM	1 nM to 1 mM	<10 nM to 1 mM	1 nM to 1 mM	0.1 % to 100%
DRIFT	<0.1 pA/min	<1.0 pA/min	1.0 pA/min	<1.0 pA/min	<1%/min
SENSITIVITY	8 pA/ μ M	1 pA/nM	1 pA/nM	1 pA/nM	N/A
PHYSIOLOGICAL INTERFERENCE	none	Contact WPI	Contact WPI	Contact WPI	none

Hydrogen Peroxide Sensors

Hydrogen Peroxide is produced in biological systems by controlled pathways at low concentrations that impact on cell signaling. At higher concentrations inflammatory cells produce local intense amounts of this oxidant to kill pathogens. In the progress of human disease, uncontrolled formation of hydrogen peroxide from the mitochondrial respiratory chain and enzymes, such as xanthine oxidase, can occur (Prof. Victor Darley-Usmar, Univ. of Alabama, personal communication). 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.

Four hydrogen peroxide sensors are currently available. The **ISO-HPO-2** is a 2.0 mm stainless steel sensor, with replaceable membrane sleeves (#600012) and an internal refillable electrolyte (#100042). The sensor is designed for use in cell cultures and similar applications.

The **ISO-HPO-100** is a 100 micron tip diameter hydrogen peroxide micro sensor designed for use in tissues and similar applications.

The sensor design is based on a flexible "activated" carbon fiber sensing electrode coated with a proprietary membrane that enhances hydrogen peroxide detection.

ISO-HPO-2

Both sensors incorporate WPI's proprietary combination electrode technology whereby the hydrogen peroxide sensing element and separate



ISO-HPO-100

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.



ISO-HPO-100H

600011	ISO-HPO Startup Kit (recommended with first purchase)
ISO-HPO-2	2mm Shielded HPO Sensor & Cable
ISO-HPO-100	100 μ m HPO Sensor*, pkg of 3
ISO-HPO-100-L	100 μ m HPO Sensor, L-shaped*, pkg of 3
ISO-HPO-100H	100 μ m 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



Oxygen Sensors

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.

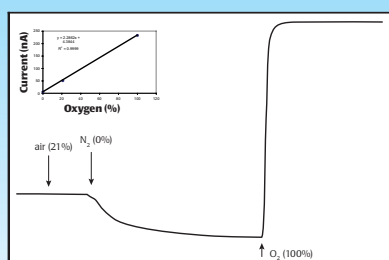
Oxygen diffuses through the membrane. The voltage applied to the sensor is held at -0.7V when the monitoring device is on and

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 O₂.

The **ISO-OXY-2** is a 2.0 mm stainless steel sensor, with replaceable membrane sleeves (#5378) and an internal refillable electrolyte (#7326). The sensor is similar in design to WPI's popular **OXELP** oxygen sensor (see page 68).

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	ISO ₂ Filling Solution (electrolyte)

Current (nA)



Time (s)

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.

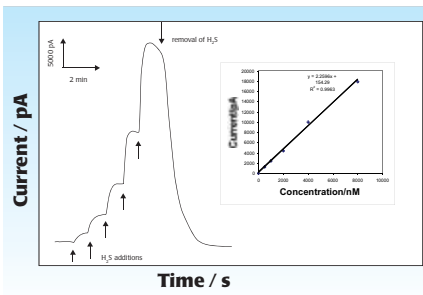
ISO-TEMP-2	2 mm Platinum RTD Temperature Sensor (requires #91580)
91580	Microsensor Adapter Cable

ISO-H2S-2 ISO-H2S-100-Cxx

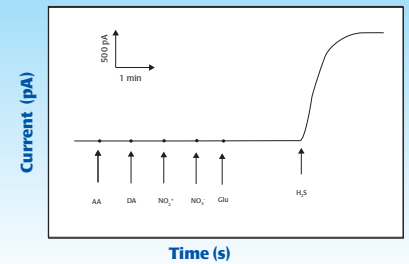
Although hydrogen sulfide (H₂S) is generally thought of as a poisonous gas, it is endogenously produced in many mammalian tissues. It has been detected in micromolar amounts in blood and brain tissue. Hydrogen sulfide is reported as having a broad range of biological functions and although its potential to participate in cell signaling is clear, this biological role is not well understood. H₂S is strongly analogous to nitric oxide (NO) because they share several physical and metabolic properties.

Like NO, H₂S is a potent vascular signal that can mediate vasoconstriction or vasorelaxation depending on the O₂ level and tissue. In the rat aorta, H₂S concentrations that mediate rapid constriction at one O₂ level will cause rapid relaxation at lower O₂ levels.

The ISO-H2S sensor is a low detection limit sensor to record H₂S *in vitro*. It is the only sensor available that measures H₂S.



The stepped response to increasing concentrations of H₂S are linear (see inset, R=0.9963).



The sensor is insensitive to competing species such as ascorbic acid, dopamine, nitrate, nitrite, and glutathials.

ISO-H2S-2	2 mm Shielded Hydrogen Sulfide Macro Sensor
ISO-H2S-100-Cxx	Hydrogen Sulfide Micro Sensor (pkg of 2)
600016	Replacement Sleeves for ISO-H2S-2 (pkg of 4)
100084	Filling Solution for ISO-H2S-2
600015	Start-up Kit for ISO-H2S-2



ISO-COP-2

Electrochemical CO Sensor for In Vivo Measurements for CO dissolved in solution

Carbon monoxide (CO) is a versatile mediator of physiological processes. Carbon monoxide (CO) formed by internal mechanisms (endogenous) is measured in a variety of ways, but standard measurement methods are of limited utility in most biological systems. WPI's ingenious ISO-COP-2 CO sensor measures CO *in vivo* or *in vitro* in real time!

This CO sensor is comprised of a 2.0mm stainless steel body with a replaceable membrane-covered sleeve. The sleeve is filled with electrolyte. It is an amperometric sensor designed for use in cell culture and similar applications.

In principle, CO diffuses through the gas-permeable membrane and

ISO-COP-2 SPECIFICATIONS

Sensor diameter	.....2mm
Sensor sensitivity	.....~0.5 pA/nM
Detection limit	.....~10nM
Linear range	.....10nM-10µM
Response time	.....<10 seconds

is then oxidized to CO₂ on the working electrode of the sensor. This oxidation creates a current with a magnitude directly related to the concentration of CO in solution.

It is designed for use with WPI's **TRB4100** (4-Channel) or **TBR1025** (1-Channel) Free Radical Analyzers.

References

Motterlini, M., Sawle, P., Bains, S., Hammad, J., Alberto, R., Foresti, R. and Green, C, "CORM-A1: A new pharmacologically active carbon monoxide-releasing molecule," FASEB Journal, November 19, 2004, express article 10.1096/fj.04-2169fje.

ISO-COP-2	2 mm Shielded Carbon Monoxide Sensor
95620	Replacement Sleeves (pkg of 4)
95611	Filling Solution
95699	Start-up Kit



IGS100 - Implantable glucose sensor

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 Apollo system.

IGS100	Implantable Glucose Sensor (pkg of 2)
91580	Microsensor Adapter Cable

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 - 300s
IN VIVO CALIBRATION	<i>In vivo</i> 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 -0.7V vs. Ag/AgCl
SENSOR LIFE	3-4 months in solutions at room temperature under continuous polarization; 15-30 days <i>in vivo</i>
SHELF LIFE	6 months
OPERATION CONDITIONS	20° to 40° C (68° to 104° F)
STORAGE CONDITIONS	10° to 25° C (50° to 77° F)



Four-Channel Free Radical Analyzer

- Real-time detection using electrochemical microsensors.
- Integrated system includes one temperature sensor, your choice of two additional sensors, and a start-up kit.
- Measure up to four different species in the same preparation or simultaneous measurement in four different preparations.
- Current measurement range from 300 fA to 10 μ A (four ranges) permits wide dynamic range for detection.
- Wide bandwidth allows recording of fast events.
- Measure nitric oxide from < 0.3 nM to 100 μ M.
- 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 (i.e., ECG, BP, etc.) data on any channel.

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 new **TBR4100**. This optically isolated four-channel free radical analyzer has ultra low noise and independently operated channels.

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.

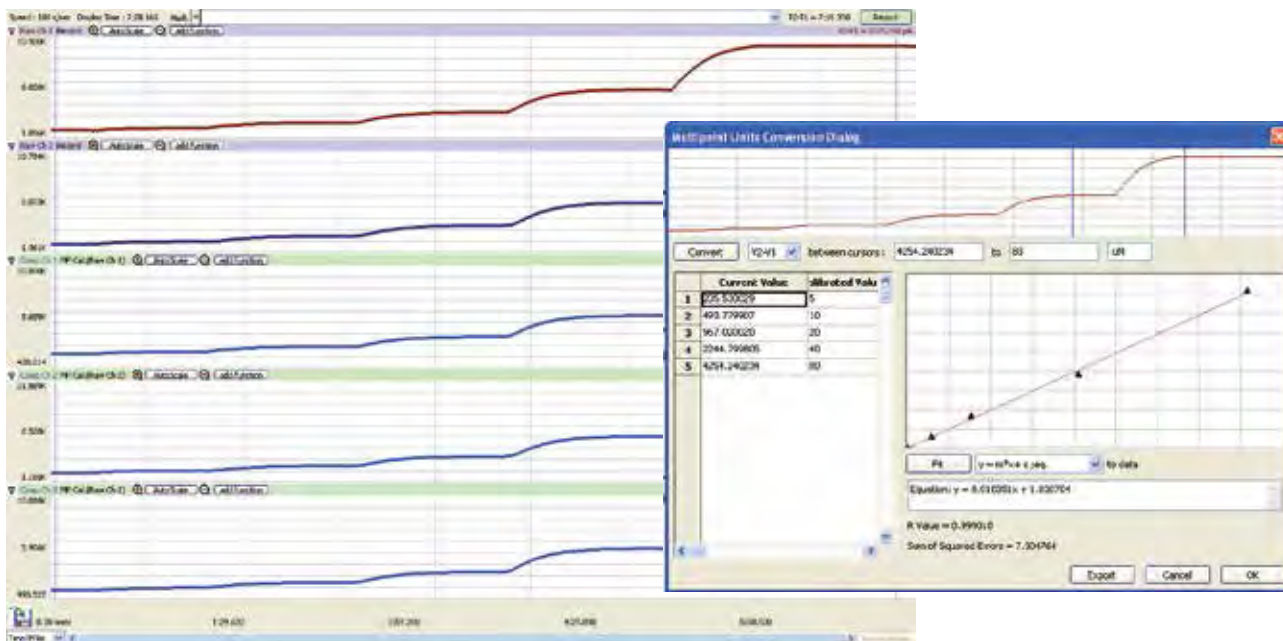
The **TBR4100** analyzer utilizes PC-based data acquisition via our **Lab-Trax** interface;

data traces are displayed and recorded in real-time. The Data-Trax 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 provides 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.



Don't need four channels? The single-channel TBR1025 packs the power of its big brother in a small, economical package.



Multipoint electrode calibration and slope determination can be quickly derived from recorded calibration data.

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
 Dimensions135 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)
 ControlsPower (on/off)
 Current Input Range
 Polarization Voltage
 Analog Output Range+/- 10 V (continuous)
 Analog Output Impedance10 kohm
 Channel to Channel Isolation>10 Gohm
 Channel to Output Isolation>10 Gohm
 Power Supply to AC Line Isolation.....>100 Mohm
 Analog Output Drift.....<10 pA/h

Temperature Input

Number of Channels.....1
 Sensing Element.....Platinum RTD, 1000 Ohm
 Range0-100°C
 Accuracy +/- 1°C
 Resolution.....0.1°C

Analog Output31.25 mV/°C (continuous)

Amperometric Input

Number of Amperometric Channels.....4
 Signal Bandwidth0-3 Hz
 Polarization Voltage (selectable via rotary switch)
 Nitric Oxide.....865 mV
 Hydrogen Sulfide.....150 mV
 Hydrogen Peroxide450 mV
 Glucose.....600 mV
 Oxygen.....700 mV
 ADJ (user adjustable).....+/- 2500 mV
 Polarization Voltage Accuracy.....+/- 5 mV
 Polarization Voltage Display Resolution+/- 1mV

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 / 1µA	< 700 pA	< 300 pA

*Instrument performance is measured as the (max-min) over 20 seconds period with open input. Typical values are given at 3 Hz and 0.3 Hz bandwidth.

Typical sensor performance with TBR4100

ISO-NOPF100 noise0.2 nM NO (<2 pA)**

**Sensor noise is measured as the (max-min) over a 20 seconds period with the sensor immersed in 0.1 M CuCl₂ solution.

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.

TBR4100-424T Four-Channel Free Radical Analyzer with Lab-Trax 4/24T Data Acquisition System

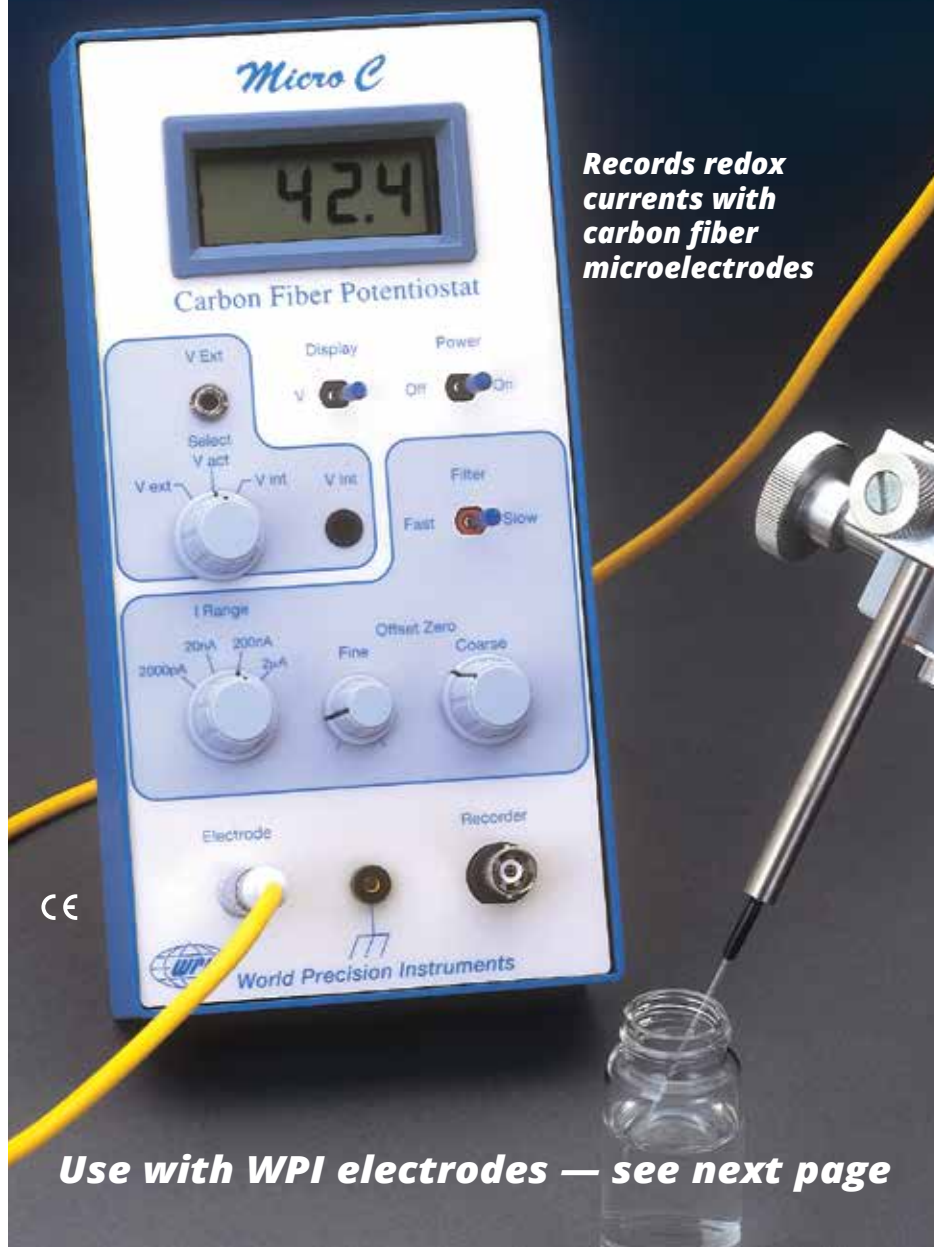
Includes TBR4100 analyzer & power cord, Lab-Trax-4/24T data acquisition system & USB cable, 4 BNC cables, 1 electrode adapter cable, 1 temperature probe, 2 sensors of your choice, and sensor start-up kit(s), if applicable

TBR1025

Single-Channel Free Radical Analyzer — *Includes 1 sensor of your choice & 1 start-up kit*

RECOMMENDED ACCESSORIES

SNAP50 SNAP S-Nitroso-N-acetyl-D-penicillamine, 50 mg vial



Records redox currents with carbon fiber microelectrodes

Micro C™

Advanced Neurotransmitter Detection

Measures oxidizable compounds such as catecholamines (epinephrine, norepinephrine, dopamine), indolamines (serotonin, melatonin), ascorbic acid and Fe (II) with exquisite sensitivity, low noise and site specificity

1-picoampere to 2 microamperes. The built-in carbon electrode activation feature allows the easy renewal of electrode sensitivity. In addition, MicroC features a low-pass filter and the option of applying DC potential externally. A wide range of compounds can be detected: dopamine, epinephrine, norepinephrine, serotonin, etc. Other compounds, such as glutamate, glucose, acetylcholine and alcohol, can also be detected with MicroC using enzyme-modified biosensors.

See Application Notes, "Carbon Fiber Microelectrodes", available as a PDF file which may be downloaded from WPI's web site.

Use with WPI electrodes — see next page

MicroC, WPI's low cost and elegant instrument for electrochemical detection using carbon microelectrodes, will record the presence and concentration of oxidizable biological compounds *in vivo* and *in vitro*. It also features inherently low noise and a sensitivity of 1 millivolt per picoampere of oxidation current. Response time to quantal catecholamine release is less than 1 millisecond. When used with carbon fiber microelectrodes, redox current can be recorded over a range of

The MicroC Potentiostat is supplied with a carbon electrode probe, with 5 feet triax cable, which accepts 0.79 mm connector pin, and a reference electrode with a 4 mm Ag/AgCl half cell (see page 121). For applications where smaller half cells are needed, please call WPI for more information.

References

- G. A. Gerhardt**, "Nafion-coated electrodes with high selectivity for CNS electrochemistry" *Brain Research*, **290**: 390-395 (1984).
- R. M. Wightman, et al.**, "Temporally resolved catecholamine spikes correspond to single vesicle release from individual chromaffin cells." *Pro. Nat'l Acad. of Sci.* **88**: 10754-58, (1991).
- Z. Zhou and S. Misler**, "Action Potential-induced Quantal Secretion of Catecholamines from Rat Adrenal Chromaffin Cells", *J. Biol. Chem.* **270**: 3498-3505, (1995).

MICROC SPECIFICATIONS

METHOD	2 electrode, DC potentiostat
APPLIED POTENTIAL	0.65 V, variable ± 2.5 V
CURRENT RANGES	2000 pA, 20 nA, 200 nA, 2 μ A
BANDWIDTH	1.67 Hz, 167-1000 Hz
NOISE	< 1 pA
DISPLAY	3½-digit LCD display, ± 2 V
RECORDER OUTPUT	± 4.5 volts
RISE TIME	< 1 millisecond
ELECTRODE PROBE/CABLE LENGTH	Triax shielded, 5 feet
POWER	Six 1.5 volt alkaline batteries (included)
BATTERY LIFE	> 1000 hours, est.
SHIPPING WEIGHT	4 lb (1.8 kg)

SYS-MICROC	Potentiostat
MICROCP	Replacement Probe for MicroC

OPTIONAL ACCESSORIES

300305	ATP Adapter (0.031" pin to 1 mm socket)
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Carbon Fiber Microelectrodes

● Sensitive, renewable/durable and economical carbon fiber electrodes for electrochemical detection of oxidizable compounds

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 (Fig. 1) 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.

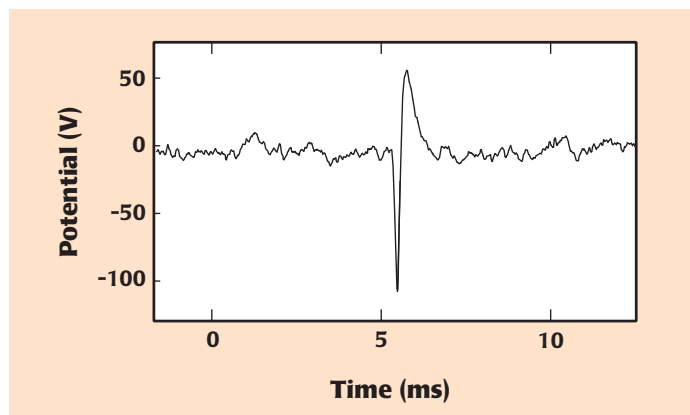


Fig. 2 — Extracellular recording using a carbon electrode in CA1 region of the hippocampus in an anesthetized rat shows ultra-low noise ($\sim 5 \mu\text{V}$). Courtesy: Dr. Carolyn Harley of Memorial University, Newfoundland, Canada.

References

- P. S. Cahill, R. M. Wightman, *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).

Dopamine Concentration/Response Curve

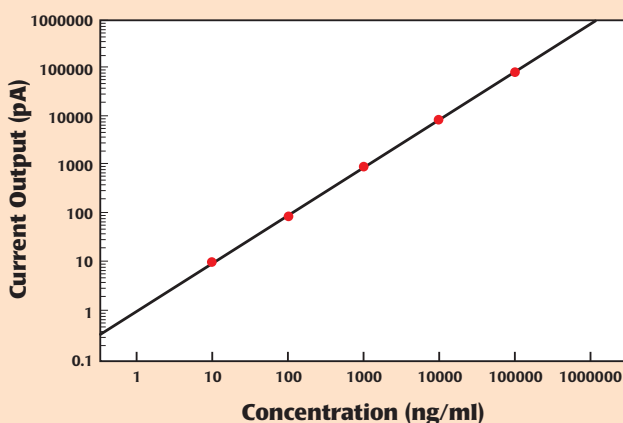


Fig. 1 — Excellent linearity in the response of carbon fiber electrode (CF30-500) to dopamine recorded on Micro-C. Courtesy: Drs. D. Yeomans and X.-T. Wang, University of Illinois at Chicago.

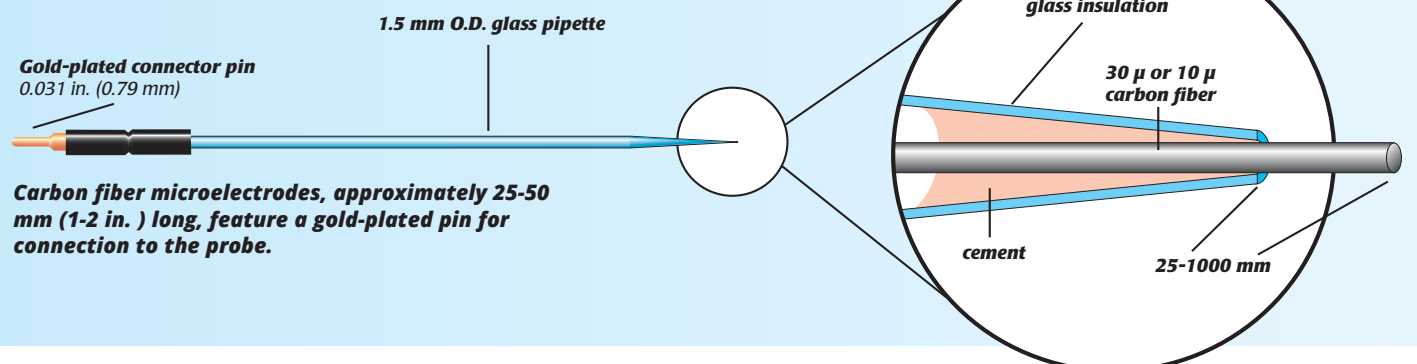
CARBON FIBER MICROELECTRODES, UNCOATED

	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	
CFN30-500 *	30 μm	500 μm	
CFN30-1000 *	30 μm	1000 μm	

* Built to order — allow up to 4 weeks manufacturing time.



Carbon fiber microelectrodes, approximately 25-50 mm (1-2 in.) long, feature a gold-plated pin for connection to the probe.

O₂ Sensor for Real-time Analysis

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. Because the unit is self-contained, it is invariant to fiber bending and stray light, and 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.

- Fluorescence-sensing detector for optical sensors, a viable alternative to traditional chemical sensing devices
- Self-contained, benchtop system—invariant to fiber bending or stray light
- Affordable—Half the cost of comparable phase measurement systems
- Excellent stability, extremely low drift and phase noise
- Simple calibration, setup and control

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. 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.

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.

AL300

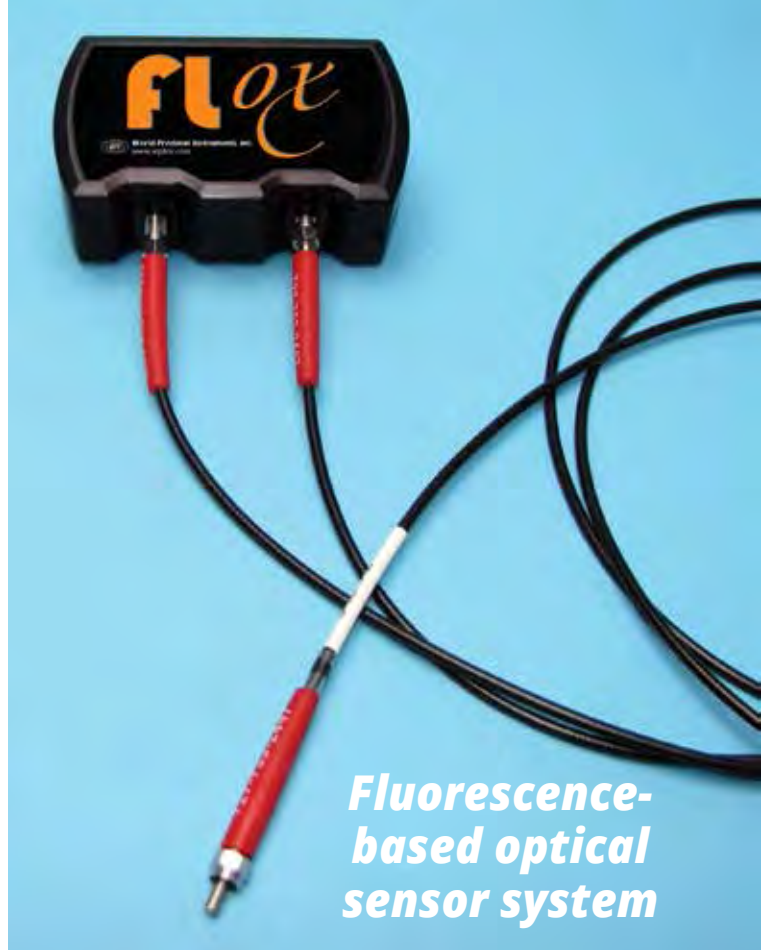
A 500 µm OD (300 µm core diameter) aluminum-jacketed optical fiber probe for applications that require fine spatial resolution. 300 µm aluminum-jacketed fiber assembly; 500 µm OD, 1 m length

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 P1600 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



Fluorescence-based optical sensor system

BIOSENSING



OR125G and OR125GT

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



INTRODUCTORY PRICE

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

Dissolved oxygen meter & oxygen electrode

Electrically isolated, the electrode can function in recording situations where ground-referred electrodes would fail



- **Measures gas and dissolved oxygen**
- **Low O₂ consumption**
- **2 mm tip**

Isolation prevents adverse interaction with other electrodes and instruments. Highly accurate and stable **ISO2** measures oxygen concentrations in aqueous solutions and in gas mixtures. Measurement modes are percent oxygen, parts per million, and oxygen reduction current in nanoamperes.

The lower detection limit (DL) for **ISO2** (in gaseous or in liquid phase) is 0.1 ppm or 0.1%. Oxygen concentration around 0.5 ppm or 0.5% and up can be routinely measured in the gaseous or in the liquid phases.

DL for a particular sensor tends to be different in gaseous and liquid phases when the baseline noise level is also different. In the case of **ISO2**, however, the baseline noise level is very close whether the electrode is immersed in solution or used in the gaseous phase, so DL for the **ISO2** remains relatively close in either phase.

The small tip size (2 mm diameter) and low oxygen consumption of the **OXELP** electrode make it ideal for measurements *in vivo* or *in vitro*. With a T-Adapter (#5399), the sensor probe can be used also for continuous-flow monitoring of oxygen in small fluid volumes. **OXELP** also features a fast response time, typically 10 seconds. Optional BNC-to-double banana adaptor (#13347) and BNC cable (#500184) allow **ISO2** to be connected directly to your chart recorder.

SYS-ISO2	Dissolved Oxygen Meter & Electrode
OXELP	Replacement Oxygen Electrode for ISO2
5378	Replacement Electrode Sleeve Kit (pkg of 4) <i>Four sleeves with membranes, plus 10 mL refill solution.</i>
7326	ISO2 Filling Solution (10 mL)
5377	Replacement ISO2 Start-up Kit <i>Includes Calibration Bottle, 10mL Refill Solution, 1 cc Syringe, 2 Replacement Membranes Sleeves, MicroFil (28 ga.)</i>
5399	T-Adapter Flow-Through Kit <i>Includes 3 female luer T's, 3 luer lock fittings, 3 2mm gaskets, 6 male luer to 1/8-in. tubing, 3 luer lock fittings</i>
13347	Chart Recorder Adapter (requires BNC cable)
500184	BNC Cable

ISO2 SPECIFICATIONS

MEASUREMENT MODES	
% O ₂ :	0-100%
ppm:	0-20
Current:	0-200 nA
RESOLUTION	0.1 ppm
ACCURACY ± 1.5%	
RECORDER OUTPUT	1000 Ω resistance for chart recorders
DISPLAY	3.5-digit LCD
POWER	2 nine-volt alkaline batteries, supplied
BATTERY LIFE	1000 hours, estimated
DIMENSIONS	8 x 4 x 2 inches (20 x 10 x 5 cm)
SHIPPING WEIGHT	5 lb (2.3 kg)

OXELP OXYGEN ELECTRODE

TIP DIAMETER	2 mm
STAINLESS STEEL SLEEVE	66 mm
OVERALL LENGTH	125 mm
CABLE LENGTH	122 cm (4 feet), including BNC connector
RESPONSE TIME	10 seconds, 90% response typical in well-stirred solution
DRIFT	< 1%/min.



Also see WPI's temperature stabilized chamber, page 65.

OxyMini & OxyMicro

A new generation of fiber optic oxygen sensors based on luminescence lifetime

The OxyMini system is optimized for process control and biotechnology applications. The OxyMicro is designed for biological research applications including implanting into tissues, cell cultures, profiling of biofilms and sediment related bioassays. 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.

OxyMini and OxyMicro Benefits

- Oxygen is not consumed during the experiment
- Immune to electrical and magnetic interference
- Excellent long-term stability
- No lengthy polarization necessary (e.g., as Clark-type oxygen electrodes require)
- 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

Measurement Principle

Conventional fiber-optic 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.). These advantages make WPI's OxyMini and OxyMicro the most advanced and reliable fiber-optic oxygen system available.

Calibration: The sensors can be calibrated by a simple two point calibration, 100% air-saturation and 0% air saturation.

OxyMini and OxyMicro oxygen meters: The OxiMini and OxyMicro fiber optic oxygen meters are compact, easy to transport. The instruments are designed for in/outdoor use and can be connected to a PC via a RS232 interface. Data can be visualized, analyzed and stored with the supplied software. A full range of sensors covering most biomedical applications are available.



OxyMicro systems

The OxyMicro is a single channel fiber optic oxygen meter for WPI's fiber optic oxygen microsensors. Applications include:

- Oxygen profiles of marine sediment, soils, or tissue
- Implantation into living tissue (e.g., heart or muscle tissue)
- Control of cell culture media in Biotechnology.

MicroTip

The MicroTip (WPI #501656) is a needle-type (27 ga.) oxygen micro sensor designed for applications where a small tip size of 50 μm and a fast response time (t_{90}) of 1 s are necessary. The oxygen sensitive sensor tip consists of 140 μm fiber tapered to a 50 μm tip. The sensor is housed inside a stainless steel needle of 22 mm length and 0.4 mm diameter. This allows penetration through a septum rubber or similar material. These sensors are ideal for oxygen profiling in sediments and biofilms.



MicroFlow

The MicroFlow fiber optic oxygen sensor (WPI #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 fiber optic oxygen sensor (WPI #501658) is an implantable probe (IMP) with a tiny probe tip size 50 μm, an exposed fiber length of 5-mm and a jacket diameter of 900 μm. The IMP sensor was successfully implanted in crabs, fishes and soil.



OxyMini systems

The OxyMini is a single-channel fiber optic oxygen meter for WPI's fiber optic oxygen minisensors. These sensors are based on 2 mm polymer optical fibers and have a length of 2.5 m. A wide range of applications is possible with these sensors.

- Process control: bottling plant in breweries and quality control of packages
- Biotechnology: Control of cell culture media and non-invasive control of bioreactors
- Implantation of oxygen sensors into soil and trees.

MiniTip

This oxygen dipping probe (WPI #501641) has a tip diameter of 4 mm and consists of a polymer optical fiber, with an oxygen sensitive coating. The MiniTip's range is 0 to 100%. This robust sensor has a response time (t_{90}) of approximately 40 s.



MiniFlow

The MiniFlow oxygen probe (WPI #501642) is a miniaturized fiber optic chemical sensor integrated in a T-shape flow through cell. The standard T-shape flow cell can be easily connected via Luer-Lock adapters to external tubings. Liquids (e.g., water, blood, etc.) can be pumped through the cell. The sensor has a response time (t_{90}) of approximately 40-s and an excellent long-term stability.



MiniFoil

WPI offers the sensor material on a 1 cm² support disk made of polyester. This material can be glued, for example, inside glass vials and the oxygen concentration can be measured non-invasively and non-destructively from outside through the wall of the flask. A plastic fiber optic cable (WPI #501644, WPI #501645) is used to illuminate the sensor foil. The wall of the flask must be transparent/non-fluorescent. Response time (t_{90}) of approximately 50 s. The material can be implanted into animal tissues or custom-made housings.



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

	MiniTip	MiniFlow	MiniSpot	MicroTip	MicroFlow	MicroImplant
Measurement 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 ₂ O ₂) autoclavable (130°C, 1.5 atm)	Y N	Y Y	Y Y	Y N	Y Y	Y Y
Drift (100,000 datapoints, 20°C)	< 0.1%	< 0.1%	< 0.1%	< 0.3%	< 0.3%	< 0.3%
Accuracy (20°C)	0.2%					
Resolution (20°C)	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					
Temperature Range	-10°C to 50°C					
Probe Assembly Length	World Precision Instruments www.wpiinc.com					

pHOptica™

A novel fiber optic pH system

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.



Features of 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.
- User-friendly software saves and visualizes measured values.
- Several pHOptica meters can be connected to one computer.
- Temperature variation is recorded using a temperature sensor.

Features of pH optical sensors

- No reference electrode is needed
- 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.

pHOptica Micro system

The pH Optica micro system is a single channel pH system for use with fiber optic mini 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.



To protect the small glass fiber tip against breaking, suitable housings and tubings around it, depending on the respective application, were designed.



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.

Implantable sensor—without any housings implantation into animal blood circuits; soil implantation; implantation in customer-made housings

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).

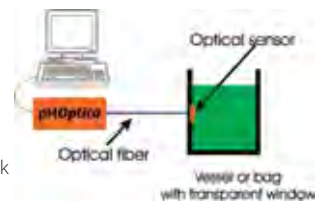
PHOPTICA SPECIFICATIONS

DATA INTERFACE	RS232
SAMPLE RATE	1 sample per second
MEASURING pH RANGE	5 - 9
RESOLUTION (at 20 °C)	± 0.03 (microsensors); ± 0.01 (minisensors)
RESPONSE TIME	< 1 min
DIMENSIONS	185 x 110 x 45 mm
WEIGHT	630 g
POWER SUPPLY	100 - 220 V AC

pHOptica Mini system

The pH Optica mini system is a single channel pH system for use with fiber optic mini sensors, foil and spot surface sensors. The applications include:

- 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 mini sensors

- OD of the dipping sensor is 4 mm.
- Sterilization of the pH sensor spots via gamma radiation.
- The 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).

Two different housings and sensor spots (sensorfoils) are offered:



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.



Planar pH Sensitive Foils and spots—non-invasive and non-destructive measurement from outside through the wall of the flask; online monitoring.

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

502120* pH MiniFlow, fiber optic pH flow sensor, pkg of 3

*Requires #503110

502122** pH MiniSpot, fiber optic pH spot sensors, pkg of 10, OD 5 mm

**Requires #501644

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

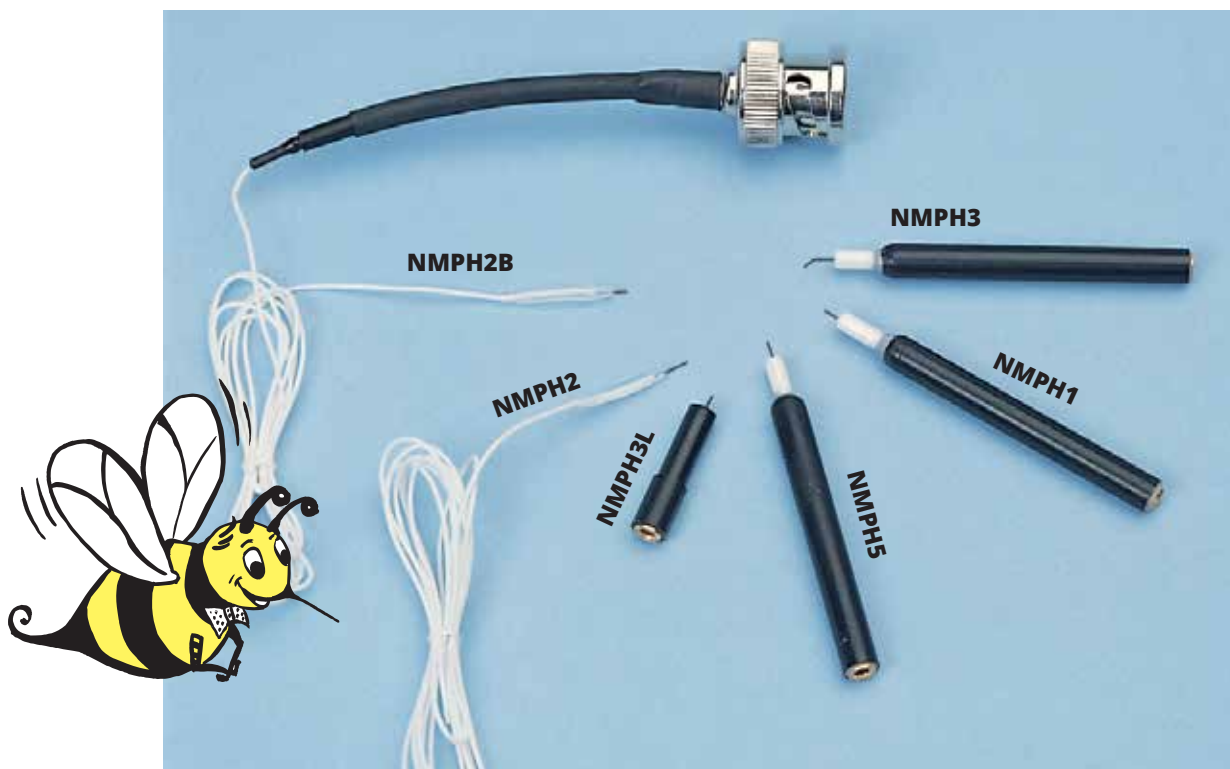
502123 pH MicroTip (needle-type), fiber optic pH sensors (140 µm OD), pkg of 3

502124 pH MicroImplant, fiber optic pH implantable sensor (140 µm OD), pkg of 3

Beetrode® Micro pH Electrodes

with 100-micron sensing tips!

- **NEW—IMPROVED—super-miniature, superfast coated wire pH electrodes**
- **100-micron diameter — ideal for monitoring fast pH changes in very small places**



Beetrode® is a solid state pH sensor with ideal characteristics over a wide pH range. Exhibits a larger E_0 than conventional glass electrodes. **Requires a separate reference electrode, such as WPI's Dri-Ref Series.** Beetrodes (except the NMPH2) connect to your pH meter via a BNC-terminated cable. Beetrodes generate mV readings on standard pH meters. To obtain pH-scale readings on standard pH meters, use **BEE-CAL™**, a small, battery-operated compensator (AA battery included) that adjusts the electrode offset potential so that Beetrodes will produce standard pH-scale readings. (NMPH2B requires ZBEECAL.)

BEETRODE SPECIFICATIONS

TIP DIAMETER	100 μ (0.1 mm)
TIP LENGTH	~2 mm, except ~2.5 mm on NMPH3L ~5 mm on NMPH5
BODY DIAMETER (NMPH 1, 3, 3L, 5)	0.187 in. (5 mm)
BODY LENGTH (NMPH 1, 3, 5)	1.875 in. (48 mm)
BODY LENGTH (NMPH 3L)	0.75 in. (19 mm)
RESPONSE TIME	1 s (90%) typical
pH RANGE	0-14
SLOPE	Nernstian
RESISTANCE	100 k Ω (max)
SELECTIVITY	No significant interference by K ⁺ , Na ⁺ , Ca ⁺⁺ in 0.1 to 1 M solutions
DRIFT	< 2.5 mV / 5 min.



NMPH1*	Beetrode—2 mm receptacle
NMPH2	Beetrode with 1 m cable (unterminated)
NMPH2B	Beetrode w/ BNC cable, 1 m cable
NMPH3*	Dental Beetrode, 45° Bend, 2 mm receptacle
NMPH3L*	Dental Beetrode w/ 2 mm loop, 2 mm receptacle
NMPH5*	Beetrode, 2 mm receptacle
SYS-BEECAL	Beetrode Offset & Cable (BNC, 2 mm pin)
ZBEECAL	Bee-Cal Level Shifting Device
3508	BNC-to-US Standard Adapter
1358	BNC-to-2 mm Pin Adapter

***Requires BEE-CAL or 1358 BNC-to-2 mm Pin Cable (4-ft) for connection to a pH meter.**

World Precision Instruments www.wpiinc.com

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Dri-Ref™ Reference 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 alkalis. 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 2-mm, 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 1 inch long, WPI's 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 138) to form a tight seal — a very convenient installation for a flow-through system.

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.

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

DRI-REF SPECIFICATIONS

	DRIREF-450	DRIREF-5	DRIREF-2	FLEXREF	SDR2	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 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™
LEAD LENGTH	30 in. (76 cm)	30 in. (76 cm)	30 in. (76 cm)	30 in. (76 cm)	30 in. (76 cm)	30 in. (76 cm)	30 in. (76 cm)	30 in. (76 cm)
CONNECTOR	2 mm pin	2 mm pin	2 mm pin	2 mm pin	2 mm pin	2 mm pin	2 mm pin	2 mm pin
RESISTANCE (typical)	< 5 KΩ	~500 Ω	~2.7 KΩ	~2.7 KΩ	< 5 KΩ	~500 Ω	~500 Ω	~2.7 KΩ
FILLING SOLUTION	KCl	KCl	KCl	KCl	KCl	KCl	KCl	KCl
ELECTROLYTE LEAKAGE (mL/hr)	—	~7.4x10 ⁻⁷	~5.7x10 ⁻⁸	~5.7x10 ⁻⁸	—	~7.4x10 ⁻⁷	~7.4x10 ⁻⁷	~5.7x10 ⁻⁸

Isoplast is a trade mark of Dow Chemical. Teflon is a trade mark of DuPont.

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: 1x10⁻¹, 1x10⁻², 1x10⁻³, 1x10⁻⁴, 1x10⁻⁵, 1x10⁻⁶, 1x10⁻⁷, 1x10⁻⁸ M at 20°C. Limited shelf life; use within 30 days.

CALBUF-1 Kit of 8 Calcium Buffer Solutions



CALBUF-2

For 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: 1x10⁻⁸, 4x10⁻⁸, 1x10⁻⁷, 2.5x10⁻⁷, 5x10⁻⁷, 7.5x10⁻⁷, 1x10⁻⁶, 4x10⁻⁶, 1x10⁻⁵, 4x10⁻⁵, and 1x10⁻⁴ M at 20°C. Ionic strength: 0.150 M. 11 bottles, 20 mL each. Limited shelf life; use within 30 days.

CALBUF-2 Kit of 11 Calcium Buffer Solutions

Kwik-Tip™

Ion selective electrodes

- Superior, stable PVC membrane
- Fast response
- 2mm diameter tips
- Interchangeable tip holder

These highly stable electrodes accurately measure calcium, potassium, hydrogen and TPP ion activity. Tips consist of 2 mm diameter plastic tubes sealed at one end with an ion-sensitive membrane. After filling with electrolyte solution, the user inserts the tube into the holder and connects 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 need 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.**

If your pH meter requires a US Standard connector, also order Part #3508 (BNC-to-US pH Standard adapter).

Each kit includes three electrode tips.

Accurate, fast and economical!

MicroFil filling syringe (included).

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)

ACCESSORIES

3508	BNC-to-US pH Adapter
-------------	----------------------

Also see *Dri-Ref Reference Electrodes*

TIP ELECTRODE SPECIFICATIONS

Part No.	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	Orange	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

CATIONS

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 K_{ij} or pK_{ij}.



When used in micropipettes to record cellular ion concentrations, consider using WPI's Duo 773 electrometer (channel A).

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



Temperature stabilized four-port closed chamber for measurements of nitric oxide, oxygen hydrogen peroxide and other species in cell culture

- Four port (WPI #NOCHM-4) chamber accommodates WPI's 2-mm sensors for nitric oxide (ISO-NOP), oxygen (OXELP), hydrogen peroxide, 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
- 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
- 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

NOCHM-4 Four-Port Closed Chamber, for use with WPI's 2.0 mm electrodes (e.g., ISO-NOP and OXELP, etc.)

NOCHM-P Spare Plug-adapter for ISO-NOP nitric oxide electrode

800100-5 Spare Center Chamber Gasket (package of 5)

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. Consequently, 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.**

NSA-3 ISO-NO Activator



ISO-NOP Rejuvenator

After an ISO-NOP 2-mm sensor is used for long periods, sensitivity may become reduced and response time may increase. This little device can restore ISO-NOP performance to original levels by applying an electric waveform for a few seconds. 9v alkaline battery included.

JUV ISO-NOP Rejuvenator

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 NO donor in medicine.

M.W.336.3 • C₁₀H₁₆N₄O₇S • Purity > 98% • Soluble in water or DMSO • Storage: -20°C

GSNO-50 GSNO 50 mg vial

GSNO-100 GSNO 100 mg vial

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

SNAP25 SNAP, 25 mg vial

SNAP50 SNAP, 50 mg vial

SNAP100 SNAP, 100 mg vial

Dual Channel Differential Electrometer



- High input impedance ($10^{15} \Omega$)
- Differential (A-B) output
- Low noise and wide bandwidth
- Electrode resistance test circuitry
- Probe test circuitry
- Driven guard shield

The **FD223a** is a dual channel differential, high impedance amplifier/electrometer designed specifically for electrochemical measurements using ion specific (K^+ , Na^+ , Cl^- , etc.) or pH glass microelectrodes.

The instrument is very stable, drift free, and features a built in provision for measuring and adjusting input leakage current. DC levels may be independently adjusted for each probe channel.

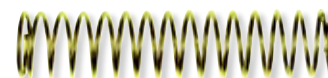
The ability to locate the sensing probes directly at the measurement site overcomes the noise introduced by the long cables usually needed to bring the measured potential to the instrument. Signal-driven guards

at the probe input maintains the specified high resistance and reduces the stray capacitance of the probes.

Careful design, coupled with quality component selection, particularly in the headstage, results in an excellent amplifier with low noise and wide bandwidth. The FD223a will faithfully reproduce the measured signal.

To reduce the noise and stray capacity even farther the probe housing includes a signal driven guard. A portion of this inner driven shell is exposed at the probe tip allowing a spring shield to be extended over the electrode holder and microelectrode.

The amplifier features a probe test port that permits testing of the electrode test feature and setting of the probe leakage current, (IG). A standby mode is included and should be used when attaching glass microelectrodes or electrode holders to the probe input. While in the standby mode the voltage at the probe input is clamped near zero volts thus protecting the input.



#2547 Driven Guard Shield

FD223A SPECIFICATIONS

INPUT IMPEDANCE	$> 10^{15} \Omega$, shunted by 0.5 pF
INPUT CAPACITANCE	1 pF, nominal
LEAKAGE CURRENT	75 fA max
GAIN	$1.000 \pm 0.1\%$
OUTPUT RESISTANCE	50Ω
INPUT SWING VOLTAGE	$\pm 10 V$
RISE TIME (10 TO 90%)	5 μs , small signal
NOISE (0.1 HZ TO 10 KHZ)	$< 100 \mu V$ p-p, input shorted
BASELINE STABILITY	$\pm 0.1 mV/day$
POSITION CONTROLS RANGE	$\pm 600 mV$
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%.

FD223A FD223a Dual Channel Differential Electrometer

2 probes, driven guard shields and micropipette holder MEH1SF included for all glass microelectrodes O.D. 1.0 mm, 1.2 mm, 1.5 mm, or 2.0 mm.

OPTIONAL ACCESSORIES

M3301L	Micromanipulator (specify left- or right-handed)
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 98
See microelectrode holders, page 106
See capillary glass, page 110

WPI's Quietest Intracellular Amplifier!

Electro 705

**BATTERY
POWERED**

PORTABLE



A low noise high quality intracellular amplifier well-suited for the student lab

Photo shows two units arranged for differential recording. Manipulators not included.

- **Remote Headstage** — Easily mounted in any manipulator, this small 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 super 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.



- **Tickler Circuit** — A momentary oscillation that helps achieve cell penetration.
- **Electrode Resistance Test** — The 705 provides a 1 nA electrode test current. Electrode resistance is monitored at the 1X output as a voltage (1 mV/M).
- **Probe Test Port** — Allows the convenience of testing the amplifier's intrinsic noise and gain without cumbersome external test hookups. Gate leakage current can also be adjusted with minimum effort.
- **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 705s can be connected in tandem to create an optional differential amplifier probe system.

ELECTRO 705 SPECIFICATIONS

INPUT IMPEDANCE	10 ¹² Ohms, shunted by 1 pF
OUTPUT IMPEDANCE	100 Ohms, both outputs
GAIN	X1: ±0.1%
INPUT VOLTAGE RANGE	±5 V
RISETIME	15 μs, 10-90%
NOISE LEVEL	500 μV peak-to-peak*
INPUT CAPACITANCE COMPENSATION	0-50 pF
GATE LEAKAGE CURRENT	±10 pA, adjustable to zero
ELECTRODE RESISTANCE TEST	1 mV/ M Ohms
DC POSITIONING	± 300 mV
COMMON MODE REJECTION	>10 ⁴ (in differential mode)
POWER	Four 9V alkaline batteries, supplied
DIMENSIONS	8.5 x 3.5 x 2.2 in. (22 x 9 x 6 cm)
SHIPPING WEIGHT	5 lb (2.3 kg)

* Full band width, with 20 M Ohms source

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

M3301L	Micromanipulator (specify left- or right-handed)
M-3	80° Tilting base
RC1T	Reference cell (Ag/AgCl)
2541	Driven guard shield for 705PF Probe
MEH1SF	Microelectrode holder
705PF	Replacement probe (includes calibration)*

*Instrument must be returned to WPI for free calibration with new probe.

See cables and connectors, page 98
See microelectrode holders, page 106
See capillary glass, page 110

Reference

Koch, U. (2000) "Interdependence of spatial and temporal coding in the auditory midbrain." *Journal of Neurophysiology* 83, 4, 2300-2314

Duo 773 Dual Microprobe System

2-channel intracellular amplifier



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} Ohms & 10^{11} Ohms probes to monitor signals from ion-specific micro-electrodes as well as KCl-filled electrodes.

* 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.

References

L. Pluja (2000) "Electrical and mechanical effects of vasoactive intestinal peptide and pituitary adenylate cyclase-activating peptide in the rat colon involve different mechanisms." *European Journal of Pharmacology* 389, 217-224.

G. X. Wang, X. B. Zhou, et al. (2000) "Effects of mitoxantrone on excitation-contraction coupling in guinea pig ventricular myocytes." *Journal of Pharmacology and Experimental Therapeutics* 293, 2, 501-508.

S. Tsuruoka (2000) "Acute effect of cadmium-metallothionein on glucose and amino acid transport across the apical membrane of the rabbit proximal tubule perfused *in vitro*." *Journal of Pharmacology and Experimental Therapeutics* 292, 2, 769-777.

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	± 10 V
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 μ V p-p 10kHz bandwidth	<50 μ V p-p 10kHz bandwidth
20 M Ω carbon resistor	<200 μ V p-p 10kHz bandwidth	<200 μ V p-p 10kHz bandwidth
RISE TIME		
10-90% direct input small signal	1 μ s, typical	
10-90% through 20 M Ω (-C "on")	25 μ s, typical	
CURRENT INJECTION	(712P only)**	
Internal DC Current	± 50 nA low range, ± 500 nA high range	
Externally commanded Current	± 500 nA low range, ± 5 μ A 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 M Ω , 0-1000 M Ω	
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	

Headstage—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 — 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 then 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.

Compliance Alarm — When the electrode voltage exceeds the probe input maximum allowed voltage, an audible over-compliance alarm will sound.

Bridge Balance—Subtracts the excess electrode voltage associated with delivering current through the recording micropipette. Electrode resistances up to 1000 M Ω 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.

Digital Meter — The Duo773 comes complete with a 3½-digit display for monitoring injection current or the voltages for either probe (single ended or differential).

SYS-773 Duo 773 Electrometer

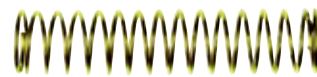
Specify line voltage

Includes two probes (712P and 715P or two 712P) with driven guard shields and eight MEH15F microelectrode holders for 1.0 mm, 1.2 mm, 1.5 mm, or 2.0 mm glass electrodes.

OPTIONAL ACCESSORIES

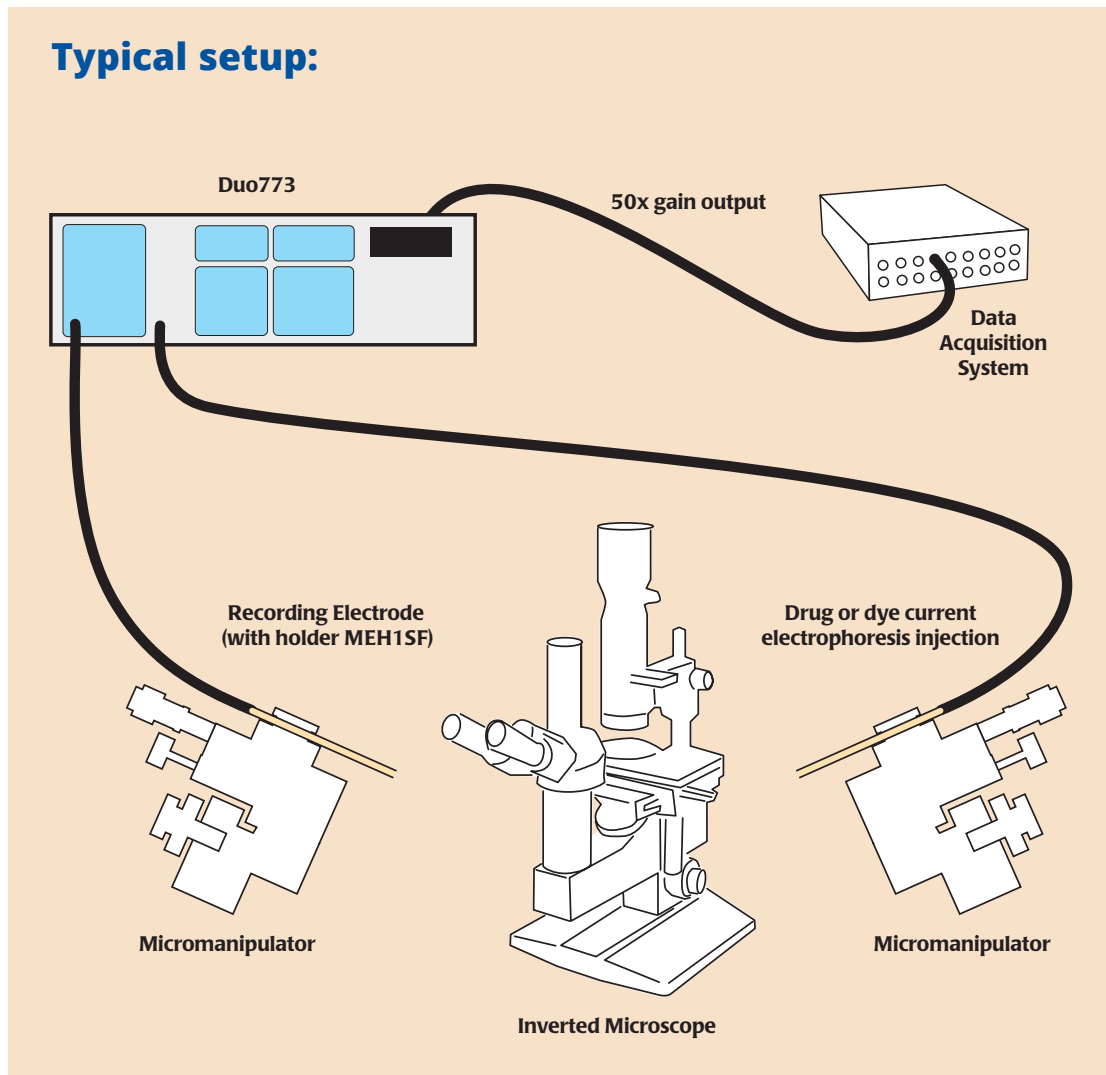
712P	Replacement probe (includes calibration)*
715P	Replacement probe (includes calibration)*
<i>*Instrument should be returned to WPI for free calibration with new probe.</i>	
2933	Rack Mount Kit, 5¼-in. high
2547	Driven Guard Shield for 712P & 715P Probes
15790	Replacement Probe Handle
TW100F-4	Glass capillary with filament
TW150F-4	Glass capillary with filament

See Dri-Ref, page 63.
See cables and connectors, page 98.

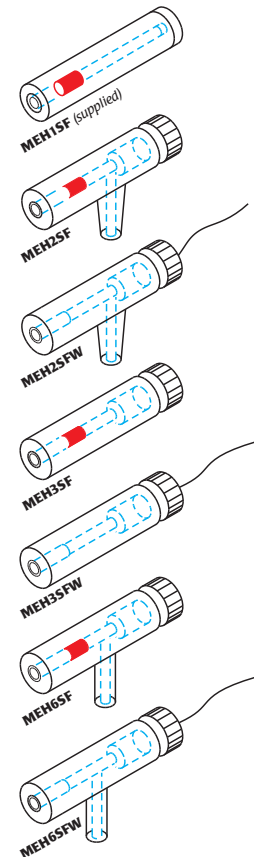


#2547 Driven Guard Shield

AMPLIFIERS, ELECTROMETERS



Optional Holders for Intracellular Amplifiers



See Microelectrode Holders, page 106

WPI's Low-Noise Amplifiers Outperform Cheap Imitations



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, and it is usually a result of the potential difference at the electrode's tip.

How does an amplifier work?

Power Supply Rails Limits 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
2mV	×1	2mV
2mV	×2	4mV
2mV	×10	20mV
2mV	×100	200mV
2mV	×10,000	20V

In the real world, however, 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 will go off scale, and the input signal will not be faithfully

reproduced. This is called "hitting the rail."

In our example, a 1.0µV input signal at an ×10⁶ 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 5.0µV, 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 will give a +5.0V DC output signal for all input signals greater than or equal to 5.0µV. In this instance, a smaller gain factor should be used to bring the output signal back into the dynamic output range of the amplifier.

Noise Limits Amplifier Useability

All electronic devices produce their own internal electronic noise, an unavoidable signal that can mask the output signal. For example, if the input signal is 2mV and the noise is 1mV, the signal to noise ratio is two to one (2:1), and the output signal would be undetectable. In this case, it is nearly impossible to discern which part of the output is generated by noise and which part is the desired signal. (Fig. 1)

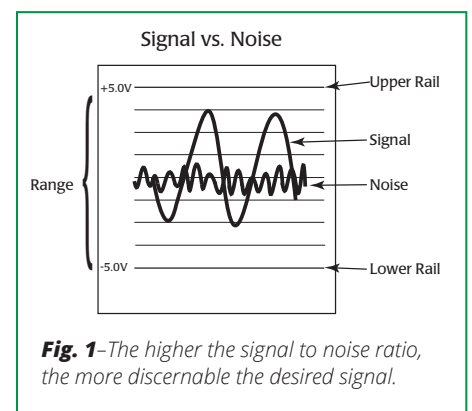


Fig. 1–The higher the signal to noise ratio, the more discernable the desired signal.

An amplifier, in simplest terms, 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 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. An ×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

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.

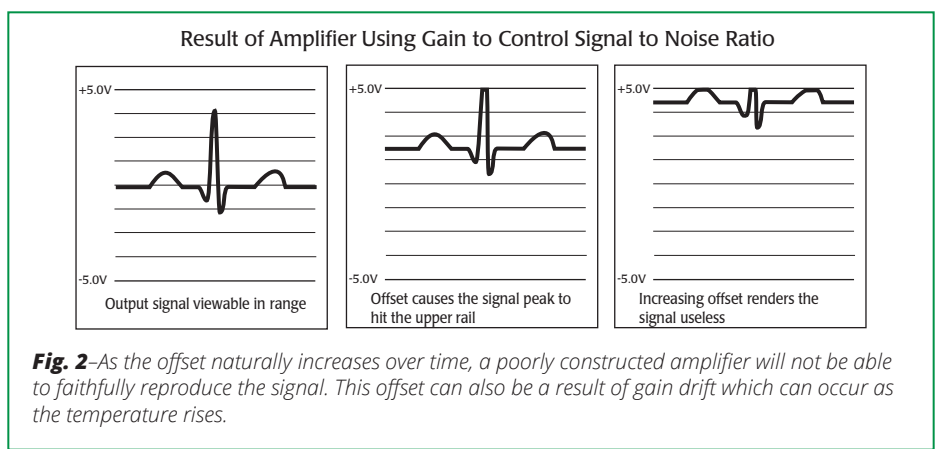
Reducing noise is a more complicated solution, but it offers a greater range and more stability in the end.

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. A poorly designed amplifier will simply increase the gain of the first stage amplification until the desired signal to noise ratio is reached.

Why not 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 $\pm 10.0V$. Therefore, it is not practical to increase the power rails of bio-amplifier

beyond $\pm 10.0V$. Since the industry standard limits us to $\pm 10.0V$ 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 does my signal flatline?

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 Fig. 2.)

The amplifier that minimizes the noise in the first stage amplification offers a larger dynamic output range and handles a much greater offset value.

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 0.1-100Hz. (That's equal to 2 μV peak-to-peak.) The chart at left compares WPI's bio-amplifiers.

Amplifier	AC/DC	Differential	Head-stage	EMG EKG	Stimulation	Isolated	Multi-channel	Battery Powered	Connectors
Intracellular Bioamplifiers									
FD223A	DC	◆	◆				2		2 mm pin
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
Epithelial Voltage/Current Clamp Bio Amplifier									
EVC4000	DC				◆		1-4		Ussing 2 mm

DAM Series Bioamplifiers

A family of very low noise battery-operated amplifiers

With Electrostatic Discharge Protection!

- Gated or manual current generation for histological marking, iontophoresis, or cell stimulation.

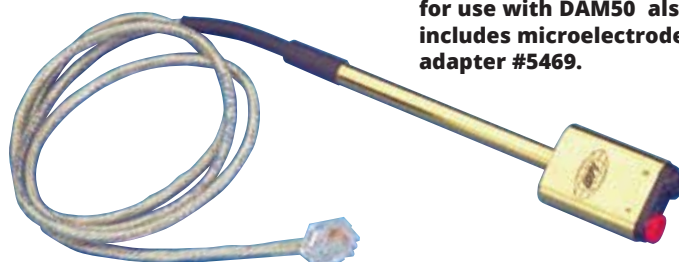
- A very low noise remote active headstage (DAM80 only) is useful for very high impedance amplification utilizing glass or metal electrodes.

DAM series amplifiers can be used as standalone 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.



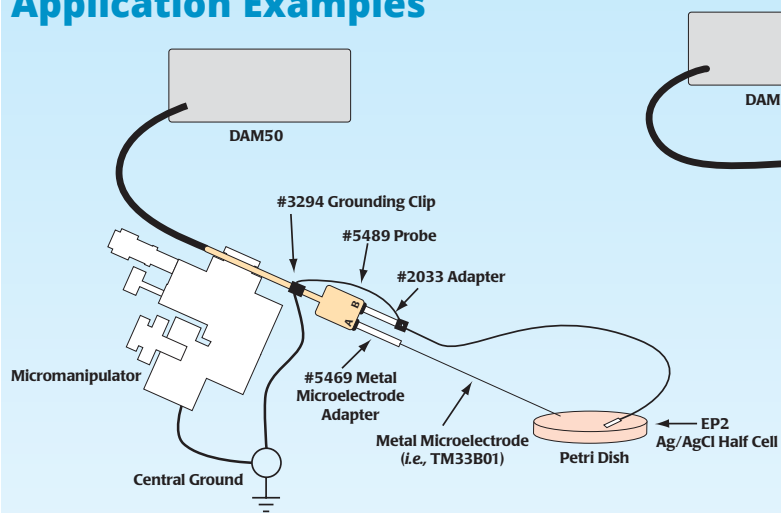
DAM50—Basic Amplifier (optional #5447 electrode adapter not included)

Optional probe #5489 for use with DAM50 also includes microelectrode adapter #5469.

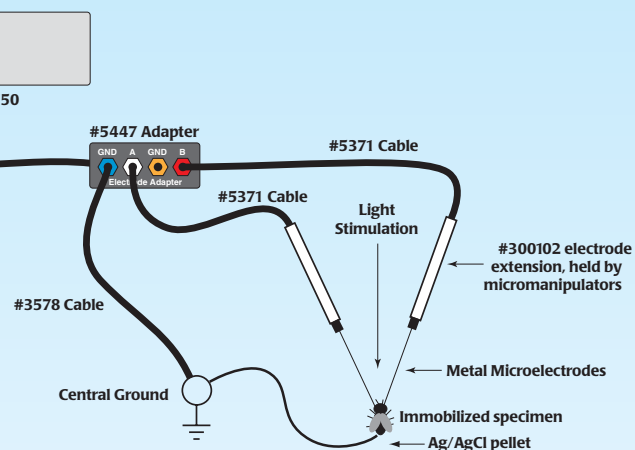


WPI's DAM series amplifier's are well known as a standard of the industry for extracellular potential amplification. These battery powered bio-amplifiers are designed with a compact chassis profile that enables the user to locate the unit closer to the preparation and thereby minimize long lead lengths 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. A choice of models offer additional features that are useful for certain applications:

Application Examples



Extracellular recording using metal microelectrode



ERG recording of fly eyes

AMPLIFIERS, ELECTROMETERS

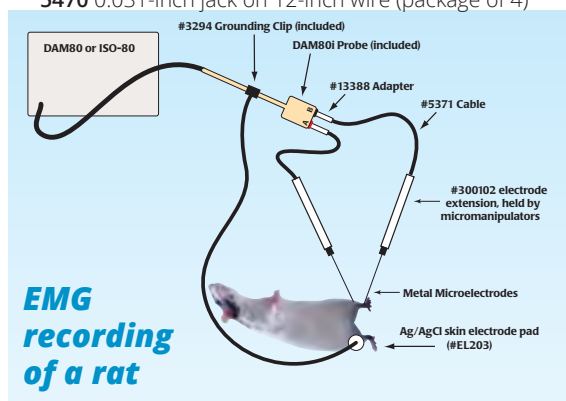


**Dam80—
With low-noise
headstage DAM80P**

DAM80, an AC amplifier only, features a very low noise headstage probe which can be mounted in micromanipulators for up-close cortical recording, for extracellular recording from high impedance glass or metal microelectrodes. Also provides a gated current for tissue marking. Microelectrode holder MEH35B is recommended.

Included with the DAM-80 is a Startup Kit containing the following accessories needed for basic metal electrode electrophysiology research:

- CBL102** Cable, BNC-to-3.5mm 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 current (two)
- EP1** Ag/AgCl pellet (70 mm wire) 1mm diam x 2.5 mm long
- M3301EH** Electrode Holder, 14cm (two)
- 5470** 0.031-inch jack on 12-inch wire (package of 4)



FEATURE

Input Mode
Input configuration
Gain Range
High / Low Filters
Offset position control
Current Generator
Remote Active headstage
Output connection
Standard input connection*
Power supply

DAM50

AC/DC
differential/single ended
100-10K (AC), 10-1K (DC)
yes
yes
No
No
BNC
underminated wire
(2) nine volt alkaline batteries

DAM80

AC
differential
100-10K (AC)
yes
yes
Yes
Yes
3.5 mm mini phone
mini banana
(2) nine volt alkaline batteries

*see optional accessories for additional alternatives

DAM SERIES SPECIFICATIONS

INPUT IMPEDANCE	10 ¹² Ω, common mode and differential
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 kHz
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)

SYS-DAM50	Bio-amplifier
SYS-DAM80	Bio-amplifier with active probe (DAM80P)
OPTIONAL ACCESSORIES	
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
2101	9V Alkaline Battery, each (2 required)

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	Electrode Extension, 4-inch
3414	9V NiMH Battery

Also see cables and connectors, metal microelectrodes, carbon-filled micropipettes.

Isolated Differential Amplifier



The improved 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 5Hz and the upper passband is 10 kHz.

ISO-80 SPECIFICATIONS

INPUT RESISTANCE	>10 ¹¹ Ohms, Common Mode and differential
INPUT LEAKAGE CURRENT	50 picoamperes, max.
AMPLIFICATION	x10 ² , x10 ³ , x10 ⁴
COMMON MODE REJECTION RATIO	100 dB typ. @ 50/60 Hz
EQUIVALENT NOISE SIGNAL INPUT	0.4 microvolts rms (0.1-100 Hz) 2.0 microvolts 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 kOhm - 10 MOhm @ 300 Hz
STIMULATION CURRENT	0 to ±20 micro amperes (constant current)
MAXIMUM STIMULATION VOLTAGE	±15 volts
MAXIMUM ELECTRODE VOLTAGE	±40 volts
DISPLAY	3½-digit LCD
BATTERY TEST	Low battery display
POWER	Two 9-volt NiCad batteries & charger, supplied
SHIPPING WEIGHT	4 lb (1.8 kg)

Included with the ISO-80 is a Startup Kit containing the following accessories needed for basic metal electrode electrophysiology research:

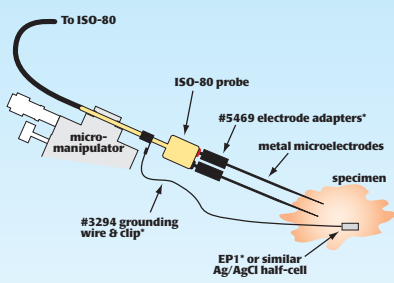
- CBL102 Cable, BNC-to-3.5mm plug, 6 ft (2m) (two)
- 5469 Adapter, mini-banana to 0.031 skt. (two)
- 13388 Adapter, mini-banana to 2mm skt. (two)
- 3294 Cable, ground clip to wire, 3 ft
- 2033 Mini-banana plug, black
- 2034 Mini-banana plug, red
- 2035 Mini-banana plug solderable current (two)
- EP1 Ag/AgCl pellet (70 mm wire) 1mm 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 Isolated Bioamplifier w/ active probe (ISO80P)

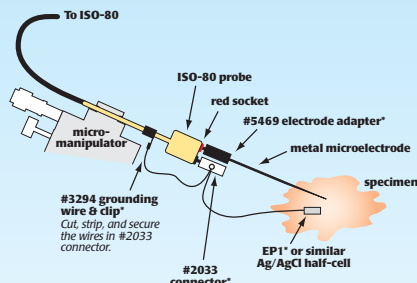
Specify line voltage

OPTIONAL ACCESSORIES

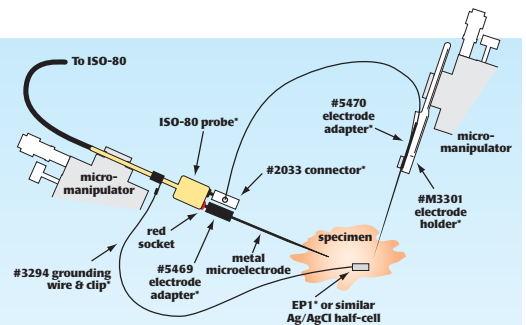
ISO-80P	Replacement ISO-80 Probe
CBL102	3.5 mm phone plug-to-BNC cable



Differential Application



Single-Ended Application



Optional Differential Application

4-Channel Transducer Amplifier

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



Transducers available separately

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.

SYS-TBM4M	Transbridge Transducer Amplifier	€2,085
<i>Specify line voltage</i>		
OPTIONAL ACCESSORIES		
13024	Single Rack Mount Kit	€114
13025	Dual Rack Mount Kit	€114
500184	BNC-to-BNC cable, 10 ft	€31
3161	8-pin DIN plug	€28
3718	Package of 4, 8-pin DIN (startup kit)	€98

Dual Microiontophoresis Current Generator



The Dual Microiontophoresis Current Generator (Model 260) is an electrically isolated, battery-operated instrument designed for the electro-iontophoresis of dyes, drugs and charged substances from micropipettes. Two identical battery operated current generators are available. In ordinary use, the two current generators are operated in parallel providing two distinct currents; one for preventing substances in the micropipette from outward diffusion (the retain or hold current) and the second for actively ejecting charged material. For pipettes with submicron tips, a hold current may not be necessary if there is little outward diffusion of pipette material. Model 260 is powered by two 9-volt alkaline batteries per side (four, in total); unique circuitry converts the ± 9 V to ± 100 V without a transformer, yielding an exceedingly quiet output.

SYS-260	Dual Microiontophoresis Current Generator
OPTIONAL ACCESSORIES	
2933	Rack Mount Kit, 5¼-in. high

Omega-Tip-Z™

Millivolt and megohm meter measures impedance of metal or glass capillary microelectrodes

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.

NOTE: Metal microelectrodes which have been precalibrated at 1 kHz should be baselined for use with Omega-Tip-Z.



**See Metal Microelectrodes, page 102.*

SYS-OMEGAZ	Omega-Tip-Z with Probe & Holder
711P	Replacement Probe
5468	Adapter to connect metal microelectrodes to probe, 2 mm socket to .031 in. receptacle

OPTIONAL ACCESSORIES	
Z-LITE	Fiber Optic Illuminator (115v, 60Hz, beige case)
Z-LITE-Z	Fiber Optic Illuminator (230v, 80Hz, black case)
500186	Bifurcated Light Guide with lenses
Z-LITE-186	Z-Lite Illuminator and bifurcated light guide



FORCE TRANSDUCERS

These rigid-lever force transducers transform applied force into proportional voltage. Using balanced strain gauges, 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.

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 grams	250 grams	1000 grams	5000 grams
OUTPUT SENSITIVITY (± 10%)	7 $\mu\text{V/V/g}$	3 $\mu\text{V/V/g}$	0.84 $\mu\text{V/V/g}$	0.38 $\mu\text{V/V/g}$
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	3x rated full scale force	3x rated full scale force	3x rated full scale force	3x rated full scale force
DRIFT	thermally compensated	thermally compensated	thermally compensated	thermally compensated
DIMENSIONS	0.3 inch diam x 4 in. (7.6 mm diam x 10.2 mm)	0.3 inch diam x 4 in. (7.6 mm diam x 10.2 mm)	0.3 inch diam x 4 in. (7.6 mm diam x 10.2 mm)	0.3 inch diam x 4 in. (7.6 mm diam x 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)



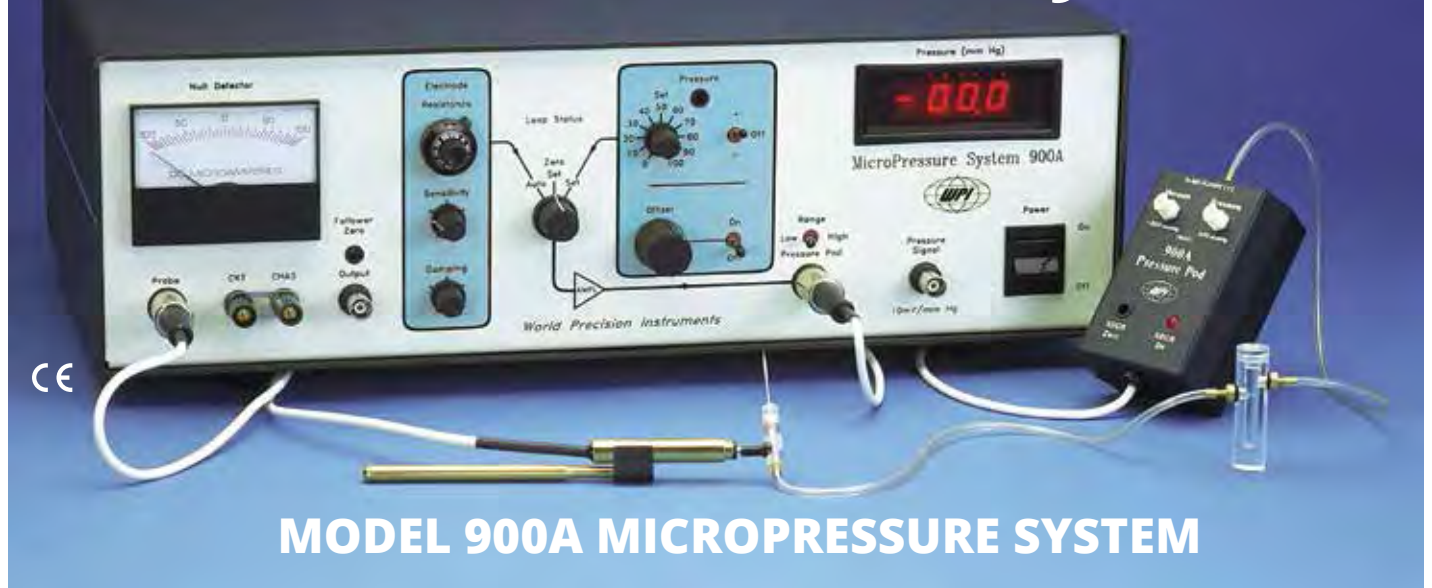
10g & 25 Force Transducers

	FORT10g	FORT25
FORCE RANGE, FULL SCALE	0-10 grams	0-25 grams
OUTPUT SENSITIVITY	10 mV/gm, nominal	3 mV/gm, nominal
INPUT & OUTPUT RESISTANCE	1500 Ω	1500 Ω
RESOLUTION	< 1mg	< 2mg
RESONANT FREQUENCY	450 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	2x rated full scale force	3x rated full scale force
DRIFT	<30 mg/hr	<50 mg/hr
DIMENSIONS	40 x 22 x 19 mm Handle 88 mm	40 x 22 x 19 mm Handle 109 mm
WEIGHT	100 gram	100 gram

These 10-gram and 25-gram force transducers are reliable tools for high precision force measurement. Using balanced semiconductor strain gauges, 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 gauges, 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.

Measure hydrostatic pressure in small vessels and oocytes



MODEL 900A MICROPRESSURE SYSTEM

- **Simultaneously measures electric potential and pressure**
- **Preset internal microelectrode pressure**
- **Air-filled system — no debubbling**

Model 900A is designed to measure hydrostatic pressure in small vessels and cells. Pressure ranges of -200 to +400 mm Hg can be measured with stability and accuracy. The system's sensing element is an electrolyte-filled glass microelectrode with a tip diameter range of 2 to 5 microns.

Pressures of electrolyte solutions are measured by maintaining a salt concentration gradient at the tip of the sensing electrode in dynamic equilibrium by applying an equal air pressure inside the microelectrode. The pressure reading appears on the front panel display and via the BNC recorder output.

Because the piezoelectric pressure controller uses external pressure and vacuum sources, pressures lower than -200 to greater than +400 mm Hg can be quickly and accurately measured at the microelectrode tip.

The open pressure chamber is almost immune to vibrations and movements and, unless they are extremely large, the open system is unaffected by leaks. The pressure controller is contained in a small, lightweight enclosure that can easily be mounted near the micropipette to help reduce dead space. It includes an amplifier, a piezoelectric valve and a pressure transducer. The user supplies fluid-filled microelectrodes, +500 mm Hg pressure source and a -300 mm Hg vacuum source.

Measuring electric potential and pressure simultaneously lets you use potential recording as an additional cue for locating the electrode where visibility is limited, or correlate pressure and potential when this is meaningful.

The unique "Set Pressure" mode lets you preset

the internal pressure of the microelectrode — select a positive pressure for flushing the tip, or a negative pressure for pulling solution into the tip. By disconnecting the microelectrode holder and attaching the tubing to a manometer, you can check the calibration against a standard.

A built-in alarm sounds to indicate maximum pressure. The alarm also sounds when the tip is blocked or electrical continuity is broken (e.g., the microelectrode comes out of the solution, too little filling solution to cover the Ag/AgCl pellet, disconnected ground reference, etc.).

The piezoelectric pressure controller regulates internal pipette pressure by controlling air flow into and out of a small pressure chamber. A vacuum source is connected on the outlet side of the chamber, and a piezoelectric valve meters air entering the pressurized chamber. The residual volume of the pressure chamber includes the micropipette, the

connecting tubing and the pressure transducer on the outlet side of the piezoelectric valve. The 900A accurately controls and adjusts the pressure in the chamber to match pressures applied externally to the microelectrode tip.

The response time of the piezoelectric valve is 0.5 ms from fully closed to fully open. Overall system response time depends largely on the amount of residual volume in the tubing. When this volume is small, the system responds very rapidly (typically 10 milliseconds).

The lightweight pressure controller pod may be mounted close to the microelectrode using small-bore tubing, to minimize system dead space.

Microelectrode holders MEH6RF and MEH6SF for 1.0 mm O.D. capillary glass included. (1.2, 1.5 and 2.0 mm also available — please specify O.D. requirement when ordering.)

SYS-900A Micropressure System

System price includes a one-day technical training session at WPI in Sarasota, Florida.

Specify line voltage

OPTIONAL ACCESSORIES

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 O.D.)
MEH6SF	Micropipette Holder (1.0, 1.2, 1.5 or 2.0 mm — Specify O.D.)
TIPTW900A	Prepulled Micropipette for 900A (1 mm thin-wall, 2 µTip) (pkg of 10)
900APP	Replacement Pressure Pod
SYS-PM015D	Pressure Manometer (15 psi)

World Precision Instruments

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Automated TEER Measuring System



CE

The **REMS AutoSampler** automates measurements of electrical resistance of transepithelial, transendothelial or Caco-2 cell membranes being grown to confluence on microporous filters of high throughput screening (HTS) 24- and 96-well microplates. It is a PC-controlled tissue resistance measurement system that offers reproducibility, accuracy, flexibility, and ease-of-operation for this kind of measurement. Automated measurement of tissue resistance in cell culture microplates provides the important advantages of speed, precision, decreased opportunity for contamination and the instant availability of measured resistance data on a computer. These measurements are useful in applications such as drug bioavailability studies and studies on the mechanisms of drug transport.

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 interface unit and the REMS software to operate the system on a Windows-based computer.

The REMS AutoSampler automates TEER measurements previously made with WPI's **EVOM** Epithelial Voltohmmeter. Automated tissue resistance measurements up to 20 k Ω can be performed on 24- or 96-well HTS microplates. Microplates presently supported include the Corning Costar HTS Transwell-24, Falcon HTS Multiwell insert systems, and Millipore Multiscreen™ CaCo 96-well plate.

The REMS AutoSampler is designed to facilitate integration with other robotic systems. Special locating bars are installed on the REMS base platform that allow other system robots to place an HTS tray into a precise location on the REMS base.

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 a x-y-z locating system, the electrode-containing arm is positioned precisely

SYS-REMS Automated Tissue Resistance Measuring System

Includes robot sampler, base plate, data acquisition board; computer, display, keyboard, mouse; software for Windows XP or Vista; and electrode for either 24-well plate (Corning Costar HTS Transwell-24 or Falcon HTS Multiwell) or 96-well plate (Millipore Multiscreen CaCo) — SPECIFY WHEN ORDERING.

ACCESSORIES

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

Contact WPI for detailed information.

REMS AUTOSAMPLER SPECIFICATIONS

MEMBRANE RESISTANCE RANGE	0 to 2000 Ω and 0 to 20 k Ω
AC SQUARE WAVE CURRENT	+/- 20 μ A @ 12.5 Hz
ELECTRODE POSITIONING	Resolution in X, Y and Z: +/- 1 mm
ELECTRODE PERFORMANCE	Repeatability in X, Y and Z: +/- 0.25 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	Choice of any well pattern sampling
LINE VOLTAGE	User specified: 100/120 V or 220/240 V
DIMENSIONS	53.5 x 43.7 x 37.1 cm (21 $\frac{1}{2}$ x 17 $\frac{3}{16}$ x 14 $\frac{5}{16}$ in.)
WEIGHT	24 kg (52 lb)

and reproducibly over each well. The ability of the REMS AutoSampler to reproducibly and precisely locate the electrode results in highly reproducible TEER measurements. TEER measurements are stored in the computer as the electrode moves from one well to the next. The Windows-based software provides user-friendly features to acquire, display and store the tissue resistance measurements.

The REMS electrode is very compact and robust in design. Each of two rod-shaped probes, 1.5 mm in diameter, consists of a pair of electrodes: one electrode for injecting current and the other for measuring the voltage. The use of two pairs of electrodes eliminates the error caused by the electrode-liquid interface. To take a measurement, the robot inserts one probe into the center of the filter well and the other into the opening slot of the 24- or 96-well plate. 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.

The REMS AutoSampler also features a rinse and calibration check station. 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.

Trans Epithelial Electric Resistance (TEER) Measurements

During the last two decades TEER measurements have become universally established as the most convenient, reliable and non-destructive method to evaluate and monitor the growth of epithelial tissue cultures *in vitro*. The confluence of the cellular monolayer is quickly

determined by a sharp increase in TEER.

TEER measurement technology, which was first introduced by WPI in the mid-1980's, has since been perfected and expanded to include a range of TEER related manual and automatic instrumentation.

EVOM²TM

Epithelial Voltohmmeter

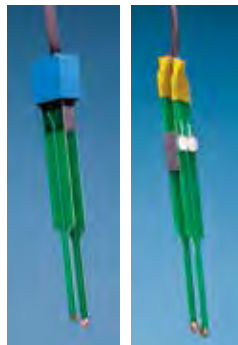
- **Manual TEER measurements of epithelial cells in 6-, 12-, and 24-well plates**
- **Electrically isolated meter that plugs into a standard outlet for continual readout without push buttons**
- **Compatible with Endohm chambers**
- **STX2 manual electrodes and test electrode included with every meter**
- **Free standing with tilt bail, making viewing results easy**



CE

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.

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. The four and a half digit readout provides a range of 1-9,999 Ω . The included



STX2

STX3

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.

EVOM2 comes complete with the popular STX2 "chopstick" electrodes, 4 mm wide and 1mm 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.

EVOM2 SPECIFICATIONS

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

EVOM2 Epithelial Tissue Voltohmmeter (includes **STX2** electrode set)

REPLACEMENTS AND ACCESSORIES

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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TEER measurements in High Throughput

STX100

Series Electrodes

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

With the development of a High Throughput Screening (HTS) protocol for faster drug discovery, a new line of cell culture filter plates have been introduced by several major cell culture insert manufacturers. These HTS plates normally have either 24 or 96 individual cell culture inserts "bonded" together as one plate so that it can be handled by a robot apparatus. In response to these developments, WPI has developed an automatic REMS system and a manual electrode, STX100, for TEER measurements using HTS plates.

STX100's design is based on the same reliable design principle as the universally used STX2 electrode, with several important modifications. The size of the electrode tip has been reduced to 1.5 mm to facilitate positioning through the narrower slit of the HTS plate. The STX100 electrode itself is constructed using a stronger material for higher durability and maximum usage applications. The bottom section of the electrode is shaped to fit neatly into the "keyhole" shaped filter well. This enables the STX100 electrode to produce increased accuracy and reproducibility of TEER readings ($\pm 5\Omega$) compared to the standard STX2. Several versions of STX100 are available, designed to fit the Corning Costar 24-well HTS plate, the Falcon 24 well HTS plate,

and the Millipore Multiscreen CaCo 96-well plate. Measurement can be directly performed when the HTS plate is in either a common or divided tray, reducing the possibility of contamination as well as mechanical damage to the cultured cells.

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

OPTIONAL ACCESSORIES

13685	Modular Cable, 7 ft
13347	Chart Recorder Adapter
2851	Standard BNC Cable, 5'2"
500184	Standard BNC Cable, 10 ft (3m)

CaliCell™

Cell culture cups with synthetic membrane for testing STX electrodes, Endohm and Ussing chambers

It takes a long time and a lot of work to grow a batch of cells, so you will want to make certain that your test apparatus is functioning properly. The CaliCell™ provides a quick and positive way to test STX electrodes, EVOMs, Endohm, and Ussing chamber.

The CaliCell™ is a major improvement in TEER electrode calibration. Its membrane makes use of our unique electric current constriction technology to produce resistance readings comparable to those obtained with real cell cultures. The CaliCell™ does not have to be refrigerated, and can be cleaned and sterilized with alcohol. Readings will not drift over time as long as the unit is kept in good physical condition.

CALICELL-12	12 mm Calibration Cell for Endohm-6/Endohm-12
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Screening (HTS) cell culture filter plates



Endohm™

For TEER measurement of endothelial cell cultures in individual cups

- **Compatible with EVOM2**
- **Improved accuracy of 1-2 Ohm**
- **Accommodates 6mm, 12mm, 24mm cups and Costar Snapwell cup**
- **Sterilized with EtO, alcohol or a bactericide**

Using WPI's EVOM2 resistance meter, Endohm chambers provide reproducible resistance measurements of endothelial tissue 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 manufacture. Endohm's symmetrically apposing 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 re-

duced 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 the experience of the user) to 1-2. 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 owing to electrode polarization or membrane capacitance are largely eliminated. Endohm together with EVOM2 offers the most accurate and economical endothelial ohmmeter now available. To date, cups from Costar, Millipore, ICN Biomedicals, and Falcon have been tested. Endohm chambers may be sterilized with EtO, alcohol or a bactericide (also see: Cidex, Microsurgery section); not autoclavable.

ENDOHM-6	Endohm for 6 mm culture cup (24 wells per plate)
ENDOHM-12	Endohm for 12 mm culture cup (12 wells per plate)
ENDOHM-24SNAP	Endohm for 24 mm & Costar Snapwell™ cup (6 wells per plate)
	<i>Requires EVOM2, EVOM, EVOMX or Millicell ERS-2</i>
53330-01	Replacement Endohm Cable

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Ussing System

For electrophysiological investigation of epithelial transport

- **Direct connect low-resistance electrodes**
- **Simplified operation, easy to control temperature and clean after use**
- **Luer type leak-free attachment of tubing and electrodes**
- **Recessed electrode ports to avoid air 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**

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 listed at right. Components are also available separately. (*Preamplifier in photo not included.*)

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. Hundreds of them are used daily by scientists in the field.

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.)

The CHM5 chamber adapts the Costar Snapwell, a cell culture insert for monolayer cell culture, into WPI's "classical" epithelial voltage clamp system. Until now, 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 will flow directly to the surface of the membrane. The voltage electrode is also inserted into the chamber at an angle so as to reduce the distance between the surface of the membrane and the electrode.



Complete Ussing System includes stand, glass reservoir, electrodes, Ussing chamber and tubing (EVC3 preamp and post mounting kit not included—see page 18).

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"); cost of the drain (\$105 to \$140) will be added to the cost of the chamber or system ordered.

Cartridge Electrodes

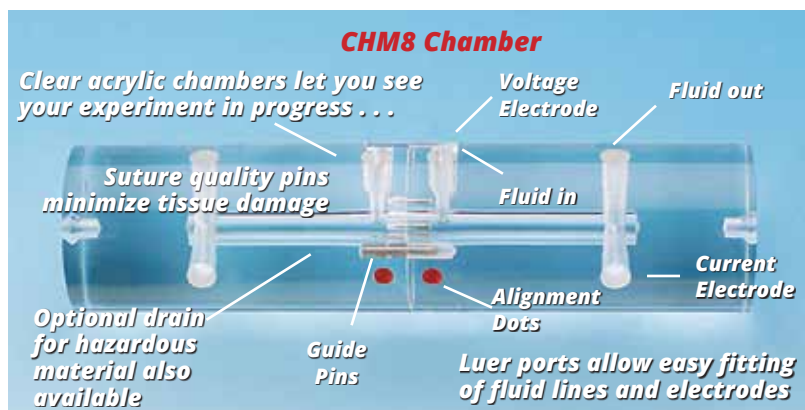
The Electrode Kit contains four voltage/current electrodes, plus four luer-tipped cartridges. Electrodes are threaded and screw securely into the end of each cartridge. The luer tip then plugs securely into the luer openings of the chamber. The cable from each electrode terminates with a 2 mm pin which may be plugged into voltage/current clamps such as WPI's DVC1000 or EVC-4000.

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.

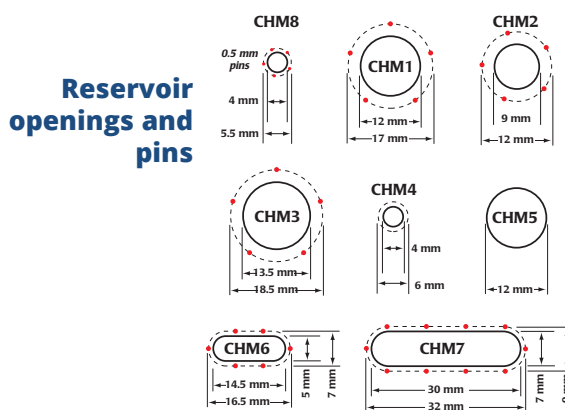


EKV and EKC Cartridge Electrodes

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



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



	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

*O-ring diam.



Circulation Reservoirs

Hand-blown borosilicate glass, with jacketed chambers for temperature control. 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.

Water Bath

The Julabo circulating bath (see page 85) is ideal for controlling temperatures of external systems. With a powerful 15L/min flow rate, the pump provides optimum heat exchange. The tap water cooling feature is standard with a range of 20-100°C. The bath opening is 15cm x 15cm x 15cm and can hold 3-4.5L of liquid.



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

* Add EVC4000 at reduced price when buying Ussing System with equivalent number of channels

EVC4000-1	1-Channel Voltage Clamp & Preamps
EVC4000-2	2-Channel Voltage Clamp & Preamps
EVC4000-3	3-Channel Voltage Clamp & Preamps
EVC4000-4	4-Channel Voltage Clamp & Preamps

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

* Drain option, \$105 to \$140, varies according to chamber.

Multi-Channel Voltage / Current Clamp



More channels and a wider range of voltage clamp commands than WPI's classic DVC-1000. The superior design of the cartridge electrodes makes 100-volt current excursion unnecessary, so this safe, low-voltage system is easier to adjust and use.

EVC4000 employs the voltage clamp technique to monitor membrane permeability as a function of membrane voltage or applied chemicals. When combined with WPI's patented EKC and EKV cartridge electrodes, EVC4000 can efficiently voltage or current clamp up to four sample membranes simultaneously using safe moderate voltages on the current wire leads. The superior design of the cartridge electrodes makes 100-volt current excursion unnecessary, so this safe, low-voltage system is easier to adjust and use. Extremely stable and accurate, each module, with its companion preamplifier, can operate independently in one of three different modes: **Voltage Clamp (VC)**, **Current Clamp (CC)**, or **Open Circuit Potential (PD)** measurement. EVC4000 can be controlled from the front panel of the instrument or from computer generated commands applied at the rear panel of the instrument. A feature unique to EVC4000 is an electronic potentiostat in the preamplifier box that maintains the serosal electrode invariant potential at zero relative to system ground. The preamplifier apparatus actively maintains one surface of the test membrane close to ground potential under all operating conditions.

References

W. K. MacNaughton (2000) "Role of constitutive cyclooxygenase-2 in prostaglandin-dependent secretion in mouse colon *in vitro*." *Journal of Pharmacology and experimental Therapeutics* 293, 2, 539-544

EVC4000-4	4-Channel Voltage Clamp & preamps (shown above)
EVC4000-3	3-Channel Voltage Clamp & preamps
EVC4000-2	2-Channel Voltage Clamp & preamps
EVC4000-1	1-Channel Voltage Clamp & preamp

Specify line voltage

EVC4000 SPECIFICATIONS

PREAMPLIFIER	
Input Resistance	10 ¹² Ohms
Input Leakage Current	100 pA, max.
Maximum Input Voltage	±15 volts
VOLTAGE CLAMP	
Panel Display	±200 mV ±0.1 mV
Clamp Voltage / External Input	100 mV per Volt
Range of Voltage Electrodes	±32 Volts
Max. Clamp Voltage	±100 mV
Fluid Resistance Compensation	0 to 1000 Ohms
CURRENT CLAMP	
Panel Display	±999 µA ±1 µA
Maximum Clamp Current	±1 milliampere
Current Clamp Output	1 µA / mV
DISPLAY RESOLUTION	
Voltage	0.1 mV
Current	1 µA
DIMENSIONS	
	18.25 x 7.2 x 9.6 in. (46 x 18 x 24 cm)
SHIPPING WEIGHT (EVC4000-4)	
	26 lb (12 kg)

OPTIONAL ACCESSORIES

SYS-EVC4000	Replacement Voltage Clamp & EVC3 Preamplifier
EVC3	Replacement Preamplifier Module
EK1	Ussing Electrode Kit (2 voltage, 2 current)
EKV	Extra Ussing Voltage Electrode (each)
EKC	Extra Ussing Current Electrode (each)
2851	BNC Cable
3485	Post Mounting Kit for Preamp

Circulating Bath

The Julabo circulating bath is ideal for controlling temperatures of external systems. With a powerful 15L/min flow rate, the pump provides optimum heat exchange. The tap water cooling feature is standard with a range of 20-100°C. The bath opening is 15cm x 15cm x 15cm and can hold 3-4.5L of liquid.

- LED temperature display (0.1°C resolution)
- Stainless steel bath tank
- Adjustable high temperature cut out and dry running protection.
- PID temperature control
- Large capacity for temperature applications with larger external systems and open systems
- Internal bath for simultaneous applications with smaller objects
- Built in cooling coil for tap water connection when you require a temperature less than the ambient temperature



JULABO BATH SPECIFICATIONS

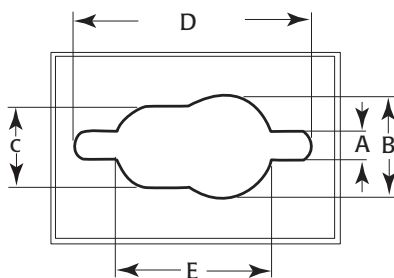
Temperature Selection digital
 Temperature Indication LED
 Resolution 0.1°C
 Temperature Control PID1
 Heater Wattage 230V-2.0kW
 115V-1.0kW

Circulating Pump

Discharge, max at 0 bar 15L/min
 Pressure, max. at 0 l 0.35 bar
 Ambient Temperature 5-40°C
 Mains Power Connection (230V/50Hz) ... 190-253V/50Hz
 Current Input (230V) 9A
 Mains Power Connection (115V/60Hz) ... 103-127V/60Hz
 Current Input (115V) 9A
 Bath Tank Stainless steel
 Working Temperature Range 20-100°C
 Temperature Stability ±0.03
 Bath Opening (WxL) 15 x 15cm
 Bath Depth 15cm
 Filling Volume 3-4.5L
 Dimensions 17 x 33 x 36cm
 Weight 7.0kg
 Recommended Bath Fluid ... soft/decalcified water

503843	Julabo Circulating Bath, 115V
503844	Julabo Circulating Bath, 230V
504122	Julabo Circulating Bath, 100V (Japan)
504142	Julabo Circulating Bath, 13L volume, 110V
504141	Julabo Circulating Bath, 13L volume, 220V

Rodent Brain Matrices



WPI offers one of the largest selections of brain matrices available. Made of acrylic, or stainless steel, these matrices are sturdy and can be heated, chilled, autoclaved (stainless steel only), 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.

Order #	Subject	Material	Section	A	B	C	D	E	Cavity Depth	Weight
RBMA-200C	Adult Mouse, 40-75g	Acrylic	Coronal	3.18	11.1	8.73	19.1	12.2	7.4	0.5 lb
RBMA-200S	Adult Mouse, 40-75g	Acrylic	Sagittal	3.18	11.1	8.73	19.1	12.2	7.4	0.5 lb
RBMA-300C	Rat, 175-300g	Acrylic	Coronal	4.7	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	10.91	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

A310 Accupulser™



Optional footswitch #3259

CE

Combining the accuracy of digital electronics with the convenience of analog controls

A pulse generator/stimulator combining the reproducibility and accuracy of digital electronics with the fine resolution and continuous adjustment possible with analog circuitry. All timing parameters are entered with ten-turn readable potentiometers and six-position range switches. Outputs are accurate to within 1% of the set value.

Pulses can be created in continuous run, single-shot, or train/burst modes. Duration of the train/burst is easily 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, bipolar pulses or trains may be easily produced. Output stimulus can be fed through the Duo 773 for iontophoresis. Footswitch allows hands-free operation.

Three separate outputs are available on the front panel. A Monitor output provides 10-15 V signals (up to 50 mA) for viewing the output on an oscilloscope or for controlling other devices. The stimulator's signal, simultaneously available at the Isolator output, is sufficient to drive any WPI A300 Series stimulus isolator (A360, A365, or A385) and is also TTL and CMOS compatible. The Variable output can provide signals varying between ± 10 V with a resolution of 1 mV. Separate variable outputs are provided for positive and negative signals.

SYS-A310 Accupulser™ Signal Generator

Specify line voltage

OPTIONAL ACCESSORIES

3259 Footswitch for A310

2933 Rack Mount Kit, 5¼ in. high

A310 ACCUPULSER™ SPECIFICATIONS

TIMING PARAMETERS

EVENT INTERVAL	100 μ s to 1000 s*
EVENT DELAY	10 μ s to 100 s *
PULSE WIDTH	10 μ s to 100 s *
TRAIN DURATION (ENVELOPE)	100 μ s to 1000 s*
PULSE INTERVAL	20 μ s to 100 s*

OUTPUTS

SYNC	5 μ s, TTL, and 5 V CMOS compatible, 20 mA max.	
MONITOR	10-15 V, 50 mA max.	
ISOLATOR	TTL & 5 V CMOS compatible, 20mA 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 μ V
DC Wide Band	<500 μ V

OUTPUT IMPEDANCE <1 Ω

INPUTS

EXTERNAL SYNC	Accepts 1- μ s minimum pulses TTL, CMOS compatible
EXTERNAL GATE	Accepts 1- μ s 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.

A300 Pulsemaster™ Multi-Channel Stimulator



CE

The Pulsemaster™ (Model A300) is WPI's third generation, multichannel, pulse/train generator/stimulator that combines the superb accuracy of digital electronics with the "you-see-what-you-get" displays only available on single-channel products. In one compact rack mountable enclosure, the Pulsemaster contains an event interval generator, five pulse train channels, two mixing channels and a very quiet variable voltage output channel. System timing is accurate to 100 ppm; output timing is continuously variable in 0.1% of full scale increments over a range of eight orders of magnitude. Bright, three-digit LED displays continuously and simultaneously show all the variable timing parameters.

An integrated five-channel pulse generator/stimulator including one interval generator, five pulse or train channels, two mixer channels and one very quiet variable voltage output stage

The Pulsemaster is designed for ease of use and flexibility. Each channel can be operated synchronized with the onboard event interval generator, triggered manually from any other channel or external source, and as an independent asynchronous pulse generator. Except for the external source, all channel interconnections are accomplished on the panel, without the use of cables. The output from each channel is compatible with standard digital circuitry and is also designed to drive WPI's A300 series stimulus isolators. If desired, any channel's output may be internally connected to the variable channel, whose amplitude can be continuously adjusted from millivolts to ten volts.

SYS-A300 Pulsemaster™ Multi-Channel Stimulator
Specify line voltage

A300 PULSEMASTER SPECIFICATIONS

EVENT INTERVAL CHANNEL

Operating Modes	EXTernal SYNC, SINGLE EVENT, CONTINUOUS ON
Input	EXT SYNC accepts $\geq 1\mu\text{s}$ pulses; TTL, CMOS, RS232C compatible
Timing	EVENT INTERVAL 10 μs to 999 s (100 kHz - 0.001 Hz), $\pm 0.1\%$ of full scale, continuously variable in 0.1% of full scale increments, through three orders of magnitude, in six ranges
Output	SYNC OUT pulse of $\approx 6\mu\text{s}$, TTL, 5 V CMOS compatible

PULSE TRAIN CHANNEL (5 provided)

Operating Modes	EXTernal SYNC, SELF SYNC, manual SINGLE event, sync from Event Interval, sync from any of other four Pulse Trains, sync from one of the MIXers, off, TRAIN/PULSE
Input	EXT SYNC accepts $\geq 1\mu\text{s}$ pulses; TTL, CMOS
Timing	DELAY and WIDTH 10 μs to 999 s, $\pm 0.1\%$ of full scale
Output	OUTPUT PULSE/TRAIN of preset timing, TTL, 5 V CMOS compatible, 4 mA sink and source

MIXER CHANNEL (2 provided)

Inputs	Any combination of an EXTernal pulse, the outputs of the five Pulse Train channels, and DC continuous ON/DC MOMentary EXT INPUT accepts $\geq 1\mu\text{s}$ pulses
Output	OUTPUT, TTL, 5V CMOS compatible, 4 mA sink and source

VARIABLE CHANNEL

Inputs	Output from any one PULSE TRAIN channel or one of the two MIXER channels or DC
Output	0 to +1 V low range, 1 mV resolution 0 to +10 V high range, 10 mV resolution 5 mA max sink and source
Output Impedance	<1 ohm
Noise	<500 μV peak @ 100 kHz bandwidth, PULSED mode <500 μV , wide band, DC mode
Signal Ground	Floating, i.e., not connected to chassis

POWER

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

BATTERIES

Three 1.2 V DC, size AA, NiMH batteries

DIMENSIONS

8.5 x 19 x 8.75 in. (22 x 45 x 22 cm)

SHIPPING WEIGHT

21 lb (9.5 kg)

STIMULATORS, ISOLATORS

Isostim™ Stimulator/Isolator

Combining the ease of use and accuracy of WPI's 300 Series stimulators with the power output of a stimulus isolator



Timing

Pulse interval and width are set with single-turn continuously variable controls from 5 ms to 5.5 s in three ranges. Pulse width is continuously variable from 50 μ s to 550 ms in four ranges.

Modes of operation

In FREE RUN, Isostim™ generates continuous square waves. In EXT GATE or EXT SYNC modes, externally applied pulses can generate trains or single events. Single pulses of finite duration can be produced using a push-button on the instrument's front panel. EXT/DC mode converts Isostim to a passive stimulus isolator.

Dual tone audible alarm

A tone sounds when an open circuit is detected or when system compliance is reached. A second tone, which sounds when a signal is applied to the input, can only be heard if the batteries have sufficient charge to operate the isolator. A violation light advises when pulse width exceeds the interval.

Current delivery

Stimulus currents up to 10 mA can be set on the front panel with a control knob and a two-position range switch. Output current is load-independent.

Power

Isostim model A320D is powered by readily obtainable 9-volt alkaline batteries (included). Under average use these will last several months before replacement is required. The rechargeable A320R is supplied with a nickel metal hydride battery stack which provides 10-12 hours of operation before recharge is required. **The A362 Battery Charger must be used with the A320R.**

ISOSTIM™ SPECIFICATIONS

TIMING PARAMETERS

Interval	5 ms to 5.5 s continuously variable in three ranges (0.18 to 200 Hz)
Pulse width	50 μ s to 550 ms continuously variable in four ranges

INPUT

External sync	Accepts 1 μ s minimum pulses
External gate	Accepts 1 μ s pulse to continuous
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

Waveform	DC, pulse from internal timing or externally generated pulse
Current ranges	0-1 mA, 0-10 mA
Load voltage excursion (compliance)	100 V nom., 150 V max.
Output polarity	Reversible, manual switch
Current rise time and delay	8 μ s, typical (1 K Ω load)
Current fall time and delay	10 μ s, typical (1 K Ω load)
Leakage resistance, output to ground	10 ¹² Ohms
Optocoupler	2500 V rated min. breakdown voltage

POWER

Dry Cell (Version D)	16 alkaline 9V batteries included
Rechargeable (Version R)	16 rechargeable NiMH 9V batteries (included)

DIMENSIONS

8.5 x 3.5 x 4.9 in (22 x 9 x 12 cm)

SHIPPING WEIGHT

4 lb (1.8 kg)



A362 Battery Charger

Required for A320R, A365R and 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).

SYS-A362	Battery Charger for A320R, A365R, A395R
A320RC	A320R with Charger (A362)
SYS-A320D	Isostim™ Stimulator/Isolator
SYS-A320R	Isostim™ Stimulator/Isolator (rechargeable)

Specify line voltage

OPTIONAL ACCESSORIES

DRL	Dummy Load Resistor Kit (set of 3)
13347	BNC-to-Double Banana Adapter

Stimulus Isolator / Precision Current Source



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 — 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 A360LA produces up to 10 milliampere current, in three ranges, at more than 100 volts compliance.

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.

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
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 Ω
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)

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

DRL Dummy Load Resistor Kit (set of 3)

13347 BNC-to-Double Banana Adapter



DRL — Dummy Load Resistor Kit
Converts current output to precise voltages.

STIMULATORS, ISOLATORS

Combines optical isolation with a ± 100 mA current generator



A385 High Current Stimulus Isolator

Delivers positive, negative, or bipolar currents. For bipolar delivery, polarity of the output is toggled to the opposite state with each pulse presented to the input. Pulse duration is controlled by an externally applied voltage. Input connector is a standard BNC, allowing signals from any source — such as computer D/A or I/O lines — to be used.

Output amplitude is set on 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 serious accidental transcutaneous shocks. A compliance/output alarm sounds

when the 36-volt limit is reached. Internal circuitry maintains electrodes short-circuited during inactive periods (“electrode exhauster” feature). A385 is not appropriate for transcutaneous stimulation.

The 1.2 amp-hour rating of the six heavy-duty lead-acid rechargeable batteries ensures that experiments will not be interrupted by dead batteries — even at peak currents. Indicator lights and audible alarms keep the user constantly apprised of battery charge status. These batteries must be recharged by the A382 System Charger designed especially for the A385.

A385RC	A385R with A382 Charger
SYS-A385R	High Current Isolator, rechargeable
SYS-A382	Battery Charger for A385 (see below)

Specify line voltage

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
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 electronically switched bipolar delivery
CURRENT RISE TIME AND DELAY	6 μ s, typical (1 K Ω load)
CURRENT FALL TIME AND DELAY	10 μ s, typical (1 K Ω load)
OUTPUT TO GROUND RESISTANCE	10 ¹² Ω
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)

A382 Battery Charger



An innovative three-step charger, 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 batteries installed in the A385.)

A382 SPECIFICATIONS

POWER	95-135 V or 220-240 V, 50/60 Hz
DIMENSIONS	8.5 x 3.5 x 5 in. (22 x 9 x 12 cm)
SHIPPING WEIGHT	5 lb (2.3 kg)

A395 Linear Stimulus Isolator

Replicates a programmed waveform of any shape or polarity

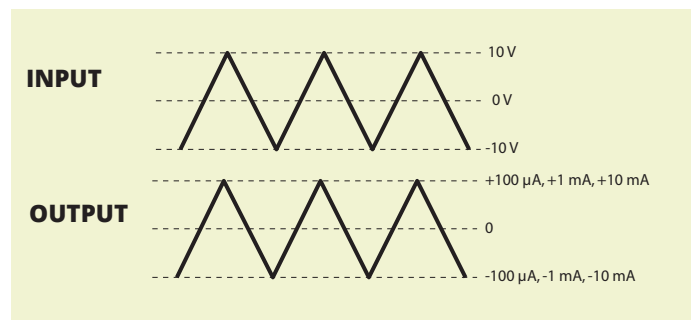


Current Delivery — A 10 V input produces the maximum output current for the current range selected, *i.e.*, 100 µA, 1 mA, or 10 mA. Front panel controls allow DC current to be generated. Externally applied signals can be superimposed simultaneously (DC offset). Warning lamps indicate open circuit or excessive current conditions.

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 $I \times R$ (load) product does not exceed the available battery supply voltage. A visual indicator (the compliance LEDs) displays if $I \times R$ 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 A395 D can generate a voltage of 70 volts or more across its OUTPUT terminals. Thus, the user can be sure that the amplitude of the current will be 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. The user would then know that (a) too much current was dialed for a given load or (b) inter-electrode resistance was too high or the electrode circuit path was open.

Model A395 generates an output current of arbitrary (user-defined) wave shape; DC, AC, pulse, and combinations thereof. Battery operated, and 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. It can be easily daisy-chained for multiple channel requirements.



Accepts analog input

Digital Meter — Measures DC or average output current.

Overload Lamps — Indicate when output voltage has reached positive or negative compliance voltage limit.

A395RC	A395R with Charger (A362)
SYS-A395D	Linear Stimulus Isolator
SYS-A395R	Linear Stimulus Isolator, Rechargeable
SYS-A362	Battery Charger

Specify line voltage

A395 SPECIFICATIONS

OUTPUT CURRENT, I_{max}	3 ranges: 100µA, 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 @ I_{max}	± 10 volts
INPUT/OUTPUT LINEARITY ERROR	< 0.5%
RISE, FALL TIME	26 µs @ 10 KΩ
POWER	
Model A395D	17 alkaline 9 V batteries
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)

A362 Battery Charger

Required for A320R, A365R and 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).



STIMULATORS, ISOLATORS

Adhesives Application Guide

Part No.	Description	Curing time	Useful Applications and Characteristics
Epoxies Form strong bonding. Used in wire bonding applications.			
4898	Silver filled conductive Epoxy	12 hrs@50C; 5 min @150C	Connecting conductors that can't be soldered. Constructing or connecting Ag/AgCl pellets.
7335	Carbon filled conductive Epoxy	48 hrs@25C; 5 min @150C	Constructing carbon electrode.
4886	High performance Structural Epoxy	12 hrs@25C.	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.	24hrs@25C	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.	72hrs@25C	Good for bonding or sealing electronics circuits (metal).
SYLG184	Sylgard, Two parts, vinyl/platinum cure sealant. Hydrogen as cure by-products. Very low toxic	24hrs@25C, 15 min.@150C	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@25C	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@25C	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 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.

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.



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

Scotch-Weld 2216 Structural Epoxy



Bonds PEEK!

Probably still 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)

4886 Scotch-Weld 2216 (2 oz.)

Low toxicity 5-minute adhesives for live tissues!

- **Specially formulated for WPI**
- **Extremely low toxicity**
- **Excellent moisture resistance**
- **Cures at room temperature**

Kwik-Sil and **Kwik-Cast** silicones are based on technology with vinyl terminated siloxane and platinum complex catalysts. In order to gain enough speed to cure at room temperature, special cross linkers and high catalyst concentration is used. Although the high concentration of catalysts makes these products more costly than traditional RTV silicones and less attractive for general usage, they provide an excellent value in applications for the biological research field.

Both **Kwik-Sil** and **Kwik-Cast** have very low toxicity before, during and after curing. In traditional RTV silicone systems, a by-product of the condensation (curing) is either acetic acid or alcohol, which are toxic to living cells. In vinyl systems, the by-product of condensation is a small amount of hydrogen gas, which is much less toxic to the cell.

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-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-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 & 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	~15minutes	
Viscosity, cps	15,000	10,000
Shelf life at 23 °C	1 year	1 year
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

KWIK-SIL Silicone Adhesive Compound (two 5-mL syringes)

KWIK-CAST Silicone Casting Compound (two 5-mL syringes)

600009 Replacement KWIK-CAST Mixing Tips (pkg of 10)

600022 Replacement KWIK-SIL Mixing Tips (pkg of 10)

PRICE BREAK

1-5 pkg

6-9 pkg

10 or More

KWIK-CAST

KWIK-SIL

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"Super" Adhesives for Life Science Research

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.

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.

503763	Gluture Topical Tissue Adhesive (10 tips), 1.5 mL
7341	Cyanoacrylate Adhesive, low viscosity—90-120 cps (package of 10 vials, each approx 1.5mL)
7342	Cyanoacrylate Adhesive, high viscosity—1100-1600 cps (pkg of 10 vials, each approx 1.5mL)
VETBOND	3M Vetbond™ Adhesive (3 mL)

Sylgard



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.

Shipping weight: 2 lb. (1 kg)

SYLG184 Sylgard (1.1 lb)

Silicone Dissecting Pad Kit



Make your own silicone dissection 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 silicone to prepare 20 dishes.

Kit Includes:

- 2-Part Sylgard silicone elastomer
- 20 plastic petri dishes with lids, 65mm
- Pins

501986 Silicone Dissecting Pad Kit

Digital Caliper



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. An SPC output can interface with external readout devices. 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.

501601

Digital Caliper

502157

Replacement Battery (package of 10)

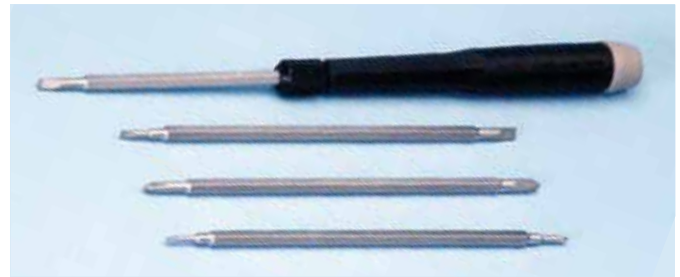
Wire Cutters



501321

Roger Wirecutting Scissors

Screwdriver Set



This production grade precision 5-piece screwdriver set is the highest quality tool you can find on the market. Made by German craftsmen, the chrome-vanadium tips will fit any screw securely without leaving marks. The set contains an ESD safe handle with 8 interchangeable blades. Phillips Sizes: 000, 00, 0, 1. Slotted Sizes: 1.5, 2.0, 3.0, 3.5 mm. The 000 size Phillips blade is the smallest you can find anywhere — it can fit smallest screw on a 35 mm camera. *Weight: 0.24 lb*

501635

Professional Quality Screwdriver Set

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.

Shipping weight: 1 lb. (0.5 kg)

4898

Silver Epoxy (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.

Shipping weight: 1 lb. (0.5 kg)

7335

Carbon Epoxy (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.

Shipping weight: 1 lb. (0.5 kg)

7128

RTV Coating (3 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.)

Shipping weight: 1 lb. (0.5 kg)

1571

RTV Sealant (4.7 oz.)

RTV Prime Coat

Enhances adhesion of silicone adhesives to many difficult-to-bond plastic surfaces.

Shipping weight: 1 lb. (0.5 kg)

6820

RTV Prime Coat, 400 ml (13.5 oz.)

Mini Glue Gun

Comes with three sticks of special formula hot melt glue. UL approved. 110V 60Hz only.

Shipping weight: 1 lb. (0.5 kg)

13316

Mini Glue Gun

Luer Valve Assortment Kit



A useful kit (above) 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.

14011 Luer Valve Assortment Kit

LAB SUPPLIES



Barb-to-Tubing Coupler Assortment Kit

Barb-to-Tubing Assortment Kit (at left) includes three different sizes of tubing and two boxes with different fittings, T-connectors, elbow connectors, check valves and plugs.

500890 Barb-to-Tubing Assortment Kit (polypropylene)

Includes 25ft. each of three tubing sizes: 1/16" ID, 1/8" ID, 1/4" ID



14012

Luer-to-Tubing Coupler Assortment Kit

Assemble quick-disconnect luer fittings for use with flexible tubing with internal diameters of $\frac{1}{16}$ ", $\frac{3}{32}$ ", $\frac{1}{8}$ " and $\frac{3}{16}$ ". 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 253 assorted parts and is offered in two different types of materials.** Polypropylene fittings are chemically inert and resistant to most organic and inorganic solvents. Nylon fittings are strong and can be bonded with adhesive.

14012 Luer-to-Tubing Coupler Assortment Kit (Polypropylene)

500895 Luer-to-Tubing Coupler Assortment Kit (Nylon)



500895

Parts now sold individually

Buy parts from Luer Valve Assortment Kit 14011 individually

	# 14040-50 Pinch Clamp for 7mm Tubing Pack of 50		# 14051-100 Pinch Clamp for 5mm Tubing Pack of 100			# 14042-100 Slide Clamp for 2.5 mm O.D. Tubing Pack of 100
	# 7465-20 Pinch Clamp Large Bore Pack of 20		# 14035-10 4-Way Stopcock, Luer Lock, Pack of 10			
	# 14041-60 Roller Clamp 3/16" Tubing Pack of 60		# 14058-10 4-Way Stopcock, Luer Lock Pack of 10			
	# 13822-10 0.135"/3.4 mm OD Tubing Pack of 10		# 14036-15 4-Way Luer Stopcock Pack of 15			
	# 14045-20 Syringe Slip Luer Valve Activated Check Pack of 20		# 14057-10 4-Way Stopcock, Luer Lock Pack of 10			
	# 14044-5 Syringe Activated Dual Check Valve Pack of 5		# 14048-20 3-Port Infusion Y Swivel Thread Pack of 20			
	# 14039-10 Check Valve Pack of 10		# 14047-10 4-Port Infusion Y Swivel Thread Pack of 10			
	# 14034-40 Injection Site Male Luer lock Pack of 40		# 3742-20 Female T Luer Pack of 20			
			# 14038-10 1-Way Stopcock Luer Lock, Pack of 10			# 13157-100 Female Luer Fitting for 3/32" ID Tubing Pack of 100
						# 13156-100 Female Luer Fitting for 1/16" ID Tubing Pack of 100

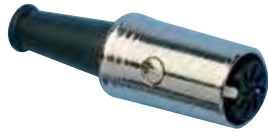
Parts in kit may differ slightly in appearance from those pictured.

Cables & Connectors



#1358

#3492



#5374



#13685



BNC Cables

- #2851 (6 ft)
- #500184 (10 ft)
- #500257 (6 in.)
- #500258 (12 in.)
- #500259 (18 in.)

#3508

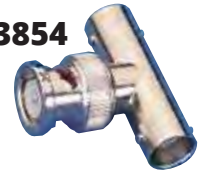


#5375

#13776



#13854



#3517



#5385

#14254



#3142



#3578

#13324



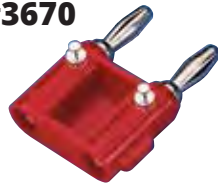
#15623



#3161



#3670



#13347



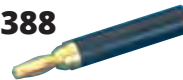
#3294



#5371



#13388



#15975



#15976



#3417-10



#5372

#13451



#300040



#3491



#5373



#13620



#500256



LAB SUPPLIES

PART #	APPLICATION/DESCRIPTION	CONNECTOR A	CONNECTOR B	CABLE LENGTH
1358	Beetrodes	BNC (male)	2 mm pin	3 ft (0.9 m)
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
3508	Adapts BNC pH electrode to pH meter with "U.S. Standard" input	BNC (male)	US Standard	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	2 mm gold pin	2 ft (0.6 m)
5372	Low-noise cable for microelectrode holders	2 mm gold jack	2 mm gold 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)
13555	Serial Cable (not shown)	DB9 (male)	DB9 (female)	6 ft (1.8 m)
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)



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
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



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



14073-4
Open-sided Frame Clamp
(pkg of 4)



503082-4
Board Frame Clamp,
opens to 8.5mm (pkg of 4)



503080-4
Frame Clamp with Parallel
Surface Mount (includes
mounting screws) (pkg of 4)



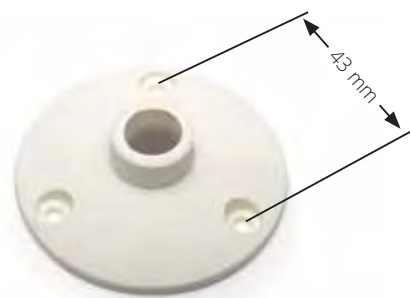
502193-4
Parallel Frame Clamp
(pkg of 4)



503078-4
T-joint Frame Clamp (pkg
of 4)



503079-4
In-line Frame Clamp
(pkg of 4)



503081-4
Vertical Surface Mount, M8
Threaded

- 503070** Polished Stainless Steel Post, 12mm OD, 25cm long, no thread
- 503071** Polished Stainless Steel Post, 12mm OD, 50cm long, no thread
- 503072** Polished Stainless Steel Post, 12mm OD, 75cm long, no thread
- 503073** Polished Stainless Steel Post, 12mm OD, 25cm long, M8 thread
- 502191** Polished Stainless Steel Post, 12mm OD, 50cm long, M8 thread
- 503075** Polished Stainless Steel Post, 12mm OD, 60cm long, M8 thread
- 503076** Polished Stainless Steel Post, 12mm OD, 75cm long, M8 thread
- 503077** Polished Stainless Steel Post, 12mm OD, 80cm long, M8 thread



LAB SUPPLIES

g-SPIN™ Microcentrifuge

- Small size with rubber feet keeps the centrifuge stable
- Supplied with interchangeable rotors and adapters for 0.5mL-2.0mL microtubes and PCR strips
- On/off switch lets you start and stop in seconds
- Safety switch stops rotor without cover in place



Also available:
4,000 RPM and
10,000 RPM
units — call for
details.

g-SPIN SPECIFICATIONS

SPEED RANGE	6000 rpm, fixed
MAX. RCF	2000× g
TUBE CAPACITY	6 x 0.5/2.0 mL tubes 2 x 0.2 mL strip tubes
ROTOR	Fixed angle 6-place 0.5—2.0-mL tubes 2 strips PCR 0.2 mL tubes
DIMENSIONS	6"W x 5"H x 7"D
POWER	110V 60 Hz or 220V 50 Hz

G-SPIN6	Microcentrifuge, 6000 RPM, 110V 60 Hz
G-SPIN6-220	Microcentrifuge, 6000 RPM, 220V 50 Hz, CE
503529	Microcentrifuge tube, 0.5 mL, natural, bag/1,000
503530	Microcentrifuge tube, 1.5 mL, natural, bag/1,000
503531	Microcentrifuge tube, 2.0 mL, natural, bag/1,000
503532	Microcentrifuge tube strips, 0.2 mL, and domed cap strips, bag of 250
503537	Microcentrifuge tube strips, 0.2 mL, and flat cap strips, bag of 250

Rackmounting Hardware

Many instruments may be mounted in standard 19-inch instrument racks with the appropriate rackmount kit, as noted on the page featuring the instrument.

Dual rackmount kits allow many smaller instruments to be joined by bolting the chassis together and mounting the pair into a standard rack.

Brackets for instruments which are less than 17.5 inches wide have "wings" which extend to the standard rack width.



3484 Rackmount Kit for DAM Series amplifiers

DAM Series amplifiers and Iso-DAM amplifiers may be mounted to the rack panels above by fastening bolts (included) through holes in the panel.



2932 Rackmount Kit, 3½-in. high (121)

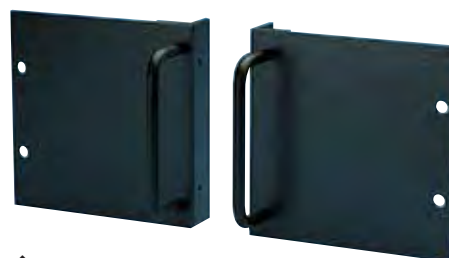


2933 Rackmount Kit, 5¼-in. high (260, 900A, DUO773, A310)

13025 Dual Rackmount Kit (TBM4M)



2935 Rackmount Kit, 8 ¾-in. high

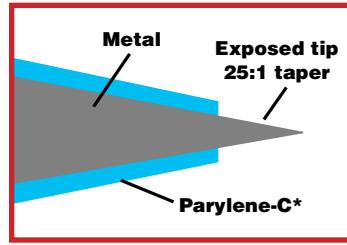


13024 Single Rackmount Kit (TBM4M)

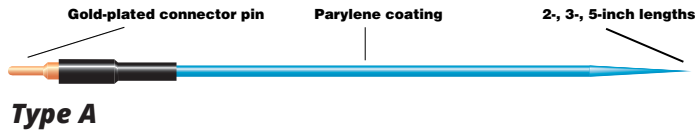
Metal Microelectrodes

Superior microelectrodes for outstanding extracellular recording — tungsten, iridium, platinum-iridium, and Elgiloy®

Nominal Impedance	EXPOSED TIP DIMENSIONS (nominal)			
	Tungsten	Elgiloy	Platinum Iridium	Pure Iridium
10 kΩ	250 μ	—	—	—
50 kΩ	200 μ	—	—	—
0.1 MΩ	100 μ	120 μ	60 μ	45 μ
0.5 MΩ	55 μ	66 μ	18 μ	14 μ
1.0 MΩ	30 μ	36 μ	10 μ	10 μ
2.0 MΩ	12 μ	15 μ	6 μ	5 μ
5.0 MegΩ	5 μ	6 μ	3 μ	2.5 μ

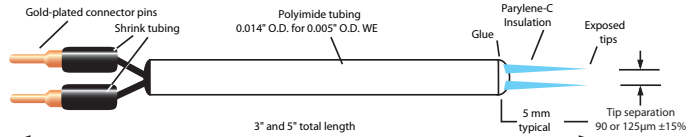


Kapton* tubing, indicated by "KT" in the part number, extends from the connector to within 5 mm of the tip, providing stiffness and additional insulation to the electrode shaft. Kapton-clad electrodes are recommended when the electrode is to be inserted through a cannula for extra deep penetration.

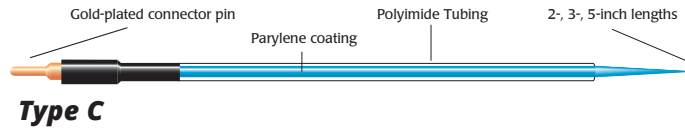


Type A

Note: Electrode diagrams not shown to scale.



Type B

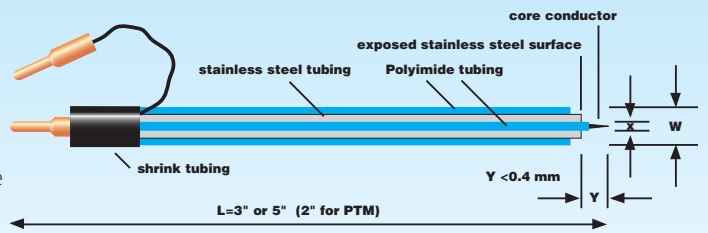


Type C

Concentric Bipolar Electrodes

Excellent for shielded macro recording as well as evoked potentials — especially well suited for bipolar stimulation

The tungsten electrode is sharpened to a point and is 75 microns 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

Heat Treated Tip

(above) 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.

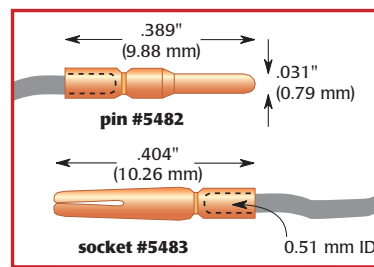
To have your electrodes heat treated, just add the suffix "H" to any of the "KT" numbers on the facing page. Cost of the treatment is \$10 per package of 10 electrodes (\$20 per package for Type B).

* Parylene is a trade mark of Union Carbide. Kapton is a trade mark of DuPont. Elgiloy is a trade mark of Elgiloy Ltd.

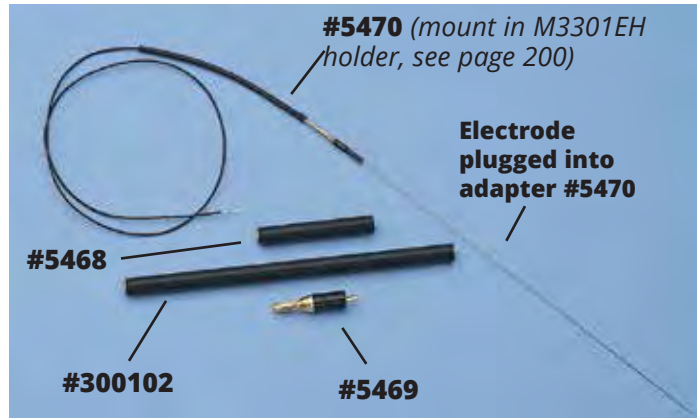
ACCESSORIES

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.



Introductory Assortments

Each of these assortment kits includes electrodes with different impedance within each style. Use an assortment kit to determine which electrode you need for your experiment. Ten electrodes per box, no mixing.

Item	Contains the following electrode impedances by quantity (pkg of 10)	Price
TM31/33Axx	TM33A05 (2), TM33A10 (3), TM33A20 (3), TM31A50 (2)	
TM31/33AxxKT	TM33A05KT (2), TM33A10KT (3), TM33A20KT (3), TM31A50KT (2)	
TM33BxxKT	TM33B01KT (3), TM33B05KT (2), TM33B10KT (3), TM33B20KT (2)	
TST33AxxKT	TST33A05KT (3), TST33A10KT (4), TST33A20KT (3)	

Concentric Electrodes*

Item	Metal Core	Length	Imp	Probe Outer Diameter (total)	Tip Diam.	Core diam.	Y dim.	X dim. w/ polyimide	Price (pkg of 5)
TM33CCNON	Tungsten	3" (76)	10-15K	0.013" uninsulated (325 µm)	3-4 µ	.003" (76 µm)	0.4 mm	.005" (127 µm)	
TM33CCINS	Tungsten	3" (76)	10-15K	0.016" insulated (400 µm)	3-4 µ	.003" (76 µm)	0.4 mm	.005" (127 µm)	
TM33CCINS	Tungsten	5" (127)	10-15K	0.018" insulated (450 µm)	3-4 µ	.005" (127 µm)	0.4 mm	.008" (203 µm)	
PTM23CC001NON	Pt/Ir	2" (51)	10K	0.020" uninsulated (525 µm)	3-4 µ	0.01" (254 µm)	0.4 mm	.014" (356 µm)	
PTM23CC02INS	Pt/Ir NS fine	3" (76)	200K	0.013" insulated (325 µm)	2-4 µ	0.002" (50.8 µm)	.25 mm	.004" (114 µm)	

*All have a stainless steel outer shaft

Selection Guide for Metal Electrodes

Item	Length	Insul. Thick.	Shaft Diam.	Nominal Impedance (± 20%)	Tip Diam.	Typical Use
Tungsten — Profile A						
Package of 10						
TM31A10	76 mm	1 µ	0.127 mm	1.0 MΩ	1 µ	Multi unit and single unit recording and microstimulation
TM31A20	76 mm	1 µ	0.127 mm	2.0 MΩ	1 µ	Multi unit and single unit recording and microstimulation
TM31C05	76 mm	1 µ	0.085 mm	0.5 MΩ	1 µ	Recording from small tightly packed cells
TM33A05	76 mm	3 µ	0.127 mm	0.5 MΩ	1 µ	Multi unit and single unit recording and microstimulation
TM33A10	76 mm	3 µ	0.127 mm	1.0 MΩ	1 µ	Multi unit and single unit recording and microstimulation
TM33A20	76 mm	3 µ	0.127 mm	2.0 MΩ	1 µ	Multi unit and single unit recording and microstimulation
TM33B01	76 mm	3 µ	0.254 mm	0.1 MΩ	1-2 µ	Single and multi unit recording and microstimulation
TM33B05	76 mm	3 µ	0.254 mm	0.5 MΩ	1-2 µ	Single and multi unit recording and microstimulation
TM33B10	76 mm	3 µ	0.254 mm	1.0 MΩ	1-2 µ	Single and multi unit recording and microstimulation
TM33B20	76 mm	3 µ	0.254 mm	2.0 MΩ	1-2 µ	Single and multi unit recording and microstimulation
TM33C05	76 mm	1 µ	0.085 mm	0.5 MΩ	1 µ	Single unit and stim / chronic use
TM33C10	76 mm	1 µ	0.085 mm	1.0 MΩ	1 µ	Single unit and stim / chronic use
Tungsten — Profile C						
Package of 10						
TM31A10KT	76 mm	1 µ	0.216 mm	1.0 MΩ	1 µ	Multi unit and single unit recording and microstimulation
TM33A10KT	76 mm	3 µ	0.216 mm	1.0 MΩ	1 µ	Multi unit and single unit recording and microstimulation
TM33B01KT	76 mm	3 µ	0.356 mm	0.1 MΩ	1-2 µ	Single and multi unit recording and microstimulation
TM33B05KT	76 mm	3 µ	0.356 mm	0.5 MΩ	1-2 µ	Single and multi unit recording and microstimulation
TM33B10KT	76 mm	3 µ	0.356 mm	1.0 MΩ	1-2 µ	Single and multi unit recording and microstimulation
Elgiloy®/Stainless — Profile A						
Package of 10						
SSM33A70	76 mm	3 µ	0.229 mm	7.0 MΩ	1-2 µ	Recording and Stimulating (Prussian blue staining)
SSM33A120	76 mm	3 µ	0.229 mm	12.0 MΩ	1-2 µ	Recording and Stimulating (Prussian blue staining)
Elgiloy®/Stainless — Profile C						
Package of 10						
SSM33A20KT	76 mm	3 µ	0.356 mm	2.0 MΩ	1-2 µ	Recording and Stimulating (Prussian blue staining)
Tungsten — Profile B						
Package of 10						
TST33A001KT	76 mm	3 µ	0.356 mm	10 kΩ	1 µ	Tissue slice stimulation
TST33A05KT	76 mm	3 µ	0.356 mm	0.5 MΩ	1 µ	Stereotrode / Bipolar, differential measurements
TST33A10KT	76 mm	3 µ	0.356 mm	1.0 MΩ	1 µ	Stereotrode / Bipolar, differential measurements
TST33A20KT	76 mm	3 µ	0.356 mm	2.0 MΩ	1 µ	Stereotrode / Bipolar, differential measurements
TST33C05KT	76 mm	3 µ	0.216 mm	0.5 MΩ	1 µ	Stereotrode / Bipolar, differential meas. — extra fine (75 µm separation)
TST53A10KT	127 mm	3 µ	0.356 mm	1.0 MΩ	1-2 µ	Stereotrode / Bipolar, differential measurements
Pure Iridium — Profile A						
Package of 10						
IRM23E10	50 mm	3 µ	0.106 mm	1.0 MΩ	1-2 µ	Single and multiunit recording and stimulation
IRM23E15	50 mm	3 µ	0.106 mm	1.5 MΩ	1-2 µ	Single and multiunit recording and stimulation
IRM23E25	50 mm	3 µ	0.106 mm	2.5 MΩ	1-2 µ	Greater selectivity - small cells
IRM23E30	50 mm	3 µ	0.106 mm	3.0 MΩ	1-2 µ	Greater selectivity - small cells
Pure Iridium — Profile C						
Package of 10						
IRM23E01KT	50 mm	3 µ	0.180 mm	0.1 MΩ	2-3 µ	Multiunit & ERP recording & stimulation
IRM23E20KT	50 mm	3 µ	0.180 mm	2.0 MΩ	1-2 µ	Greater selectivity & microstimulation
IRM23E25KT	50 mm	3 µ	0.180 mm	2.5 MΩ	1-2 µ	Greater selectivity - small cells
IRM23E30KT	50 mm	3 µ	0.180 mm	3.0 MΩ	1-2 µ	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).

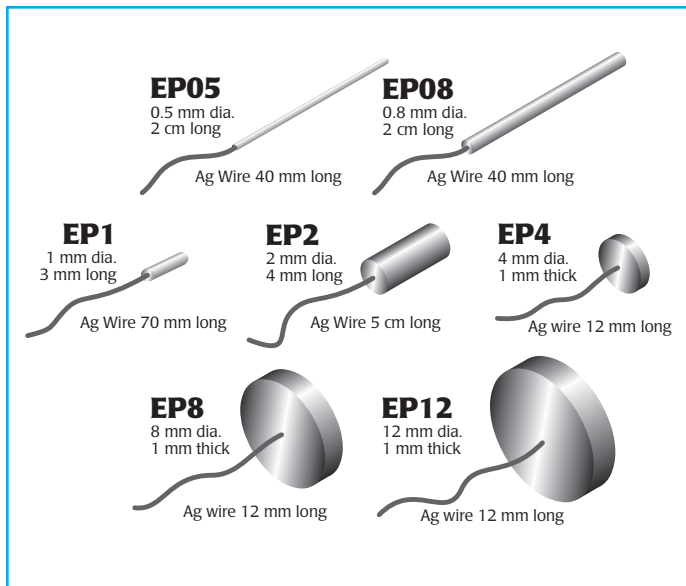
Ordering:

Add the B suffix where blunt electrodes are desired. (For example, an IRM123A10KT ordered as a blunt will be IRM123A10KT(B).)
Add the H suffix where heat treated electrodes are desired. (For example, an IRM123A10KT ordered as with heat treatment will be IRM123A10KT(H).)

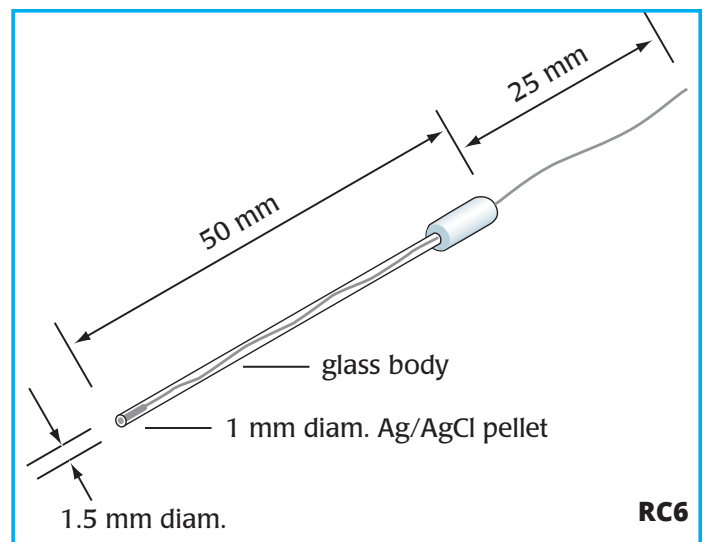
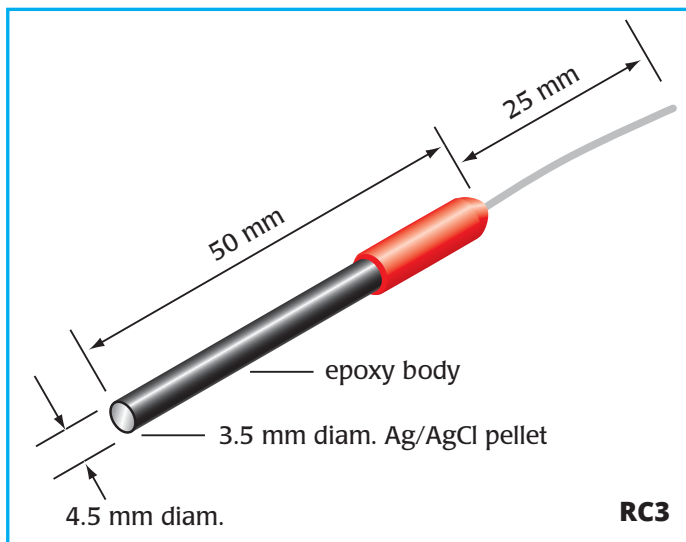
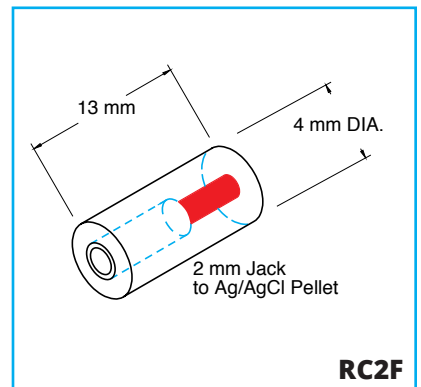
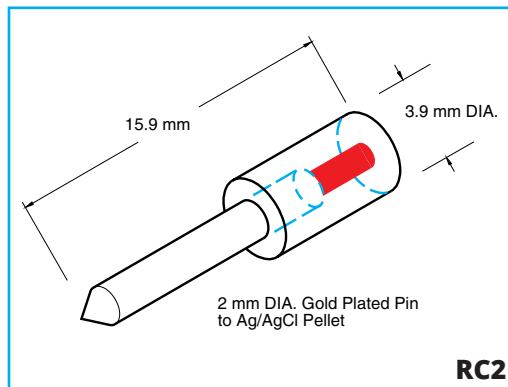
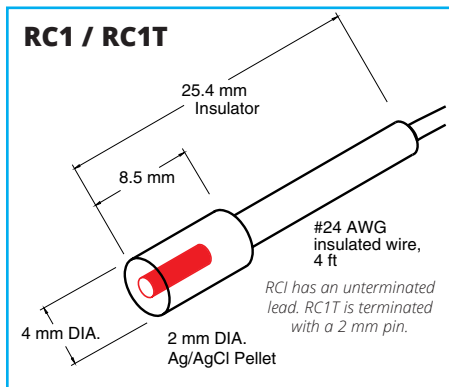
Additional metal microelectrodes available on website
www.wpiinc.com

Ag/AgCl Half-Cells

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.



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	Reference 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



GLASS, HOLDERS & ELECTRODES

Precious Metal and Specialty Wire



New! 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 μ m).

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.

Titanium wire (**Tlxxxx**) is 98.9% pure, annealed, in two diameters.

Stainless steel wire (**SSxxxxx**) is type 316.

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 μ m)	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. (0.4x0.61mm)	20 ft (6 m) ⁵

*Brown & Sharpe

¹ Plus 0.002 in. for Teflon coating

³ Teflon adds 0.00015 in. (4 μ m) 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

Micropipette Holders & Half-Cells

We offer a large variety of micropipette holders. Our popular ones 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

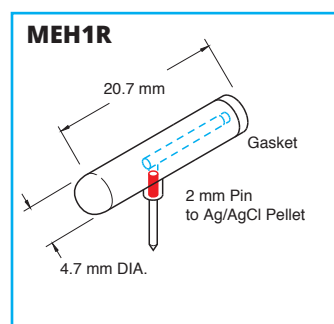
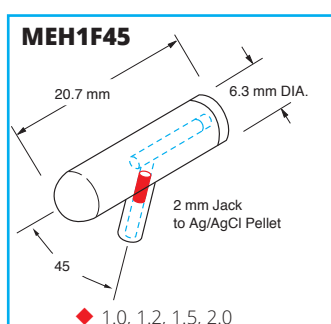
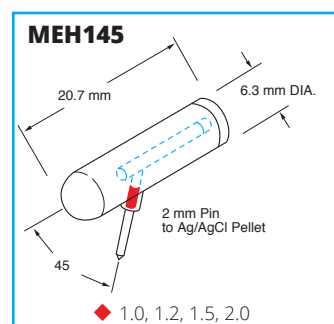
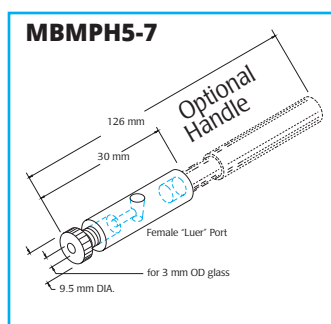
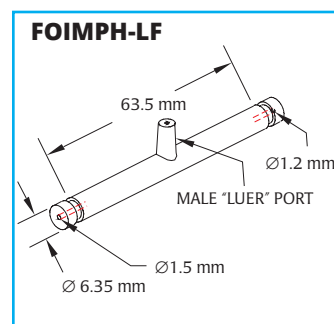
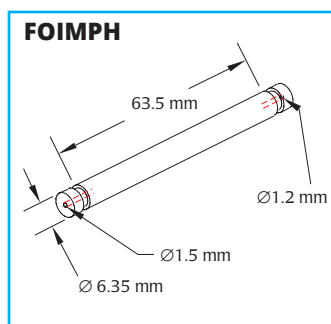
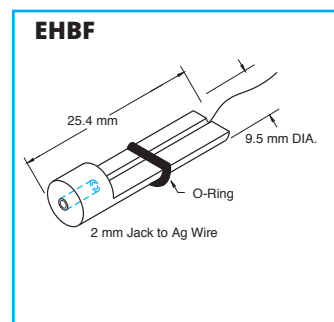
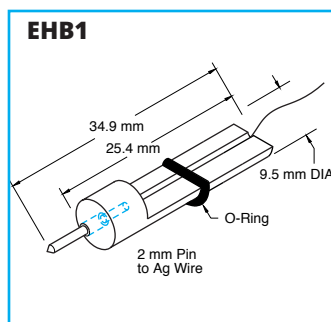
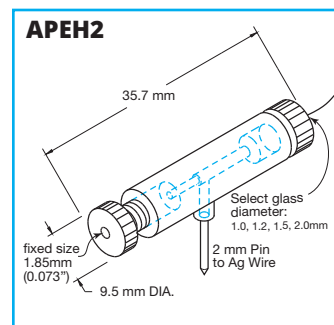
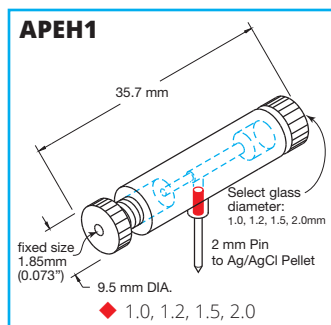
WPI's microelectrode holder-half-cells couple fluid-filled glass micropipettes to high input impedance amplifiers. A Ag/AgCl pellet (or a silver wire) molded into the holder body provides stable potential. Electrical connection is made via male 2 mm pins or female 2 mm sockets. The pipette may be mounted 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 CaCl₂. 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 micropipettes.
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. APEH models are also designed for use in pressurized injection procedures.

♦ denotes holder sizes manufactured for you as custom orders. Call for price.



Additional holders shown on pages 108-109.

MICROELECTRODE HOLDERS

◆ = custom order (call for price)

Order Number <i>Replace XX with glass diameter *</i>	Glass Capillary Diameter (mm)				Electric Connection Angle	Connector	Half-Cell	Pressure Port	Screw Cap	Designed for WPI Products
	1.0	1.2	1.5	2.0						
APEH1xx	◆	◆	◆	◆	Right	Male	Pellet	No Port	2 Caps	
APEH2xx					Right	Male	Wire	No Port	2 Caps	
EHB1					Straight	Male	Wire	No Port	N/A	MBS, 48000
EHBf					Straight	Female	Wire	No Port	N/A	MBS, 48000
FOIMPH					Straight	Fiber Optic	None	No Port	w/Cap	MBS, 48000
FOIMPH-LF					Straight	Fiber Optic	None	Male Luer	w/Cap	MBS, 48000
MBMPH5-7					---	None	None	Female Luer	w/Cap	For P-5 or P-7 glass only
MEH145xx	◆	◆	◆	◆	45°	Male	Pellet	No Port	No Cap	
MEH1F45xx	◆	◆	◆	◆	45°	Female	Pellet	No Port	No Cap	705, 773, 767, 721, FD223
MEH1Rxx					Right	Male	Pellet	No Port	No Cap	
MEH1RFxx	◆	◆	◆	◆	Right	Female	Pellet	No Port	No Cap	705, 773, 767, 721, FD223
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)

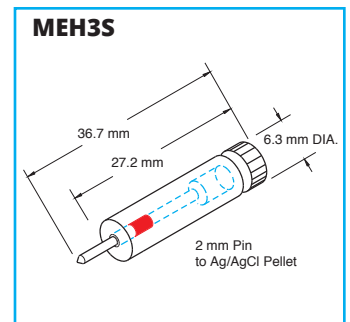
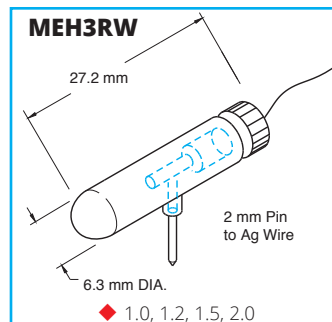
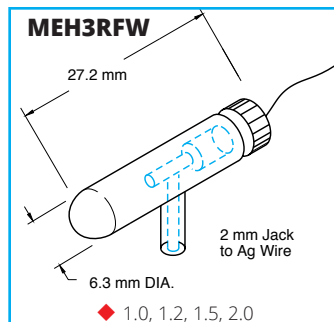
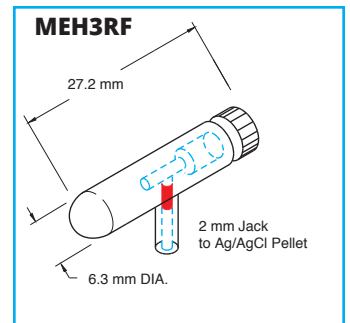
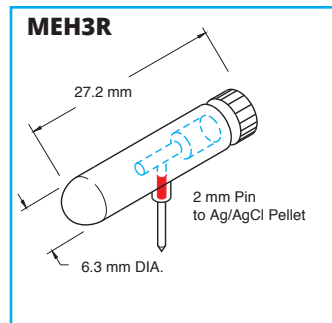
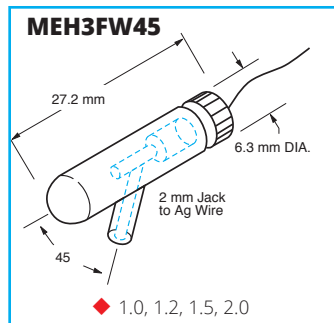
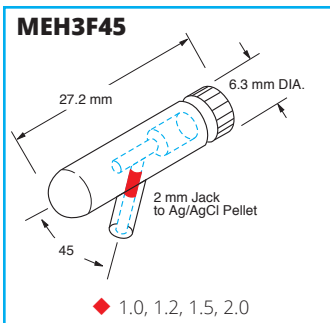
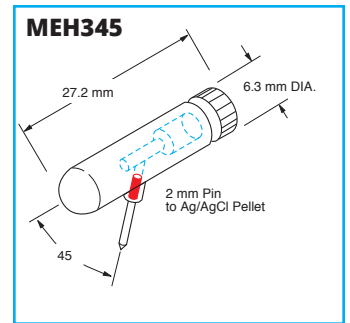
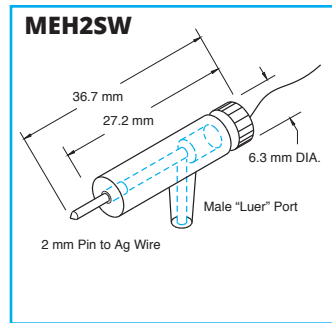
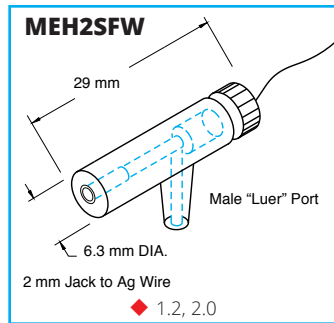
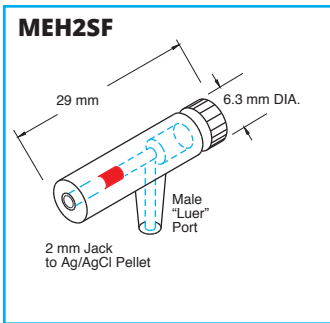
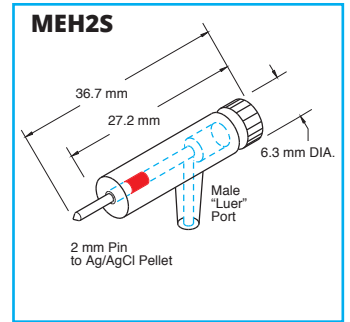
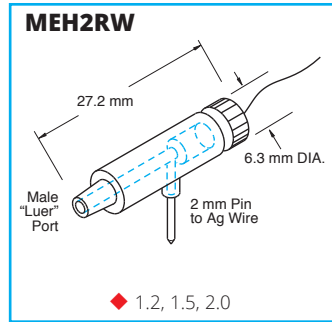
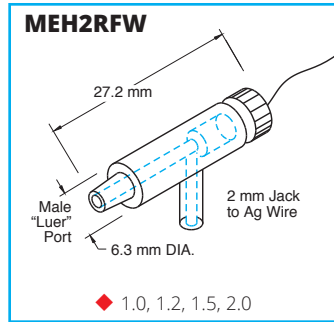
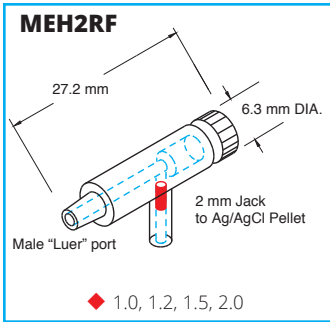
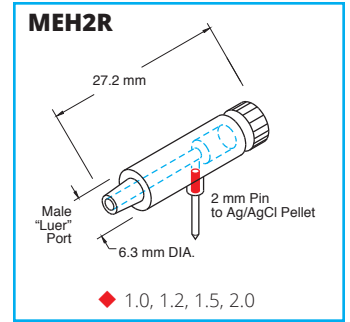
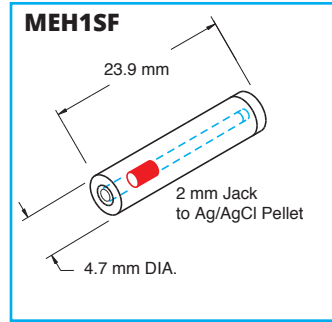
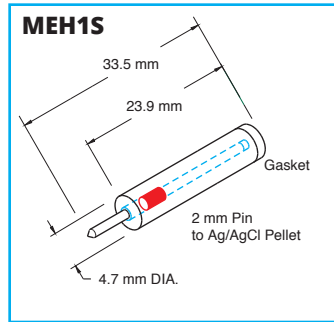
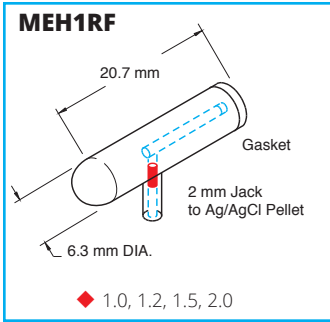
* Specify O.D. of glass (1.0, 1.2, 1.5 or 2.0 mm) by replacing XX in the Order Number with 10, 12, 15 or 20.

Handles and Accessories (not included)

Handle #2505 is for use with WPI manipulators. The smaller diameter handle #5444 is required for use with Narishige and Zeiss manipulators.

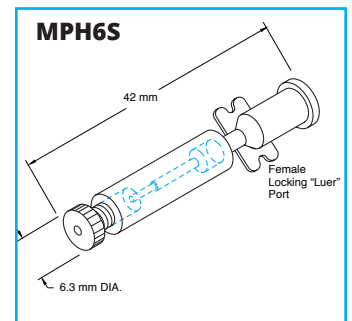
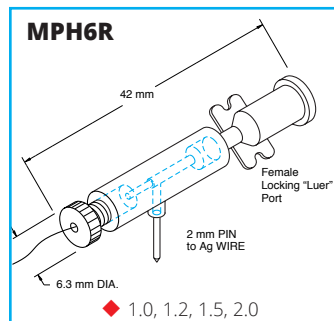
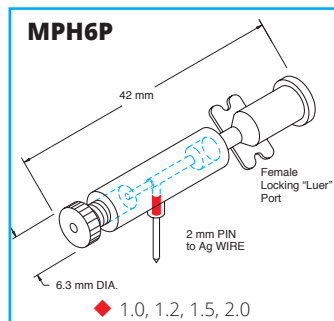
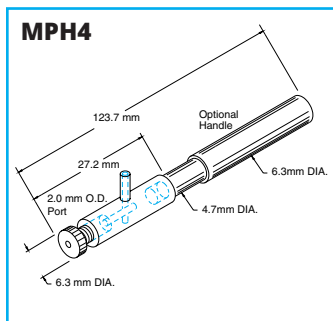
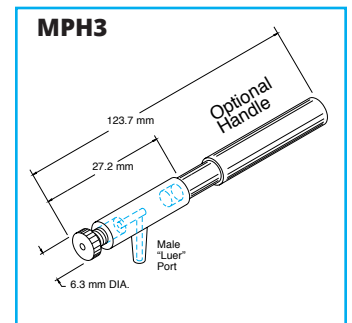
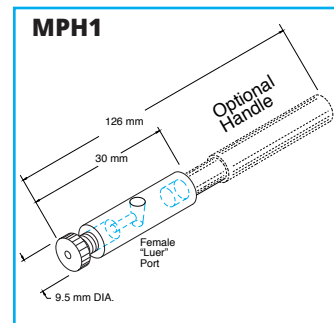
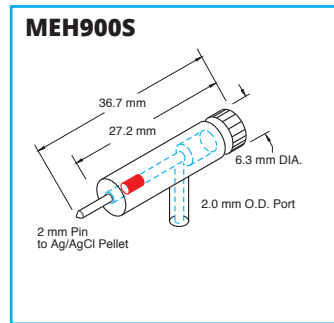
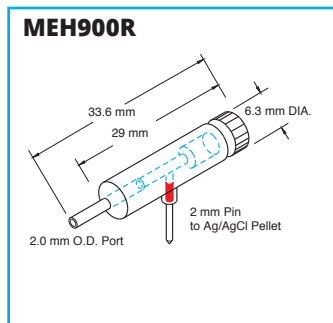
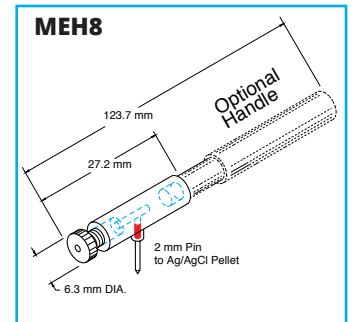
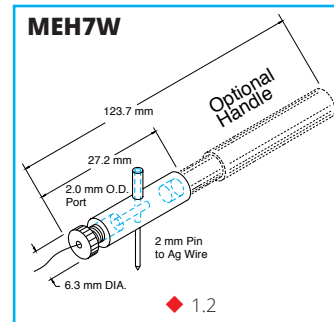
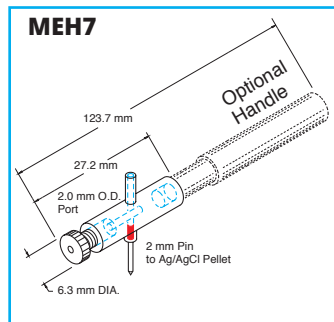
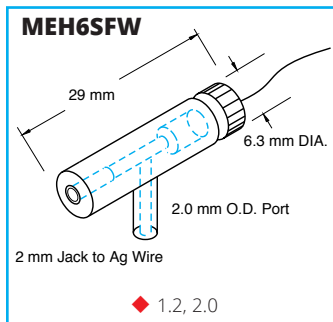
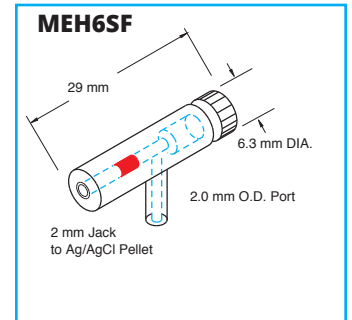
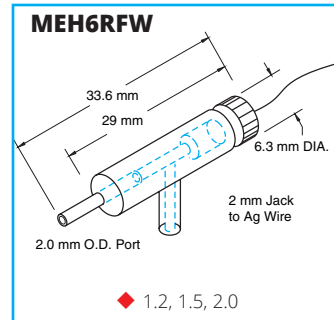
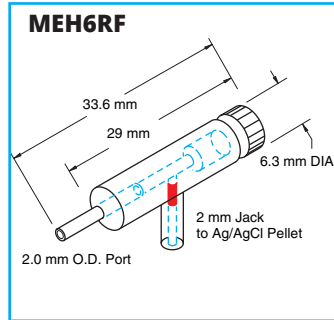
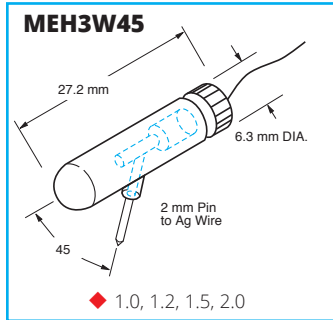
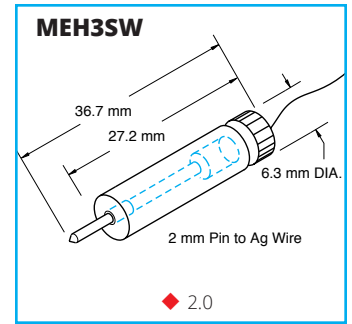
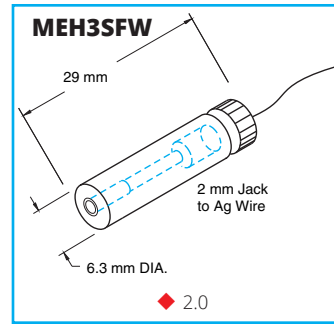
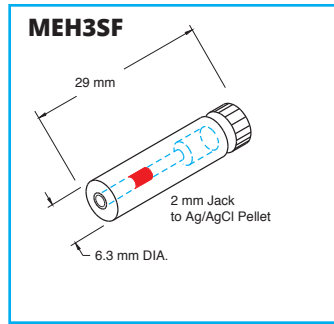
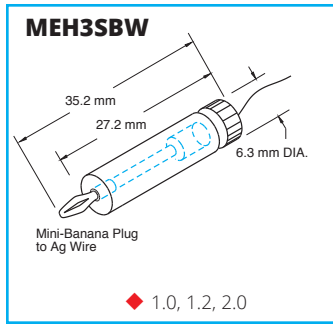
2505	1/4-in (6.3 mm) diameter handle
5444	3/16-in (4.8 mm) diameter handle
GO1-100	Replacement gasket 1.0 mm, Package of 100
GO2-100	Replacement gasket 1.2 mm, Package of 100
GO3-100	Replacement gasket 1.5 mm, Package of 100
GO4-100	Replacement gasket 2.0 mm, Package of 100
1571	Clear Silicone Rubber Sealant (-4.7 oz-)

◆ denotes holder sizes manufactured for you as custom orders. Call for price.



GLASS, HOLDERS & ELECTRODES

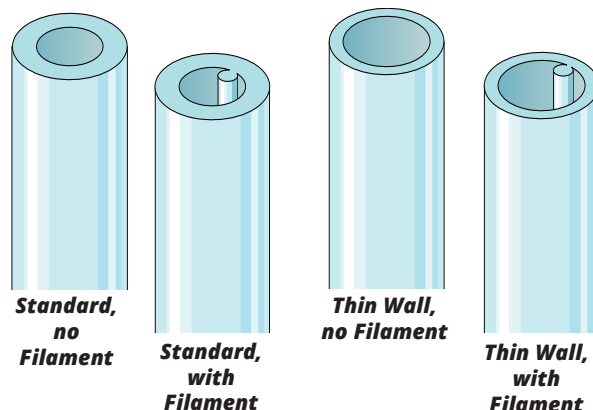
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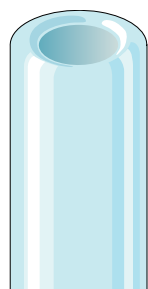
GLASS, HOLDERS & ELECTRODES

Glass Capillaries

Clean, high quality glass for making micropipette electrodes and other research implements



WPI offers a wide spectrum of high-quality glass capillaries. We take pride in our ability to ship your glass order within 48 hours. If you need a special glass that does not appear in our catalog, please call us. We will make every effort to provide it for you.



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.

Borosilicate glass capillaries: Close dimensional tolerances assure microelectrode uniformity and reproducibility. Available in one-, two-, three-, five- and seven-barrel configurations; a 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.

Single Barrel standard wall thickness capillaries are offered either with or without inner filaments for quick filling in a variety of lengths and diameters. Two usable electrodes can be made from one 6-inch length. Borosilicate glass is Corning N51A.

Thin Wall single barrel capillaries are offered both with or without inner filaments. The concentricity of this material provides excellent strength. Micropipettes made from thin wall capillaries have fine tips with a short taper.

Note: Because electrode tips erode when left filled with saline solutions for long periods, electrodes should be made and filled immediately prior to use.

Single-Barrel Standard Borosilicate Glass Tubing

Length	OD (mm)	ID (mm)	Filament	Fire-Polished	Quantity	Item
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 Borosilicate (Schott Duran) Glass Tubing

OD (mm)	ID (mm)	FIL	Fire-Polished	Length	Quantity	Item
1.0	0.75	✓		3 in. (76 mm)	500	TW100F-3
1.0	0.75			3 in. (76 mm)	500	TW100-3
1.2	0.90	✓	✓	3 in. (76 mm)	400	TW120F-3
1.2	0.90			3 in. (76 mm)	350	TW120-3
1.5	1.12	✓		3 in. (76 mm)	225	TW150F-3
1.5	1.12		✓	3 in. (76 mm)	300	TW150-3
1.0	0.75	✓		4 in. (100 mm)	500	TW100F-4
1.0	0.75		✓	4 in. (100 mm)	500	TW100-4
1.2	0.90	✓		4 in. (100 mm)	350	TW120F-4
1.2	0.90			4 in. (100 mm)	350	TW120-4
1.5	1.12	✓		4 in. (100 mm)	225	TW150F-4
1.5	1.12		✓	4 in. (100 mm)	300	TW150-4
1.0	0.75	✓		6 in. (152 mm)	500	TW100F-6
1.0	0.75		✓	6 in. (152 mm)	500	TW100-6
1.2	0.90	✓	✓	6 in. (152 mm)	400	TW120F-6
1.2	0.90			6 in. (152 mm)	350	TW120-6
1.5	1.12	✓		6 in. (152 mm)	225	TW150F-6
1.5	1.12		✓	6 in. (152 mm)	300	TW150-6

Patch Clamp Capillary Glass

To select the best patch clamp glass for your experiments, we have evaluated available glass types in terms of the four properties most crucial to successful patch clamp studies:

The **softening temperature** determines how easily each glass type can be pulled to the desired shape and the extent to which it can be heat polished. Glass with a high softening temperature is difficult to pull and causes unnecessary wear on the heating element of the puller. This makes it very hard to make electrodes that are reproducible and of consistent quality. Patch clamp glass with a low softening temperature is preferred; however, higher softening temperature glass is stronger.

Electrical properties determine how much noise the glass is likely to produce in recording situations. The lower the product of dielectric constant times the loss factor, the smaller the equivalent noise current the glass will produce (Rae and Levis, *Methods in Enzymology*, 207, p67, 1992). Patch clamp glass with good electrical properties is critical especially in single-channel recording.

Sealability: It is not clear what factors determine the sealing ability of the patch to the glass. Almost any glass can form a gigohm seal under the right conditions. Different glass types vary, however, in how easily they form a seal. It is important to select a patch clamp glass that seals easily. Good fire polish is critical for seal (see DMF1000).

Leachable components: Substances leached from glass can alter channel behavior. Since different channels are sensitive to different glass components, it is best to record one type of channel with several different kinds of pipette glass to eliminate any artifact due to the glass.

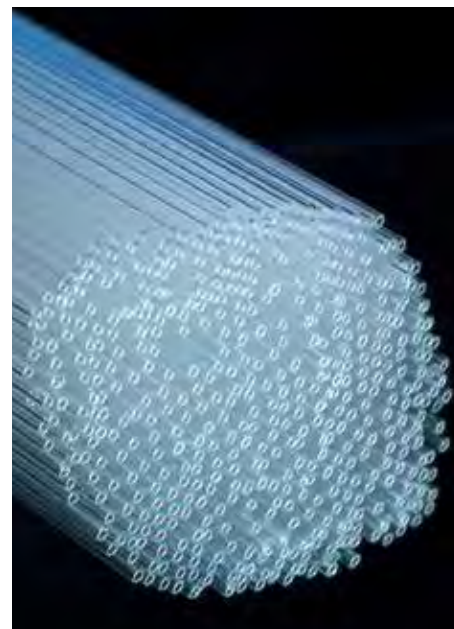
WPI offers capillary tubing made from two glass

types widely used in constructing patch clamp electrodes. The significant characteristics of each are as follows:

PG52151-4, **PG52152-4** 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.



PATCH CLAMP CAPILLARY GLASS

Catalog#	Glass Type	OD/ID (mm)	Dielectric Constant	Softening Point °C	Quantity
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

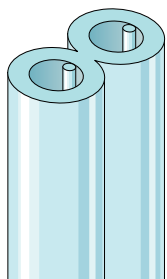
Glass Handling Forceps

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.

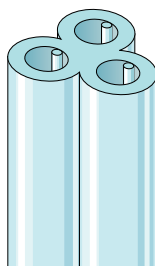


77020 Glass Handling Forceps

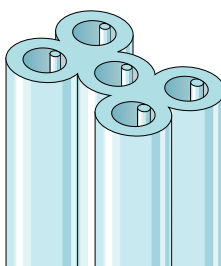
Multi-Barrel Glass Capillaries



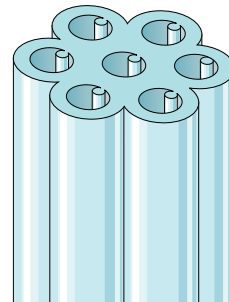
Two-Barrel



Three-Barrel



Five-Barrel



Seven-Barrel

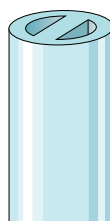
Multi-barrel configurations are designed especially for microiontophoresis. Because the capillaries are fused together during manufacture, you will not need to twist them while pulling to seal the tips together. An inner filament in each barrel makes filling easy and fast.

Also see PolyFil for a novel way to connect multi-barrel pipettes

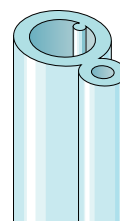
Special Configuration Borosilicate Capillaries

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 trans-tip 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 glass consists of a pair of borosilicate capillaries fused together during manufacture. 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.



Septum Theta



Piggyback

Multi-Barrel Borosilicate Glass Tubing with Filaments

Length	Description	OD/ID (mm)	Filament	Quantity	Item
4 in. (102 mm)	Two-Barrel	1.5/0.84	✓	100	2B150F-4
4 in. (102 mm)	Three-Barrel	1.2/0.68	✓	100	3B120F-4
4 in. (102 mm)	Five-Barrel	1.2/0.68	✓	65	5B120F-4
4 in. (102 mm)	Seven-Barrel	1.2/0.58	✓	60	7B100F-4
4 in. (102 mm)	Seven-Barrel	1.2/0.68	✓	75	7B120F-4
6 in. (152 mm)	Two-Barrel	1.5/0.84	✓	100	2B150F-6
6 in. (152 mm)	Three-Barrel	1.2/0.68	✓	100	3B120F-6
6 in. (152 mm)	Five-Barrel	1.2/0.68	✓	65	5B120F-6
6 in. (152 mm)	Seven-Barrel	1.0/0.58	✓	60	7B100F-6

Special Configuration Borosilicate Glass Tubing

Description	OD/ID (mm)	Length	Quantity	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

Borosilicate Glass Rod

Description	OD (mm)	Length	Quantity	Item
Glass Rod	1.0	4 in. (102 mm)	500	GR100-4
Glass Rod	1.0	6 in. (152 mm)	500	GR100-6

Micropipette Storage Jar

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.



- 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



MicroFil™

**Nonmetallic
syringe needle 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.

1-5 pkgs 6-10 pkgs

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 CMF90UxxL which has a maximum length of 10 cm because of its high resistance to flow. Quantity discounts available. **Specify length when ordering by inserting the length (in centimeter increments) into the catalog number in place of the XX's.**

CMF20GxxL MicroFil, 20 Gauge, 700 µm ID, 850 µm OD (pkg of 4)

CMF22GxxL MicroFil, 22 Gauge, 530 µm ID, 700 µm OD (pkg of 4)

CMF23GxxL MicroFil, 23 Gauge, 530 µm ID, 665 µm OD (pkg of 4)

CMF26GxxL MicroFil, 26 Gauge, 320 µm ID, 430 µm OD (pkg of 4)

CMF28GxxL MicroFil, 28 Gauge, 250 µm ID, 350 µm OD (pkg of 4)

CMF31GxxL MicroFil, 31 Gauge, 100 µm ID, 238 µm OD (pkg of 4)

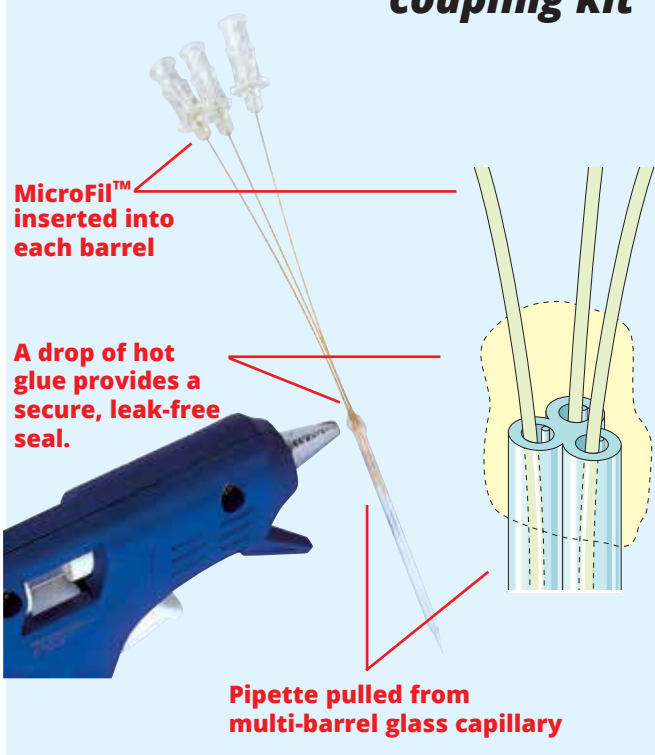
CMF34GxxL MicroFil, 34 Gauge, 100 µm ID, 164 µm OD (pkg of 4)

CMF35GxxL MicroFil, 35 Gauge, 75 µm ID, 144 µm OD (pkg of 4)

CMF90UxxL MicroFil, approx. 36 Gauge, 20 µm ID, 90 µm OD (pkg of 4)

PolyFil™

**Multi-barrel
micropipette
coupling kit**



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.

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.

5440 PolyFil Multi-Barrel Micropipette Coupling Kit

13316 Mini Glue Gun and (3) glue sticks



Eliminate the cost and trouble of making your own micropipettes — WPI can quickly supply your need for consistently sized pre-pulled glass micropipettes for injection of dyes or proteins into cells, oocytes and for many other biomedical laboratory applications. Tip diameters (ID) range from 0.1 to 10 micrometers.

- Schott Duran borosilicate glass
- 0.5 micrometer and smaller ID micropipettes include an internal glass fiber for easy filling
- Tip inner diameter tolerance $\pm 20\%$
- 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 packed

Silanized Tips (Luer Shank)

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.

Micro Cannula

- 0.4mm O.D., 0.2mm I.D. tubing
- Autoclavable
- Biocompatible Perfluorocarbon tubing material

KZ1101 Micro Cannula, 3-inch

Shank	Tip I.D.	Shank 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 A203W glass *	No	Yes	TIP10XV119
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 2000.

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

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.



Sometimes the simplest designs work best.

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. It is perfect for patch pipette tip polishing, tip size reduction, contact stretching, *in vitro* fertilization pipette production and a variety of other pipette configurations. The MF200 simple, reliable and is priced economically.

Features of the MF200

The MF200 system includes: An easy to use analog temperature controller, a specially configured WPI model W30S-LED research grade compound microscope, 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. It is also the only commercial microforge using the Kohler illuminator and Abbe condenser for illumination. This provides less glare and sharper image of the pipette than frosted glass illuminator, which was used on all of the other commercial Microforge.

MF200 Microforge



MICROFORGES, PULLERS, BEVELERS

- MF200-1** Complete Microforge System, incl. W30S-LED Microscope (110 v)
 - MF200-2** Complete Microforge System, incl. W30S-LED Microscope (220 v)
 - MF200-M1 MF 200 without microscope (110v)**
 - MF200-M2 MF 200 without microscope (220v)**
- *Above MF200 microforges include 40X long working distance objective*

OPTIONAL ACCESSORIES

- 500292** Optional 15x Eyepieces (pair)
Note: No reticle available for 15x eyepieces
- 500329** 25x Long-Working Distance Objective
(fits most microscopes with a 160 mm Focal Length)
- 13142** **Optional foot switch**

REPLACEMENT ACCESSORIES

- MF200-H2** Replacement heating filament (large gauge)
- MF200-H3** Replacement heating filament (medium gauge)
- MF200-H4** Replacement heating filament (small gauge)
- 75090** Filament Adjustment Assembly for 22mm OD Objectives
- 75050** Replacement Micropipette Slide
- 75040** Replacement Filament Cable

MF200 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
OBJECTIVE	40x Long-Working Distance (3 mm)
OPTIONAL	25x Long-Working Distance (5 mm)
EYEPIECE	10x (pair)
RETICLE (10x eyepiece only)	1.25 μm/division (at 40x) 0-90° Angle at 5°/division
OPTIONAL EYEPIECE	15x (pair)
GLASS HOLDER	Mounts on Microscope Stage
DIMENSIONS: Control Unit	4 x 7 x 1 1/2 in. (10.2 x 17.8 x 4.8 cm)
SHIPPING WEIGHT	3 lb. (1.4 kg)
MICROSCOPE	See W30S
SHIPPING WEIGHT	16 lb. (7.3 kg)

MICROFORGE 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	—	✓

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Microforging, Micropipette Calibration and Microinjection — in a single device!

The **DMF1000** is a 'state-of-the-art' 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.

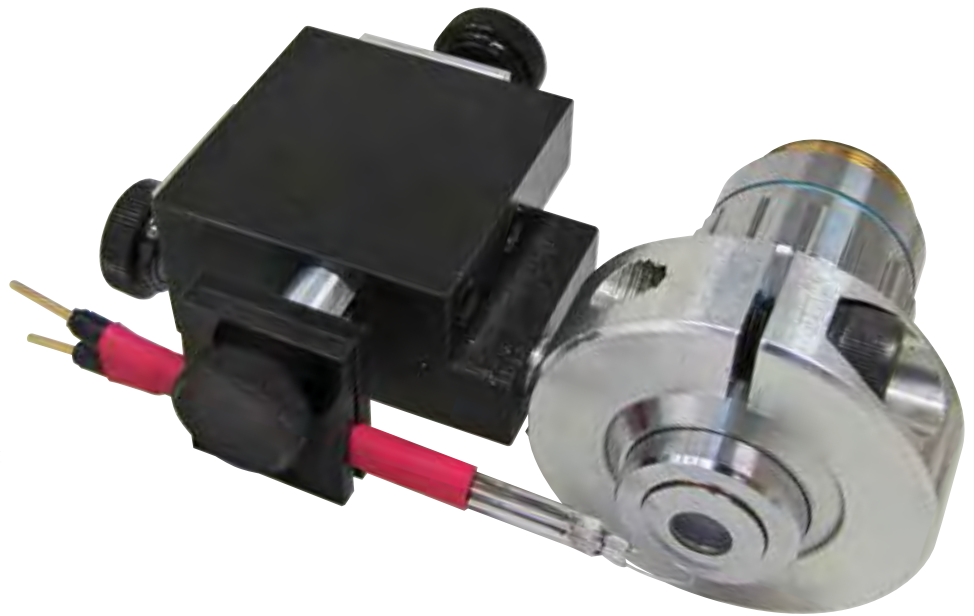
Unique Features of the DMF1000 System

The DMF1000 system includes a specially configured WPI model W30S-LED research grade compound microscope equipped with a high quality metallurgic 40x long-working distance objective and a pair of 10x eyepieces. It is the most powerful long-working distance objective currently available on any commercial microforge. The long working distance objective reduces the danger of damage to the objective lens during the heating process.

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).



Filament Holder mounts directly to objective to provide precise control of heating element position.

DMF1000

Ease of use

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 microscope's objective. Hence it can be easily adjusted to any position within the viewing area.

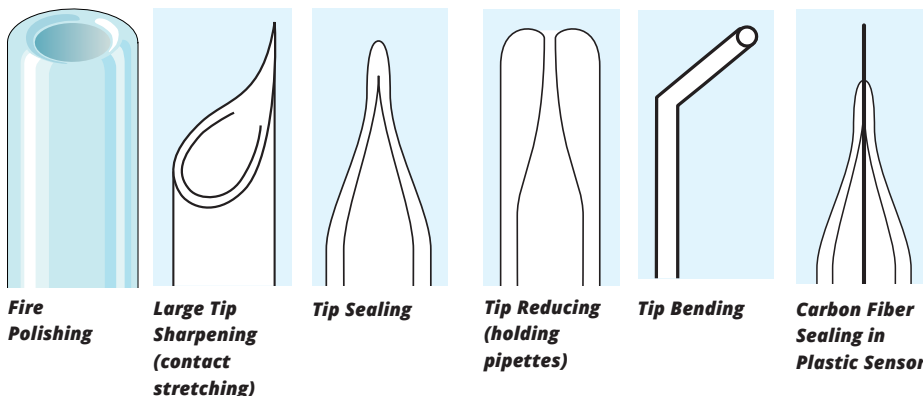
The low heat capacity and low thermal coefficient of linear expansion of the filaments are key design features of the DMF1000. The low

heat capacity of the filament allows it to reach fire-polishing temperatures without excessive heat. This permits the user 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 with the DMF1000 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.

The Pipette and 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 pipettes movement. This configuration also eliminates the need and expense of an additional micromanipulator to control pipette movement.



Fire Polishing

Large Tip Sharpening (contact stretching)

Tip Sealing

Tip Reducing (holding pipettes)

Tip Bending

Carbon Fiber Sealing in Plastic Sensor

Typical applications of the DMF1000

Polishing the Patch Pipettes

It is well known that the 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, since the DMF1000 uses a 40X long-working distance objective, pipette polishing is much more accurately controlled. Pipettes polished using the DMF1000 achieve excellent stable giga-seals with a wide variety of cells. Both whole cell patch pipettes and single channel patch pipettes can be conveniently polished with the DMF1000 to the highest quality and reproducibility achievable with any microforge.

For the single-channel patch clamp pipettes the pipette needs to be pre-coated with Sylgard 184 before polishing. For this procedure the user can follow a simple and effective coating method described previously (Li, 1999)

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.



DMF1000-1	Complete Microforge, incl W30S-LED Microscope (110 v)
DMF1000-2	Complete Microforge, incl W30S-LED Microscope (220 v)
DMF1000-M1	Microforge without microscope (110v)
DMF1000-M2	Microforge without microscope (220v)

*Above DMF1000 microforges include 40X long working distance objective

OPTIONAL ACCESSORIES

500329	25x Long Working Distance Objective, 5 mm 0.50NA
500292	Optional 15x Eyepiece (pair)
13142	Optional foot switch

REPLACEMENT ACCESSORIES

800292	40x Long Working Distance Objective, 3 mm 0.25NA
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

Professional-Grade Microscope

The **W30** 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 anti-fungal coating. The W30 is the choice for superior performance at a great price.



W30S-LED	Binocular Microscope
W30ST-LED	Trinocular Microscope
503513	21 mm 10X Eyepiece with 100/10 reticle

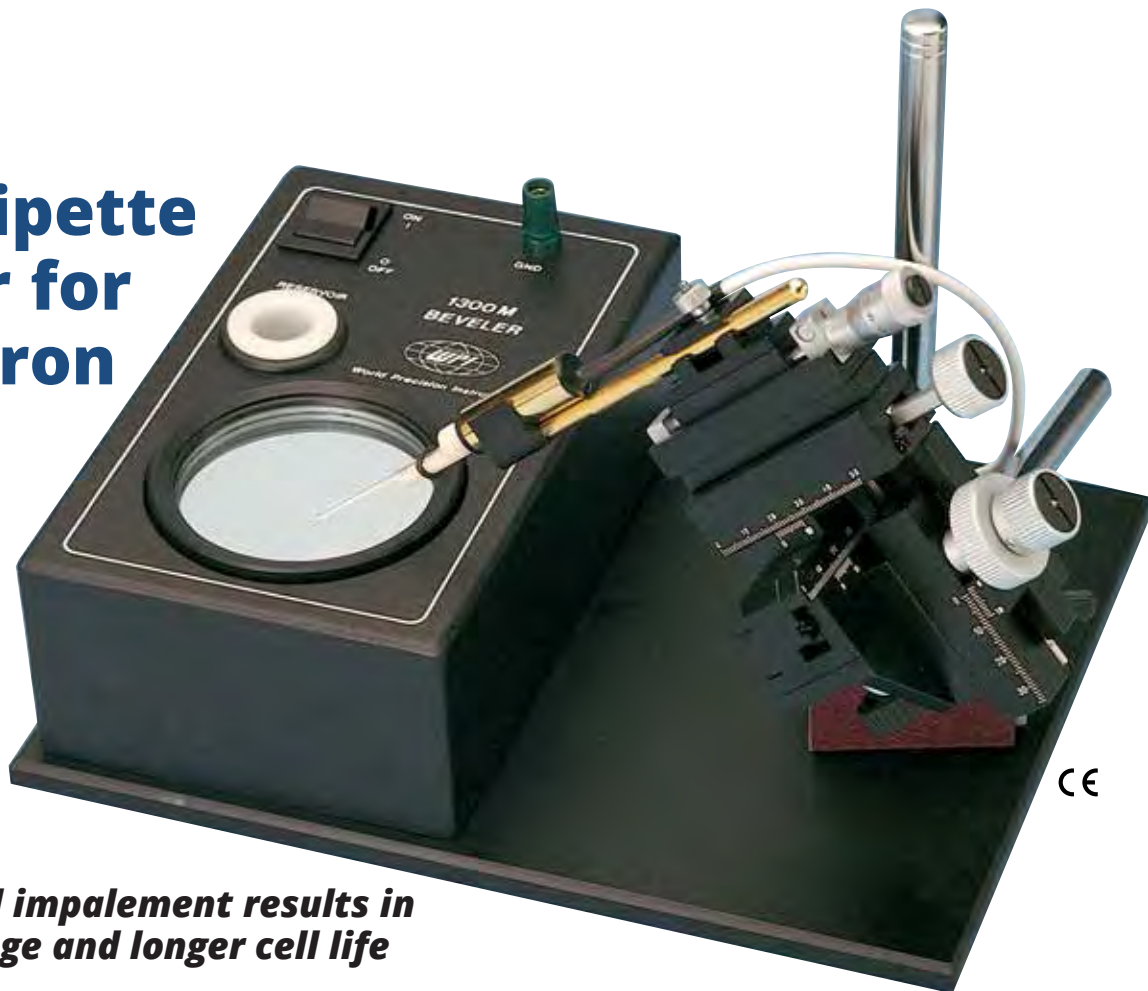
DMF1000 SPECIFICATIONS

AC POWER MODULE	100-240 VAC 50/60 Hz
TIMER RANGE (for heater & timer)	0.01 to 360 sec
NUMBER OF MEMORIES	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. 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 1 7/8 in. (10.2 x 17.8 x 4.8 cm)
SHIPPING WEIGHT	4 lb. (1.8 kg)
MICROSCOPE	W30S-LED (see below)
SHIPPING WEIGHT	16 lb. (7.3 kg)

W30S-LED SPECIFICATIONS

HEAD	Binocular (Seidentopf) Inclined 30°, rotates 360° Dual diopter adjustment, Interpupillary distance range 55-75mm 10X/18 wide field eyepieces
NOSEPIECE	Quadruple forward-facing nosepiece
OBJECTIVES	DIN Plan, anti-fungal 4X, 10X, 40X, 100XR (oil) Parfocal, parcentric, color-coded
STAGE	Mechanical stage (140mm x 140mm) Coaxial drive controls XY Movement: 73mm x 43mm
FOCUS	Coarse adjustment: range of 30mm Fine adjustment: graduation of 2µm Tension control knob
ILLUMINATION	Moveable Abbe condenser, NA 1.25, Iris diaphragm Variable LED light source (3W bulb) 110V/220V switchable electronics
DIMENSIONS AND WEIGHT	15" (38cm) x 9" (23cm) x 7" (17.8cm) (h x l x w) 14 lbs. (6.4kg)

Glass Micropipette Beveler for submicron tips



Easier cell impalement results in less damage and longer cell life

An optically-flat mirrored glass disk, wetted with an abrasive slurry, spins at 60 rpm (120 V), producing sharply beveled tips on fluid-filled glass microelectrodes of one micron or smaller. This eases cell impalement and improves the electrode's linearity. The microelectrode's resistance can be monitored during beveling with WPI's Ω mega-Tip-Z™ megohm meter (see page 81). The beveler is permanently mounted on a precision magnetic plate that gives stable support for the optional 1350M Micropositioner shown. Start-up kit includes 0.05 μ m alumina abrasive powder #3531, wick electrode, and wick support.

Model 1350M Micropositioner — This package (shown with beveler above) includes WPI's M3301R Manipulator and an M10 magnetic stand. The stand-manipulator assembly mounts directly onto the beveler baseplate, allowing convenient positioning of electrodes onto the beveling surface. Three axes of adjustment, including coarse and fine control in the axis of the electrode.

SYS-1300M Microelectrode Beveler & Start-Up Kit
(micropositioner not included)
Specify line voltage.

OPTIONAL ACCESSORIES

2478	Replacement Mirrored Disk
3531	Alumina Abrasive, 0.05 μ m (5 g) fine
3551	Alumina Abrasive, 0.30 μ m (5 g)
2479	Replacement "O" Ring
SYS-OMEGAZ	Ω mega-Tip-Z with Probe & Holder
1350M	Micropositioner (M3301R) and M10 Magnetic Stand
711P	Replacement Probe
5468	Adapter to connect metal microelectrodes to probe, 2 mm socket to .031 in. receptacle
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)
500186	Bifurcated Light Guide with lenses
Z-LITE-186	Z-Lite Illuminator & Bifurcated Light Guide
Z-LITE-Z186	Z-Lite Illuminator & Bifurcated Light Guide

MES Microelectrode Beveler System
MES includes: 1300M Microelectrode Beveler; 1350M Micropositioner & Magnetic Stand; OmegaZ; 5052 Steel Base Plate; 5468 Adapter; 3485 Ringstand Mount. Shipping Weight: 59 lb. (27 kg)

1300M SPECIFICATIONS

BEVELING SURFACE	7.8 cm diameter, optically flat reflective glass
MAXIMUM BEVEL	0.5 μ , I.D.
ALUMINA ABRASIVE POWDER	0.05 μ size supplied (0.3 μ also available)
RPM	60 rpm at 120 V, 60 Hz; 50 rpm at 240 V, 50 Hz
MOTOR	AC synchronous
POWER REQUIREMENTS	95-135 V or 220-240 V, 50/60 Hz
DIMENSIONS	
Steel base plate	8.5 x 11 x 0.375 in. (22 x 28 x 1 cm)
Overall height	4 in. (10 cm)
Height of abrasive surface	2.75 in. (7 cm) above base plate
SHIPPING WEIGHT	20 lb (9.1 kg)

The only microbeveler system *with Guided Light!*



Illuminator in photo differs from actual Z-LITE included with system. See page 145.

System now includes PZMIII stereo microscope

Bevel micropipette tips larger than 1 micron, for applications such as microinjection

- Tool holder on microscope keeps pipette in focus during beveling
- Steel base provides solid support for beveler and other magnetic stands
- Includes stereo zoom microscope PZMIII with up to 90x magnification
- Variable speed, reversible
- Abrasive surface can be easily replaced by several types of Diamond and Alumina Lapping Film
- Pipette tip illuminated internally via fiber optic illuminators

The advantage of WPI's MicroBeveler over other types of solid-surface bevelers is that the abrasive surface can be easily refreshed. Instead of using a conventional solid abrasive disk, the MicroBeveler abrasive surface is made of a high quality lapping film, widely used in the fiber optics industry. When the surface is damaged or loaded up with glass particles, the abrasive film can be easily replaced.

The solid polishing surface of WPI's new MicroBeveler, turning at 5,400 rpm, provides sufficient cutting force for a very sharp tip in a very short time. The cutting surface is very flat and turns very smoothly, ensuring an undamaged tip.

48000 SPECIFICATIONS

BEVELING SURFACE	3.5 inch diameter disk
ABRASIVE MATERIAL	alumina, diamond
SPEED OF ROTATION	100 to 5,400 rpm
MOTOR	Reversible Direction
POWER REQUIREMENTS	120 volts, 60 Hz or 240 volts, 50 Hz, 20 VA to supplied power supply
DIMENSIONS	
Base Plate	8.7 x 11 x 0.4 in. (22 x 28 x 1 cm)
Overall Height	3 in. (8 cm)
SHIPPING WEIGHT (48000)	16 lbs. (7.6 kg.)
SHIPPING WEIGHT (MBS)	35 lbs. (16 Kg.)

MBS	MicroBeveler System
<i>Includes 48000 MicroBeveler, Z-LITE illuminator, fiber optic cable, PZMIII Stereo Zoom Microscope with tilting base especially adapted for use with MicroBeveler, two clear 20x eyepieces, one 20x eyepiece with reticle, tool holder, and pipette holder FOIMPH.</i>	

SYS-48000	MicroBeveler
Specify line voltage	

OPTIONAL ACCESSORIES	
48015-03	Lapping Film, Alumina, 0.3 micron (50-pack)
48015-10	Lapping Film, Alumina, 1 micron (50-pack)
48015-30	Lapping Film, Alumina, 3 microns (50-pack)
48014-01	Lapping Film, Diamond, 0.1 micron (3-pack)
48014-05	Lapping Film, Diamond, 0.5 micron (3-pack)
48014-10	Lapping Film, Diamond, 1 micron (3-pack)
48014-30	Lapping Film, Diamond, 3 microns (3-pack)
48025	Fiber Optic Cable for Pipette Illumination
15934	Replacement Beveler Disk Plate
48300	Tilt Base Assembly for PZMIII binocular head
48200	PZM Tool Holder

Microprocessor-Controlled 4-Step Micropipette Puller

NEW!



**Program sequences up to four steps
Produce micropipettes with a tip diameter
less than 0.1µm or greater than 10µm**

- Store up to 30 programs in memory**
- Two factory programs installed**
- Tempered glass cover to reduce the effects of humidity on puller reproducibility**
- Switchable power supply ensures that line voltage fluctuations don't affect reproducibility**

PUL-1000 SPECIFICATIONS

HEATER ELEMENT.....	Platinum/Iridium
PULLING FORCE	Solenoid, adjustable
CAPILLARY OD RANGE	1.0–1.5mm
MAXIMUM CAPILLARY LENGTH	170mm
MINIMUM CAPILLARY LENGTH.....	55mm
MEMORY SETS.....	30
POWER	90–240VAC, 50/60 Hz
DIMENSIONS	34 x 24 x 12cm
SHIPPING WEIGHT	15 lb
REPLACEMENT FILAMENTS.....	2.5 mm Square Box Filament, 2.5 mm wide (# 13834)

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 tighter 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.

Construction

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

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 240VAC.

PUL-1000	Micropipette Puller	\$3595
13834	Replacement Filaments	\$35

Microprocessor real-time controlled system performs programmable multipulling steps, optical-digital measurement and precise digital feedback heating control to achieve exceptional repeatability.



Programmable Multipipette Puller

- **Produces two identical pipettes every time**
- **25 saved programmable sequences**
- **Optical-digital measurement**
- **22 manufacturer preset sequences**
- **Pull patch clamping pipettes, intracellular electrodes, injection micropipettes and micro-needles**
- **Pneumatic pressure (instead of gravity or magnetic fields) yields consistent pulling force**

The **PMP-102** is a microprocessor controlled pipette puller. The **PMP-102** is designed to pull a pipette horizontally to produce two identical micropipettes. Different kinds of pipettes can be pulled repeatedly using the preset program sequences. You can create your own patch clamp electrodes, intracellular electrodes, injection micropipette and micro-needles using preset sequences.

Exclusive Optical-Digital Taper Measurement

Instead of the mechanical tip length setting like other pipette pullers, there is an exclusive optical-digital ruler in the **PMP-102** to apply precise taper length settings, and for real-time measurement and control. With

this feature, you can handle taper pulling precisely and easily. Equipped with a powerful computerize tip sensing function, the puller can automatically finish the tip pulling. You can pull the ideal tip every time.

Computerize Real-Time Feedback Heater Control

The **PMP-102** includes an advanced microcontroller to perform real-time heater monitoring and control. When you select a heating level, the microcontroller measures the actual heating power applied during a pull. The real-time measurement is displayed, and the feedback to the control unit dynamically adjusts the power to match your setpoint. As a result, the puller always provides precise heating power, despite variables like thermal/electrical changes. When the heating level is set to AUTO, the heater automatically determines the melting point for different glass pipettes. The microcomputer control ensures smart, reliable heating.

Programmable, Savable Sequences

There are 25 manufacturer/user programmable pulling sequences with 18 steps in each sequence. You may easily program different pipette tip sizes, tip lengths and tip shapes in different sequences for a variety of applications. Time and length count, heat level, heat control and action parameters can be individually set in each step.

Pneumatic Pulling Force and Compact Size

Other pipette pullers use gravity or magnetic fields as the pulling force. The **PMP-102** applies precisely controlled pneumatic pressure as the pulling force, which gives more control, plus even and consistent dragging characteristics. With double horizontal pulling, the **PMP-102** can pull two identical injection tips or microelectrode tips at the same time. The **PMP-102** is compact, requiring little bench space. And, it precisely and automatically performs multi-step pulling without manual interruption. A precision micro-linear ball bearing rail and advanced pneumatic components are used to provide no fault pulling movement. A simple 4x4 keypad and a full information display LCD let you easily control and monitor the pulling parameters directly. Parameters include sequences, steps, time, timing, heater level, heater control, tip length and actions. The heater power control and action time count up or down in real-time on the display.

With the versatility of the intelligent **PMP-102**, pulling an ideal micropipette is no longer an uncertainty of hand skill, but a reproducible, automatic process.

Preset Programs

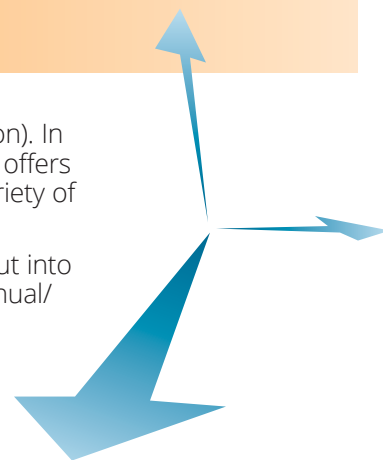
The **PMP-102** pipette puller is well tested and comes with pre-installed programs. The User Manual includes sample pictures along with the characteristics of the pipettes you can expect from each program. Select your sequence and press START. Save time and money by using presets. If you can't find exactly what you need in the presets, you can use the presets as templates for creating new programs.

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 and Motorized.

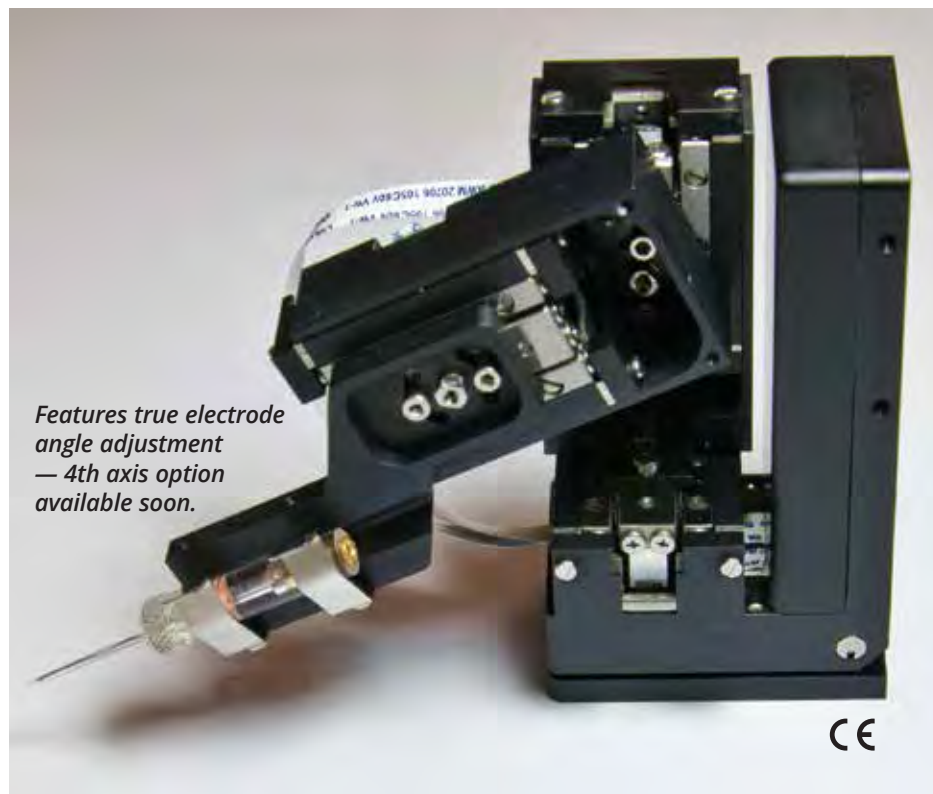


Micromanipulator	Manual or Motorized	Resolution	Travel	Stands	Tilt Base	Piezo Translator	Notes
SN-PZ-50	Motorized	0.5 μm resolution 30nm min. step					
SM325	Motorized	25nm/step 40,000 steps/rev	25mm (3 axes)	M9, M10, M10L, 501622, 501623	TBS, M-3		Use MCL3 Controller
DC3001*	Manual/ Motorized	Motor-0.5 μm Manual-0.1mm	Motor-10mm (3 axes) Manual- X: 37mm Y, Z: 20mm	M9, M10, M10L, 501622, 501623	TBS	MPM10 MPM20 (with STM3 joystick)	Controller is required. Options: • MS314 (DC3314) • MPM10 • MPM20 with STM3 joystick
HS6-3	Manual/ Motorized	10nm/step	25mm (3 axes)				Use MCL3 Controller
M3301*	Manual	0.01mm (X fine) 0.1mm (X,Y, Z)	X(fine): 10mm X: 37mm Y: 20mm Z: 25mm	M9, M10, M10L, 501622, 501623	TBS, M-3	MPM20	
KITE	Manual	0.1mm	X(fine): 10mm X: 35mm Y,Z: 20mm	M9, M10, M10L, 501622, 501623	TBS, M-3		
M325	Manual	10 μm	X: 25mm Y,Z: 10mm	M9, M10, M10L, 501622, 501623	TBS, M-3		
MMJ	Manual	0.1mm	X: 37mm Y: 20mm Z: 25mm	M9, M10, M10L, 501622, 501623	TBS, M-3		Joystick control
MD4	Manual	10 μm (X fine) 100 μm (X,Y, Z)	X(fine): 10mm X: 37mm Y: 20mm Z: 25mm	M9, M10, M10L, 501622, 501623	TBS, M-3		Holds two electrodes
HS6	Manual	5 μm	25mm (3 axes)				
MM3-3	Manual (mini)	1.5 μm	13mm				340g load
MM1-3	Manual (mini)	1.0 μm	3mm				225g load

Smallest micromanipulator features full 20 mm of piezo-movement in all axes!

- **Ultra-stable and precise electrode positioning**
- **Smooth movement with minimal vibration**
- **Penetration mode with high acceleration single steps**

- **Back-flip mechanism for easy electrode exchange**
- **Powered off in standby for zero noise interference**
- **Ergonomic controller can operate up to 14 manipulators**



Features true electrode angle adjustment — 4th axis option available soon.



SN-PZ-50 SPECIFICATIONS

SN-PZ-50 MICROMANIPULATOR

POSITIONING RANGE	20x20x20 mm3 (x-y-z)
MINIMUM STEP SIZE	30 nm
CLOSED-LOOP CONTROL	0.5 µm resolution and 3 µm repeatability for absolute position
MAXIMUM SPEED	~3 mm/s
MAXIMUM LOAD	200 g*
TABLE MOUNTING	magnet or bolt
ELECTRODE DRIVE ANGLE	0 - 35 deg
BACK-FLIP MECHANISM	
DIMENSIONS**	32x40x80 mm
WEIGHT**	260 g

SN-PCZ CONTROL UNIT

Backlit display	
Three rotary knobs with optical encoders	
Can operate up to 14 micromanipulators*	
Two memory positions for each micromanipulator	
DIMENSIONS	190 x 210 x 40 mm
WEIGHT	510 g
AC POWER	110-240 V; 50-60 Hz
*1-to-8 connector hubs available for connecting more than two manipulators	

*Load balancing options available for loads exceeding 50 g

**Dimensions and weight without head-stage or electrode holder adapter; axis in initial positions

SN-PCZ-50L	Miniature Piezo Micromanipulator (left-hand version) and Controller
SN-PCZ-50R	Miniature Piezo Micromanipulator (right-hand version) and Controller

SN-PZ-50L	Miniature Piezo Micromanipulator (left-hand version)
SN-PZ-50R	Miniature Piezo Micromanipulator (right-hand version)

Specify line voltage

Battery-operated control unit with rotating knobs and information display. Push buttons allow easy speed adjustment and operation of memory positions. Double-curved profile provides good ergonomics and operation of rotating knobs without moving hand.



Joystick controller also available.

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 Diameter	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)

502102

Non-Rotating Spindle Micrometer Head

Universal Manipulator Stand



Universal Micromanipulator Stands enable scientists to mount their manual and motorized micromanipulators at variable angles and heights. A solid aluminum platform with a grooved tower allows the user to attach any micromanipulator of any size or shape to the post for infinite flexibility. Once mounted, the micromanipulator can be set at any height along the entire length (30 cm or 45 cm). The platform base comes configured with industry standard pre-bored holes (1/4-20 x 1" or M6 x 25 mm), allowing direct mounting to any type vibration-free table (for patch clamp recordings) or optical bench (for laser and optical measurements).

Using additional Rotation Clamps (one included with stand), two or more micromanipulators can be mounted on the stand simultaneously in a space-saving convenient manner. WPI's Universal Stand not only allows the user 360° flexibility in manipulations but also promotes independent angular transitions using a single feather-light tensioner/adjustment screw. This affordable stand is currently the *preferred* choice in micromanipulator stands — head and shoulders above set-ups using multiple magnetic-based stands costing hundreds more when combined with antiquated heavy steel base plates.

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) Matrix M6 x 25mm grid (2 bolts supplied)
SHIPPING WEIGHT	501622 9 lbs (4 kg) 501623 11 lbs (5 kg)

501622	Universal Micromanipulator Stand 30 cm (includes one clamp)
501623	Universal Micromanipulator Stand 45 cm (includes one clamp)
501624	Additional Rotation Clamp
VFP	Vibration-Free Platform (24"x30")

Vibration-Free Workstation — see page 137

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

Vibration-free Platform (VFP) not included

World Precision Instruments

www.wpiinc.com

MICROMANIPULATORS

High speed penetration and precise control

The piezo-ceramic element in WPI's **MPM10** provides high penetration speed over an extremely short distance (0.5 to 10.0 μm). Because the range of travel of a dedicated piezomanipulator is much too limited for it to be useful independently, it must be mounted on a manipulator. The MPM-10 piezo translator combined with a **DC3001** motorized micromanipulator (available separately) provides a single electronically controlled system.

When the piezo element is activated, the MPM-10 axis carrying the micropipette shoots forward at a rate which is set on the control panel, then immediately returns (at a slower speed) to its starting position. As soon as the piezo element begins its reverse travel, the motorized manipulator starts to travel forward. The complimentary opposition of these two travel sequences results in the micropipette tip remaining in its advanced absolute position.

The three axes of the DC3001 are controlled by six buttons. Pressing a button for less than 0.3 seconds activates one step, the size of which (0.5 to 10.0 micron) is set on the Step Size control. Pressing longer activates the continuous mode, at the rate set on the Motor Speed control. Pressing the button for the X axis forward direction activates the piezo mode. Advancement speed of the piezo element can be separately adjusted from 1 to 100 mm/sec.

Precise construction and special vibration stabilizers ensure the MPM-10's excellent

MPM10 Piezo-Translator



Adapter MPH8 allows use of WPI electrode holders!



DC3001 micromanipulator and M-3 tilting base not included.

puncture characteristics. Lateral deviation from the ideal axis of puncture (measured at the tip of the electrode holder) is $\pm 5\%$ of the step size.

Includes controller, piezo translator, electrode holder, cables and mounting bracket. Shipping weight: 6 lb (2.7 kg).

SYS-MPM10	Piezo Controller for DC3001 Motorized Micromanipulator
PM5	Remote Controller for MPM-10
PM6	Replacement Electrode Holder for MPM10
14104	Record/Inject Electrode Holder for MPM10, MPM20
MPH8	Electrode Holder Adapter for MPM10 & MPM20
M-3	80° Tilting Base 6mm x 1mm screw (Shipping Weight: 2 lb)

Specify line voltage



Adapter MPH8 allows use of WPI electrode holders!

MPM20



Piezo Translator

For use with M3301 and DC3001 micromanipulators

Especially recommended for use with the M3301 micromanipulator, the MPM20 is a very efficient tool for intracellular injection. High penetration speed and precise axial advance allows injection pipette to be brought to its target position with tremendous accuracy. Lateral escape of the cell is almost eliminated, and even tough membranes can be penetrated. Independently selectable reverse speed setting can be used for fast withdrawal, preventing adhesion of the injected cell to pipette tip. Mounts directly onto DC3001 and M3301 micromanipulators. **Use with DC3001 requires MS314 controller** (for the micromanipulator).

The combination of the MPM20, a micromanipulator, and the **PV820 PicoPump** (see page 180) constitutes an extremely efficient system for intracellular injection; cell penetration, injection and withdrawal are executed automatically with the press of a button.

Shipping weight: 10 lb (4.5 kg).

SYS-MPM20	Piezo Translator
PM7	Replacement Electrode Holder for MPM20
14106	Footswitch for MPM20

Specify line voltage

Micromanipulator not included.

Programmable High Precision Motorized Micromanipulator suitable for patch clamp and IVF

WPI introduces a compact high precision motorized micromanipulator (SM325). It features low noise, high stability, a user-friendly software interface and economy that are major concerns in IVF and patch clamp research.

The SM325 is driven in all three axes through high resolution stepping motors, which can achieve 40,000 steps per revolution (25 nm/step) with completely vibration-free motion. In a normal lab environment, it can stay localized overnight without drifting. The 25mm long range of travel makes it unnecessary to have an additional manual coarse adjustment.

Its compact construction makes mounting onto the stage plate of a microscope practical. The x-axis can be tilted by 90° that allows for a better positioning of the injection tool. An additional tilting fixture makes it possible to tilt the tool holder for fast and easy cleaning and exchange of the injection tool.

The MCL3 controller features a dynamic micro-step function that makes very quick positioning possible with maximum accuracy. Motor control is achieved with a linear output amplifier, which also drastically reduces electronic noise. Users can control the micromanipulators by joystick, keyboard, mouse or computer. The user-friendly software program can be enabled to remember up to 999 position coordinates from previous procedures and can robotically repeat this same positioning sequence.



SM325 SPECIFICATIONS

CONTROL METHOD	Joystick, software, or both
TRAVEL DISTANCE	25 mm each axis
RESOLUTION	25 nm/step or 40,000 steps/rev
MAXIMUM SPEED	4 mm/second
POWER SUPPLY	120/240V, 50/60Hz
DIMENSIONS	
SM325-M	5x7x5.5 in. (13x18x14 cm) (WxLxH)
MCL3	9.8x9x3.7 in. (25x23x9.5 cm) (WxLxH)
SHIPPING WEIGHT	
SM325-M	6 lb. (2.7 kg)
MCL3	11 lb. (5 kg)

SM325 High Resolution 3-D Motorized Micromanipulator (SM325-M) & Controller (MCL3)

SM325-M High Resolution 3-D Motorized Micromanipulator
MCL3 Controller with Joystick and software for SM325-M

OPTIONAL ACCESSORIES

M3301EH Replacement Electrode Holder, straight, 14cm

15873 Angled Electrode Holder, 13 cm long

501622 Universal Micromanipulator Stand, 30 cm high

501623 Universal Micromanipulator Stand, 45 cm high

VFP Vibration-Free Platform

Vibration-Free Workstation — see page 143

Programmable Ultra High Precision Motorized Micromanipulators

M3301EH Electrode Holder included

HS6-3

The HS6-3 is supplied with manual controls and stepper motor drives in all 3 axes. The extremely solid construction eliminates the vibrations and drifts. With the utmost precision and long travel distance in all three directions, HS6-3 is the ideal tool for patch-clamp or electrophysiological applications. The tilting device is mounted on the base plate serves as coarse height adjustment as well and the tool holder can be swiveled in all directions.

The MCL3 controller features a dynamic micro-step function that makes very quick positioning possible with maximum accuracy and free of vibration. Motor control is achieved with a linear output amplifier, which also drastically reduces electronic noise. Users can control the micromanipulators by joystick,

keyboard, mouse or computer. The user-friendly software program can be enabled to remember up to 999 position coordinates from previous procedure and can robotically repeat this same positioning sequence.

HS6-3 SPECIFICATIONS

CONTROL METHOD:	Joystick, software, or both
TRAVEL (X-Y-Z):	25 mm
RESOLUTION:	10 nm/step
MAXIMUM SPEED:	4.5 mm/sec.
STABILITY:	1 nm/hour at 24°C
POWER SUPPLY:	120/240 V, 50/60 Hz
DIMENSIONS:	
HS6-3:	6.1x9.7x9.9 in (15.5x24.6x25 cm) (WxLxH)
MCL3:	9.8x9x3.7 in (25x23x9.5 cm) (WxLxH)
WEIGHT:	
HS6-3:	13.2 lb. (6kg)
MCL3:	7.7 lb. (3.5kg)

HS6-3 High Resolution Motorized HS6 Micromanipulator and Controller

includes HS6-3M and MCL3

HS6-3M High Resolution Motorized HS6 Micromanipulator MCL3 Controller with Joystick and software for HS6-3M

OPTIONAL ACCESSORIES

M3301EH	Replacement Electrode Holder, straight, 14cm
15873	Angled Electrode Holder, 13 cm long
501622	Universal Micromanipulator Stand, 30 cm high
501623	Universal Micromanipulator Stand, 45 cm high
VFP	Vibration-Free Platform

Vibration-Free Workstation — see page 143

DC3001

The DC3001 is the popular, high-precision manual/motorized micromanipulator. With 0.5µm resolution, it can be used with an optional joystick or an

MS314 controller. (With the controller, it is sold as **SYS-DC3314**.) It can be mounted on the TBS tilt base but is too heavy for the M-3 tilt base. When performing intracellular microinjection, the DC3001 can be used with the MPM10 or MPM20 piezo translators.

Manual coarse controls use cross roller bearing slides. Vernier scales allow readings to 0.1 mm. All controls are closely grouped so adjustments can be made in any plane with minimum effort. The DC3001 features DC motor drives and fine control micrometers in all three axes. Left- or right-handed versions of the DC3001 are supplied with a standard 12 mm clamp. Standard accessories provided include one microelectrode holder and a securing bolt and wrench.

The sophisticated MS314 Controller allows control of all three axes. Movements may be continuous through the use of cross switches, or the controller can cause the DC3001 to step in defined increments. Steps as small as 0.5 µm are possible. A popular joystick controller, STM3, allows control of the X, Y and Z axes.

If the MPM10 piezo system is used, it replaces the MS314 controller. This configuration moves the motor forward as the piezo retracts, keeping the micropipette in the penetrated cell. When using the MPM20, the MS314 is necessary as the DC3001 motor controller because the MPM20 controls only the piezo element. The MS314 and MPM20 do not interact with each other.

SYS-DC3314R Manipulator (right-handed) & MS314 Controller

SYS-DC3314L Manipulator (left-handed) & MS314 Controller

Specify line voltage.

System components also available separately:

DC3001R Motorized Manipulator, right-handed

DC3001L Motorized Manipulator, left-handed

SYS-MS314 Controller for DC3001

STM3 Joystick Controller for DC3001

OPTIONAL ACCESSORIES

TBS Tilt Base with Screw Adjustment

PM5 Remote controller for MS314 and MPM-10

5464 5-lb Weight for Tilting Base (shipping weight: 7 lb [3 kg])

M4C Microscope Stage Adapter

M3301EH Replacement Electrode Holder (14 cm long)

15873 Angled Electrode Holder (13 cm long)

501607 Cable for MS314 and DC3001



MCL3-HS6



15873 Electrode Holder not included

TBS Tilt Base not included

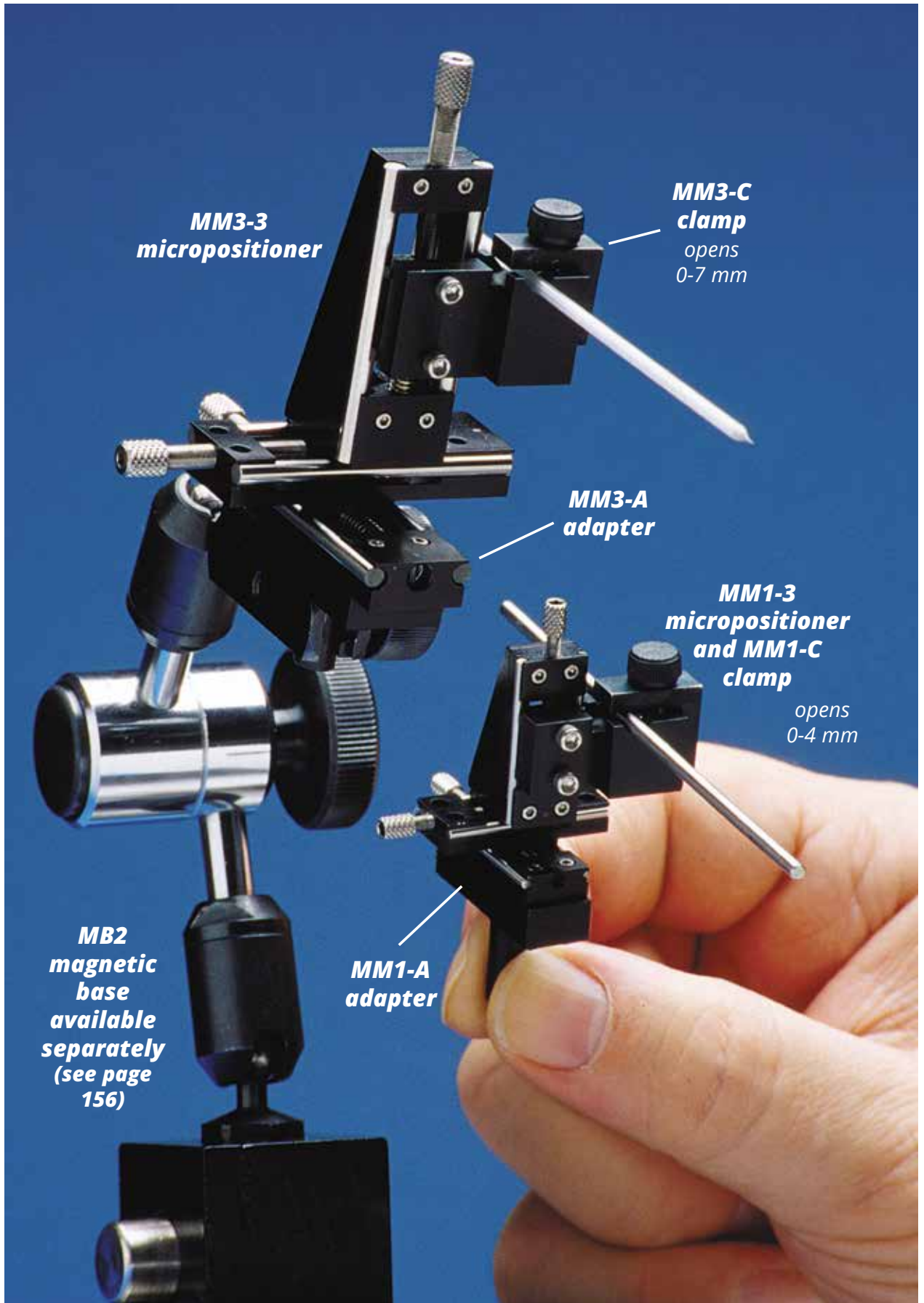
MS314 Controller

STM3 Controller (available separately) →

DC3001 SPECIFICATIONS

	TRAVEL RANGE	RESOLUTION	
MANUAL:	X-axis 37 mm	0.1 mm	
	Y-axis 20 mm	0.1 mm	
	Z-axis 20 mm	0.1 mm	
MOTORIZED:	TRAVEL RANGE	RESOLUTION	MAXIMUM SPEED
	X-axis 10 mm	0.5 µm	0.2 mm/sec
	Y-axis 10 mm	0.5 µm	0.2 mm/sec
Z-axis 10 mm	0.5 µm	0.2 mm/sec	
SHIPPING WEIGHT:			
	DC3001:	3 lbs (1.4 kg)	
	MS314:	1.8 lbs (0.9 kg)	
	STM3:	2.8 lbs (1.3 kg)	

Miniature Micropositioners



**MM3-3
micropositioner**

**MM3-C
clamp**
opens
0-7 mm

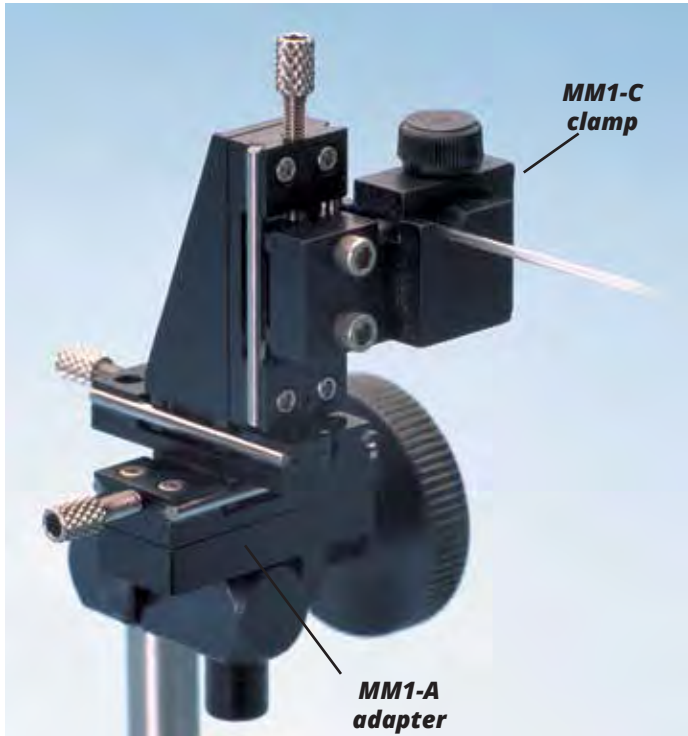
**MM3-A
adapter**

**MM1-3
micropositioner
and MM1-C
clamp**

opens
0-4 mm

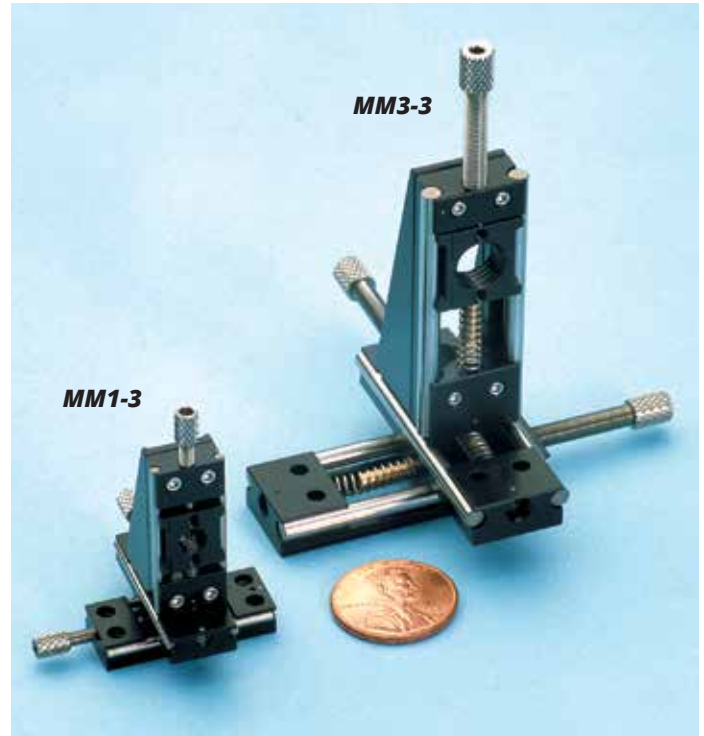
**MB2
magnetic
base
available
separately
(see page
156)**

**MM1-A
adapter**



Mini Micropositioner (MM1 and MM1-3)

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 micron and less than 1 micron 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), X-Y, and X-Y-Z (MM1-3) axis configurations.



Micropositioner (MM3 and MM3-3)

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 microns, and less than 1.5 microns maximum wobble. Features fine 80 TPI screw adjustment. 13 mm square mounting surface has a 7 mm tapped center hole for transmission and/or mounting. Available in single X (MM3), X-Y, 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 micron over 3 mm travel	Within 1 micron over 3 mm travel	Within 1.5 micron over 13 mm travel	Within 1.5 micron 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 grams/axis	12 grams/axis	14 grams/axis	48 grams/axis
TYPE	Fine Screw	Fine Screw	Fine Screw	Fine Screw
TRAVEL	3 mm	3 mm	13 mm	13 mm

- 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

KITE



Economy Manual Micromanipulator

Vernier scales allow readings to 0.1 mm. X-axis fine control allows readings to 10 μ m.

Left- or right-handed versions of the KITE micromanipulator are supplied with a standard **12 mm clamp** and **electrode holder**

M3301EH.	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

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
SHIPPING WEIGHT	3 lbs (1.4 kg)	

OPTIONAL ACCESSORIES

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

Also see magnetic stands.

M3301 Manual Micromanipulator

The world's most widely used micromanipulator

Weighing just 550 grams 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 250x. 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 microns.

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



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

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

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
SHIPPING WEIGHT	3 lbs (1.4 kg)	

Here's a new angle.

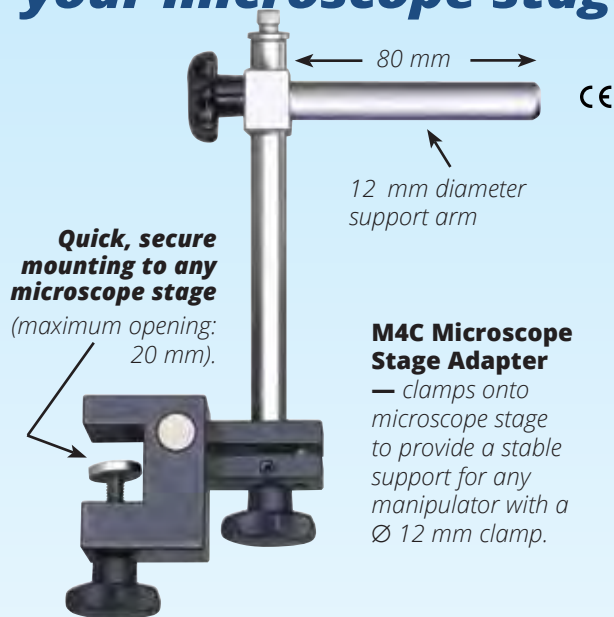


Ball-joint holder attachment



- 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

Mount a manipulator on your microscope stage

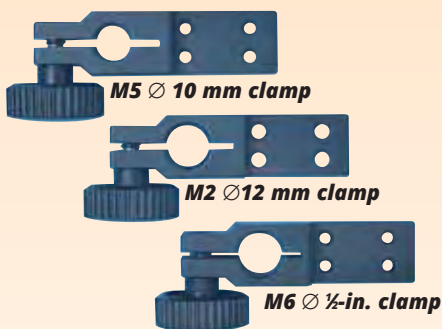


Quick, secure mounting to any microscope stage
(maximum opening: 20 mm).

M4C Microscope Stage Adapter — clamps onto microscope stage to provide a stable support for any manipulator with a Ø 12 mm clamp.

M4C Microscope Stage Adapter

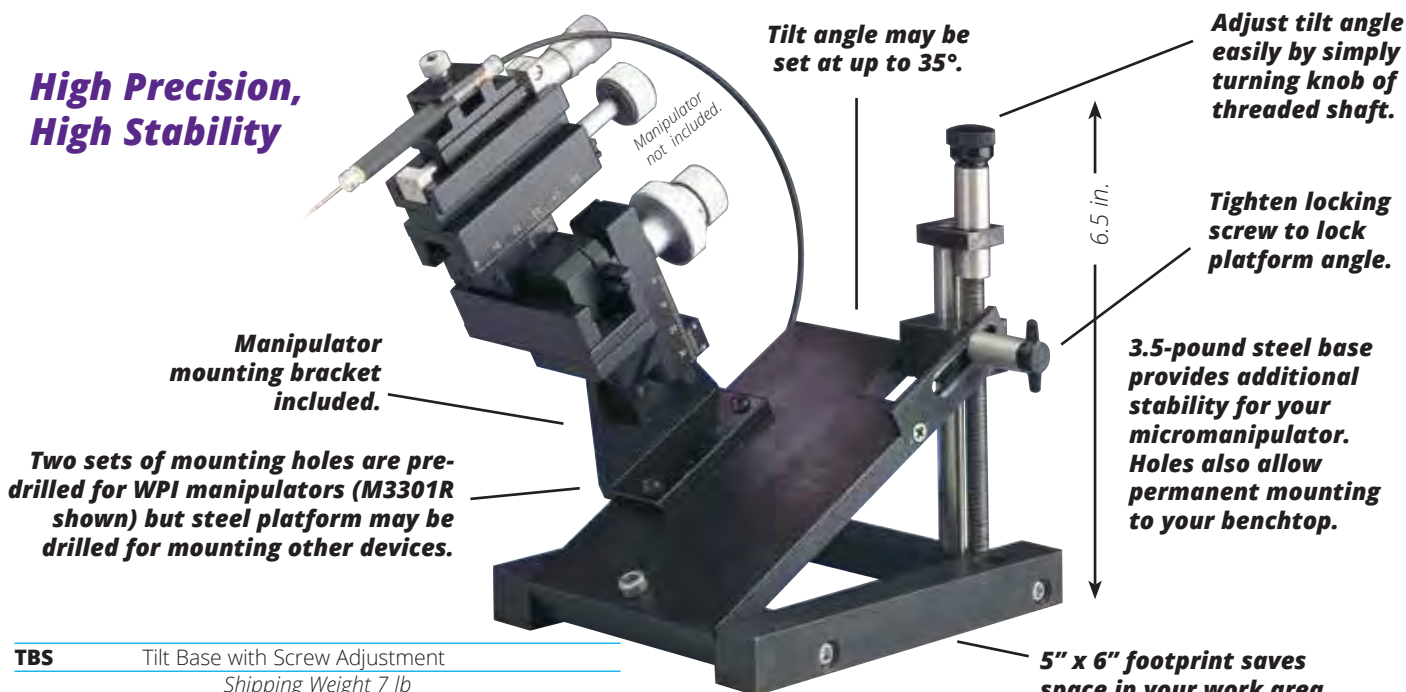
Interchangeable clamps allow manipulators to be mounted on a variety of supports.



M2	Ø 12 mm Clamp
M5	Ø 10 mm Clamp
M6	Ø 1/2-in. Clamp

At last — a tilt base you can operate with one hand!

High Precision, High Stability



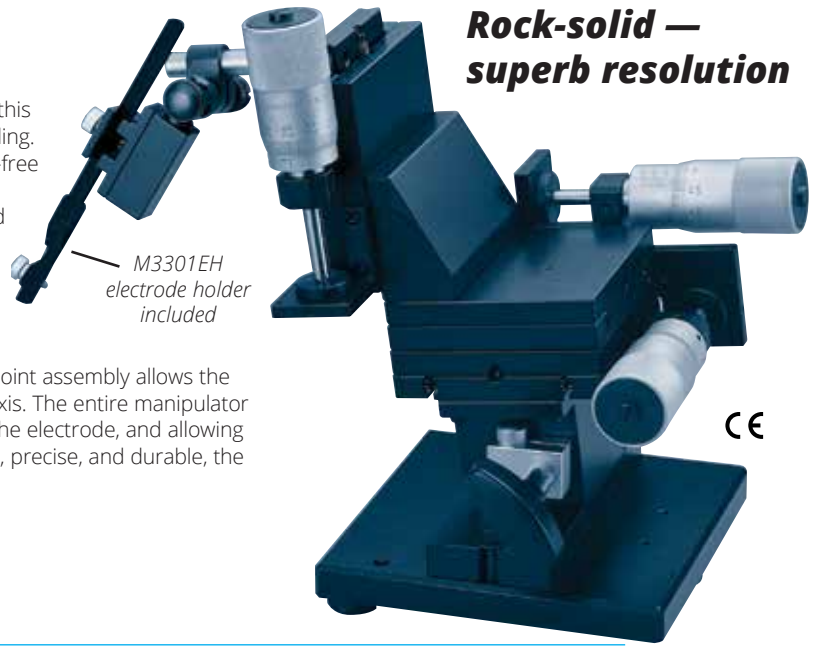
TBS Tilt Base with Screw Adjustment
Shipping Weight 7 lb

5" x 6" footprint saves space in your work area.

High Resolution Manual Micromanipulators

HS6 Micromanipulator

Engineered for stability, and built on a twelve-pound steel plate, this instrument is chosen worldwide for high resolution micro-recording, such as patch clamping, and other research requiring solid, drift-free performance. A superior tool in its own right, HS6 serves equally well as a base for other precision microdrives. HS6 can be bolted directly to a lab fixture or vibration-free platform. Resolution is extremely high — each graduation on its large micrometer barrels indicates just 5 micron movements. Rack and pinion drive, V-shaped guideways, and cross roller bearings give sure, repeatable movements without sideplay, slipping, or sticking. All contact parts are milled of hardened steel. A flexible ball-joint assembly allows the electrode to be positioned at any angle relative to the x, y, or z axis. The entire manipulator tilts forward to 25 degrees allowing rapid coarse adjustment of the electrode, and allowing cell penetration along the axis of any of the micrometers. Simple, precise, and durable, the HS6 will provide years of dependable performance.



Rock-solid — superb resolution

HS6 SPECIFICATIONS

	TRAVEL RANGE	RESOLUTION
X-axis	25 mm	5 μ m
Y-axis	25 mm	5 μ m
Z-axis	25 mm	5 μ m
SHIPPING WEIGHT	25 lbs (11 kg)	
DIMENSIONS	9.9 x 6.6 x 9.9 in. (H x W x L)	

SYS-HS6	Micromanipulator
M3301EH	Replacement Electrode Holder (14 cm x \varnothing 7.2 mm)
15873	Optional Angled Electrode Holder (13 cm long)
VFP	Vibration-Free Platform

Vibration-Free Workstation — see page 143

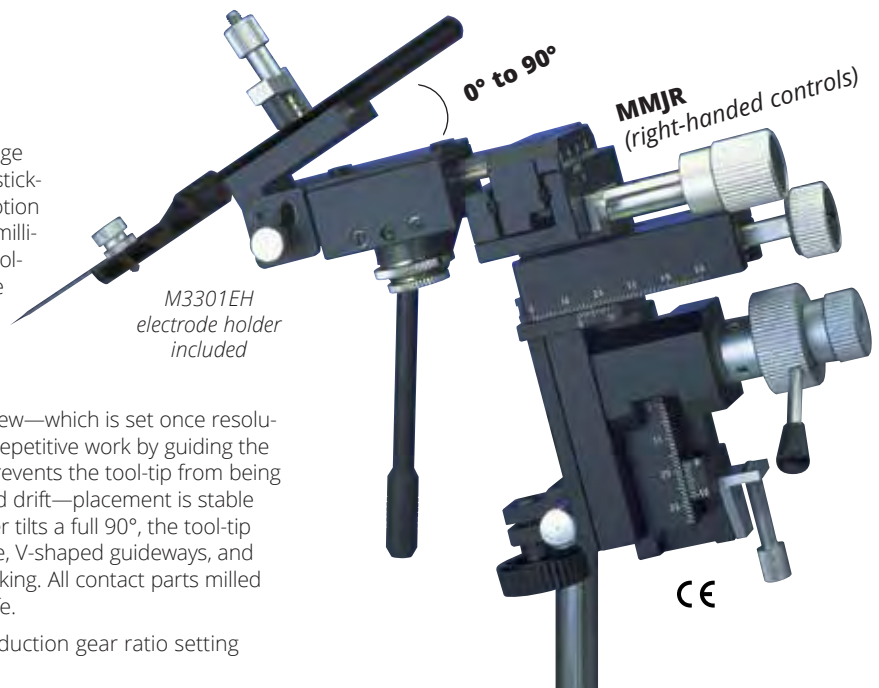
Joystick-Controlled Micromanipulator

Specially adapted for use with the **Nanoliter Injector** (page 186) for oocyte injection and similar applications, this joystick-controlled micromanipulator allows an easy “steering” motion that translates normal hand movement into smooth submillimeter shifts. Viewed microscopically, movement of the tool-tip corresponds naturally to hand movement, so accurate resolution is intuitive and quick. All fine adjustment can be controlled by the joystick. Pivoting forward, backward, or laterally gives precise x-y adjustment. For added convenience, a separate coarse control lever is also provided for quick raising and lowering. A stop screw—which is set once resolution is achieved—eliminates refocusing and streamlines repetitive work by guiding the tip to its previous focussing plane. The stop screw also prevents the tool-tip from being broken during sudden lowering and eliminates downward drift—placement is stable enough for even extended use. Because the probe holder tilts a full 90°, the tool-tip pivots easily for precise positioning. Rack-and-pinion drive, V-shaped guideways, and cross roller bearings eliminate backlash, slipping, and sticking. All contact parts milled from hardened steel for precise performance and long life.

Joystick travel: 0.35 mm to 3.5-mm, depending on reduction gear ratio setting (adjustable between 1:15 and 1:150).

MMJR	Joystick Micromanipulator (Right-Handed)
MMJL	Joystick Micromanipulator (Left-Handed)
OPTIONAL ACCESSORIES	
M3301EH	Replacement Electrode Holder (14 cm X \varnothing 7.2 mm)
15873	Angled Electrode Holder (13 cm long)
M4C	Microscope Stage Adapter
500475	Ball Joint, 7 cm long, for \varnothing 8 mm Holder
500476	Ball Joint, 4 cm long, for \varnothing 4 mm Holder

Also see magnetic stands.



MMJ SPECIFICATIONS

	TRAVEL RANGE	RESOLUTION
X-axis	37 mm	0.1 mm
Y-axis	20 mm	0.1 mm
Z-axis	25 mm	0.1 mm
JOYSTICK (X,Y axis)	0.35~3.5 mm	
SHIPPING WEIGHT	4 lbs (1.8 kg)	

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.

M325 SPECIFICATIONS

	TRAVEL RANGE	RESOLUTION
X-axis	25 mm	10 µm
Y-axis	10 mm	10 µm
Z-axis	10 mm	10 µm
SHIPPING WEIGHT	4 lbs (1.8 kg)	

The M325 three-axis manual micromanipulator is built of precision micrometer-actuated linear slides. Each slide is comprised of a large micrometer head and a spring-return linear slide. The micromanipulator has been carefully designed to minimize wear in the moving components to achieve a long operational life without the necessity for frequent maintenance or adjustment. The micrometer head is graduated in 10 micron steps which enable repeatable positioning to an accuracy of ± 2 microns.

A unique spring return mechanism is used to transmit movement of the micrometer spindle to the slide carriage — eliminating backlash, lost motion and reducing thread wear. Each linear slide utilizes ball bearings which enable the M325 to carry loads of up to 1 kg.

The toolholder can clamp onto tools with shaft diameters of 3.0 mm to 12.7 mm and allows rotation around two axes. This provides a wide range of options for incorporating the manipulator into your workstations. The M325 can also be configured very easily in left- or right-handed versions to allow several units to be positioned in close proximity.

A quick-release clamp allows easy mounting onto any rod from 10-mm to 12.7 mm diameter.

M325 3-Axis Fine Controlled Manual Micromanipulator

OPTIONS AND ACCESSORIES

M3301EH Replacement Electrode Holder (14 cm long)

15873 Optional Angled Electrode Holder (13 cm long)

500475 Ball Joint, 7 cm long, for Ø 8 mm Holder

500476 Ball Joint, 4 cm long, for Ø 4 mm Holder

Also see magnetic stands.

Dual Tool-Holder Micromanipulator

A small and compact micromanipulator for manual manipulation in all three axes (x, y and z), the MD4 is equipped with a mounting bracket for a second tool or electrode holder which can be positioned in the x and y axes independent of the manipulator and may also be tilted and swiveled by two fine-adjust screws. Scales allow readings of coarse adjustment with an accuracy of 100 µm. Additional x-axis fine control is achieved with a micrometer screw with a resolution of 10 µm. Supplied with one M3301EH electrode holder and a 12 mm clamp for mounting on M10 Stand or other 12 mm supports. May also be mounted on optional M-3 Tilting Base.

Travel, standard electrode: x-axis, 37 mm (fine, 10 mm); y-axis, 20 mm; z-axis, 25 mm. Additional electrode: x-axis, 7 mm; y-axis, 10 mm.

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

M3301EH Replacement Electrode Holder (14 cm long)

15873 Optional Angled Electrode Holder (13 cm long)

M2 Additional Ø 12 mm Clamp

M-3 80° Tilting Base 6mm x 1mm screw

M4C Microscope Stage Adapter

M5 Additional Ø 10 mm Clamp

M6 Additional Ø 1/2-in. Clamp

5464 5-lb Weight for Tilting Base*

500475 Ball Joint, 7 cm long, for Ø 8 mm Holder

500476 Ball Joint, 4 cm long, for Ø 4 mm Holder

*Shipping weight: 8 lb (3.6 kg)

Also see magnetic stands.

Also see Universal Manipulator Stands.



M3301EH electrode holders included

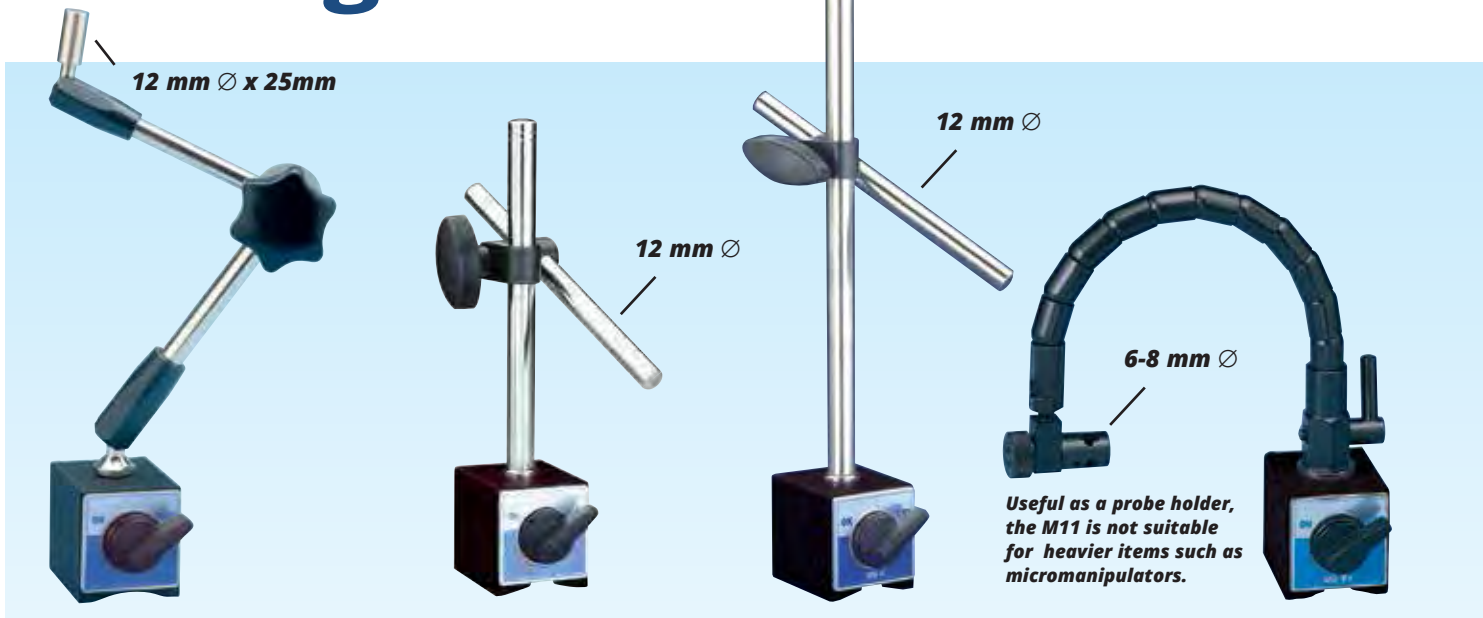
MD4L (left-handed controls)

M-3 Tilting Base not included

MD4 SPECIFICATIONS

	TRAVEL RANGE	RESOLUTION
X-axis Fine	10 mm	10 µm
X-axis	37 mm	100 µm
Y-axis	20 mm	100 µm
Z-axis	25 mm	100 µm
SHIPPING WEIGHT	3 lbs (1.4 kg)	

Magnetic Holding Devices



M9

Mechanical clamp tightens three rotatable joints simultaneously with one locking knob. Arm adjusts without distortion. Base exerts a magnetic force of 100 kilos for greatest stability. Equipped with fine adjustment for precise operations.

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.)
Ø 12 mm (0.472 in.)

Clamp Hole:

none

Weight:

1.8 kg (4 lb)

M9 Magnetic Stand

M10

Similar to M1 but with a 12 mm diameter sub pole (fits 12 mm 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)

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)

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)

M11 Magnetic Stand

Powerful Ball Joint Rare Earth Magnet

Use in constructing your own holding device 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

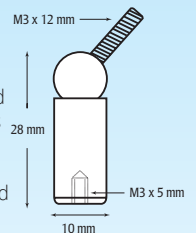


This novel magnetic ball joint has phenomenal holding power for up to 2 kg of attached weight while permitting the ball a full 360° rotation on a 180° axis. You can freely orient your equipment to an infinite number of positions within this rotation. This is made possible by the combination of a steel ball (10 mm diameter) and a powerful rare earth magnet contained in the magnet cylinder (ø 10 x 20mm).

Convenient M3 attachment sites are provided on

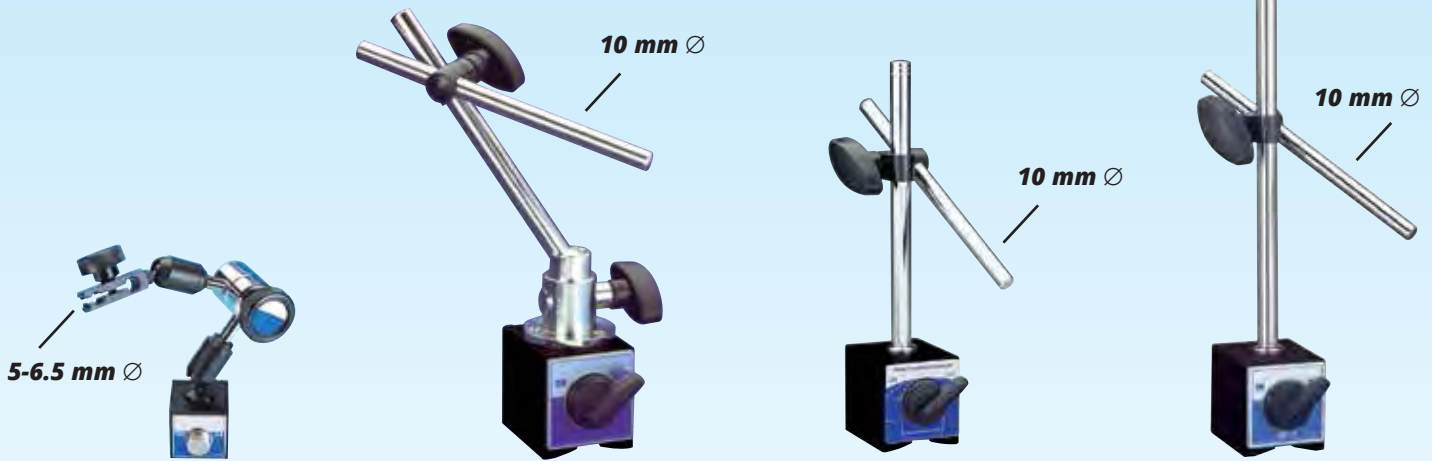
both the ball (male) and the magnet base (female).

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 Magnetic Ball Joint

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 just by on-tough operation. Arm is freely adjustable without distortion. Equipped with fine adjuster and medium size magnet for stabilizing the base. Suitable for performing precision operation.

Magnetic Base:

30 (w) x 30 (l) x 30 (h) mm
(1.2 x 1.2 x 1.2 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)

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)

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)

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)

M1L Magnetic Stand

Mounting your Micromanipulator

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 12 mm mounting clamp with the optional **M5** clamp.

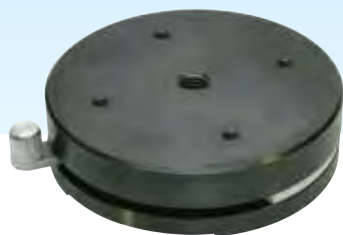


M5 — Ø 10 mm clamp

M5 Ø 10 mm Clamp

Magnetic Holding Devices

MICROMANIPULATORS



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)

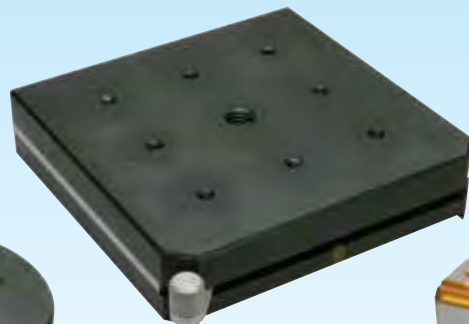
Dimension:
75 (OD) x 20 (h) mm
2.9 (OD) x 0.8 (h) in.

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

Weight:
0.7 kg (1.5 lb)

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

* Posts with M4-threads not available from WPI. See posts with M8 threads on page 142.



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)

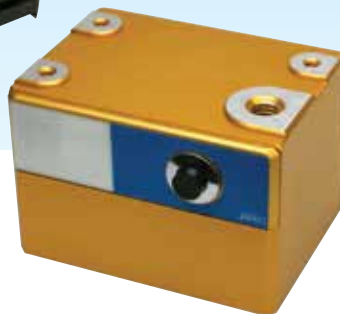
Dimension:
65 (w) x 65 (l) x 20 (h) mm
2.6 (w) x 2.6 (l) x 0.8 (h) in.

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

Weight:
0.6 kg (1.3 lb)

501653	Magnetic Base, 65x65mm
503569	Magnetic Base, 45x45mm
503570	Magnetic Base, 90x90mm
503571	Magnetic Base, 120x120mm

* Posts with M4-threads not available from WPI. See posts with M8 threads on page 142.



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 20mm *
M8, depth 15mm

Weight:
0.7 kg (1.5 lb)

501652 MOBITY Magnetic Clamping System

* Posts with M4-threads not available from WPI. See posts with M8 threads on page 142.



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: 7mm (0.28 in.)
Length: 52mm (2 in.)

Clamp Hole:
Diameter: 6mm

Weight:
0.36 kg (0.8 lb)

M7 Compact Magnetic Stand



12"x24" Steel Base Plate #5479



8 1/2"x12" Steel Base Plate #5052

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; and the special black coating provides a durable protective finish.

ACCESSORIES

5052	Steel base plate, 8 1/2 x 12 in. (10 lb)
5479	Steel base plate, 12 x 24 x 3/8-in. (32 lb)

Bench Top Vibration Isolation Platforms

Simple Set-Up and Adjustment



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.

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

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)

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

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

Vibration-Free Tables

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. The short-term effects of such vibrations include inconsistent and unreliable performance. The long-term effects are excessive wear, maintenance, and fatigue failures. In order to protect sensitive instruments and equipment from faulty operation or failure, vibration must be significantly reduced. This can be efficiently accomplished by using Vibration-Free Platforms and Vibration-Free Workstations.

Vibration-Free Workstation

- **Vertical and horizontal vibration isolation**
- **High performance Active-Air Suspension**
- **Automatic leveling**
- **VibraDamped Steel**
- **Class 100 Cleanroom compatible**
- **Leveling feet**

Additional tabletop sizes and finishes are available, as well as optional accessories such as side rails and casters.

Call for more information and prices for the configuration you require.

For more information, see www.wpiinc.com/vfw



World Precision Instruments

www.wpiinc.com

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Germany: Tel: +49 (0)30-6188845 • wpide@wpi-europe.com

US: Tel: 941-371-1003 • sales@wpiinc.com

Precision Stereo **ZOOM** Microscope

- **Modular, two parallel beam design**
- **Planachromatic objectives, no optical distortion**
- **High-contrast imaging, ideal for observing transparent, low-contrast objects**
- **Large zoom ratio: 8:1**
- **Large zoom range: 0.62x-5.0x**
- **Long working distance**
- **Step and continuous zoom**
- **5-year warranty**

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 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), 1x planachromatic distortion-free objective. See the Table on next page for all optical options.



All PZMIV and PZMTIV microscopes come with 10x eyepieces, built-in 1x auxiliary lens, and light ring adapter.

USBCAM50 digital camera included with version shown, also available separately

Shown: 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.

Computer and display not included

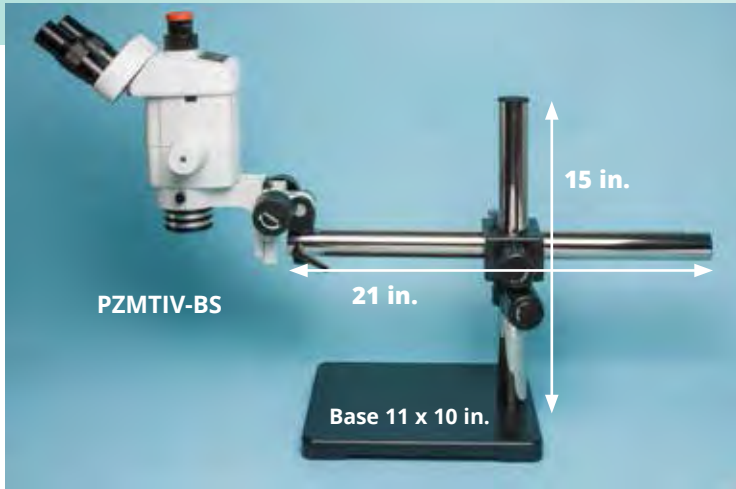
Z-LITE fiber optic illuminator now included with systems below differs from unit in photo — see page 145.

PZMIV	Precision Stereo Zoom Binocular Microscope (Model IV), on Track Stand
PZMIV-BS	PZMIV Microscope on Boom Stand (tubular)
PZMTIV	Precision Stereo Zoom Trinocular Microscope (Model IV), on Track Stand
PZMTIV-BS	PZMTIV Microscope on Boom Stand (tubular)
PZMTIV-DIG50	PZMTIV Microscope System, including PZMTIV, USBCAM50 USB Computer Camera, 0.5x CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide
PZMTIV-BS-DIG50	PZMTIV Microscope System, including PZMTIV, USBCAM50 USB Computer Camera, 0.5x CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide, Boom Stand
PZMTIV-BS-LWD-DIG50	PZMTIV Microscope System, including PZMTIV, USBCAM50 USB Computer Camera, 0.5x CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide, Boom Stand, 0.5x Objective, 20x Eyepieces for Long Working Distance Viewing

See web site for complete configurations.

World Precision Instruments

www.wpiinc.com



#502005 Ball Bearing Boom Stand
— Dual Arm Ball Bearing Boom Stand for increased stability and smoother horizontal movements.

PZMIV & PZMTIV Eyepieces and Objectives

Objective	10x Eyepiece		16x Eyepiece		20x Eyepiece		25x Eyepiece		Working Distance
	Mag	Field (mm) (Video Field)	Mag	Field (mm) (Video Field)	Mag	Field (mm) (Video Field)	Mag	Field (mm) (Video Field)	
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.

OPTIONAL ACCESSORIES

502000	PZMIV Binocular Body With 10X Eyepieces, 1x Objective, Eye guards
502001	PZMTIV Trinocular Body With 10X Eyepieces, 1x Objective, Eye guards
502004	Boom Stand (Heavy) W/O Focus Mount (requires 502009 Focus Mount for PZMIV)
502005	Ball Bearing Boom Stand (Heavy) W/O Focus Mount (requires 502009 Focus Mount for PZMIV)
502006	Boom Clamp Stand (Heavy) (requires 502009 Focus Mount for PZMIV)
504123	Extension for Heavy Clamp Stand
502007	Articulated Arm and Table Clamp w/o Focus Mount (requires 502009 Focus Mount for PZMIV)
502009	Universal Focus Mount for 76 mm PZMIV (Required for BS, AAC, BBS, and BCS) (5/8" pin)
504596	76mm Halogen-Halogen Dual Illuminated Track Stand
504597	Replacement Lamp for 504596
502010	10x Wide Field Eyepiece for PZMIV (pair)
502011	16x Wide Field Eyepiece for PZMIV (pair)
502012	20x Wide Field Eyepiece for PZMIV (pair)
502013	25x Wide Field Eyepiece for PZMIV (pair)
500264	10x Eyepiece with Reticle (matches 10x eyepiece #502010)
500266	20x Eyepiece with Reticle (matches 20x eyepiece #502012)
502015	Ring Light Adapter for PZMIV (For R-8-8-WPI01 Ring Light Guide)
502016	0.32x, Planachromatic Objective (Distortion-free) (278 mm WD)
502017	0.50x, Planachromatic Objective (Distortion-free) (174 mm WD)
502018	0.63x, Planachromatic Objective (Distortion-free) (138 mm WD)
502019	1.0x, Planachromatic Objective (Distortion-free) (73mm WD)
500261	0.35x CCD Camera Coupler, C-Mount (Use with USBCAM33)
500262	0.5x CCD Camera Coupler, C-Mount (Use with COLCAM, USBCAM50)
500028	1x CCD Camera Coupler, C-Mount (Use with COLCAM)
502163	Wall Mount Plate for Articulated Arm System
Z-LITE	Z-Lite Fiber Optic Illuminator
500186	Bifurcated Light Guide with Lenses
R-8-8-WPI01	Ring Light Guide
Z-LITE-186	Z-Lite Fiber Optic Illuminator with Bifurcated Light Guide and Lenses

LED Ringlight



See Page 145

PZMIV SPECIFICATIONS

EYEPIECES	WFH 10x
AUXILIARY LENSES	1x
ZOOM RANGE	0.62x - 5x
TOTAL MAGNIFICATION	6.2x - 50x
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
DIOPTRER ADJUSTMENT	± 5 Diopter
MICROSCOPE BODY	Rotatable 360°
OPTIONAL ACCESSORIES	
Eyepieces	16x, 20x, 25x
Auxiliary lenses	0.32x, 0.5x, 0.63x
Total Magnification	1.9x - 125x
Field of view	Ø106 - Ø1.8 mm
Working Distance	80 - 296 mm
SHIPPING WEIGHT	23 lb.

Precision Stereo **ZOOM** Microscope

Quality and Precision to Improve Your Vision

WPI's third-generation stereomicroscope, **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 stereomicroscopes costing almost twice as much. Zooming is achieved by a spring-loaded



PZMIII



**Shown:
PZMTIII-BS-DIG50
Includes Boom
Stand and USB
Digital Camera**

*Computer
and display
not included*

*Z-LITE fiber optic
illuminator now included
with systems below
differs from unit in photo
— see page 145.*

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 stereomicroscope. See next page for options.

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, including PZMTIII, USBCAM50 Computer Camera, 0.5X CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide
PZMTIII-BS-DIG50	PZMTIII Microscope System, including PZMTIII, USBCAM50 Computer Camera, 0.5X CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide, Boom Stand
PZMTIII-BS-LWD-DIG50	PZMTIII Microscope System, including PZMTIII, USBCAM50 Computer Camera, 0.5X CCD Camera Coupler, Z-LITE Optical Illuminator, Bifurcated Optical Fiber Light Guide, 0.5x Objective, 20x 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.

PZMIII

LED Ringlight



See Page 145



PZMIII-BS



#502007
Articulated Arm

#502163 Wall-Mount Plate — Mount the microscope on the wall for convenient storage when space is tight.



Max. clamp opening: 50 cm

#502006 Boom Clamp Stand — Combines the stability of a boom stand with the versatility of an articulated arm.



PZMIII Eyepieces and Objectives

Objective	10x Eyepiece		15x Eyepiece		20x Eyepiece		25x Eyepiece		Working Distance (mm)
	Mag.	Field (mm) (Video Field)*	Mag.	Field (mm) (Video Field)*	Mag.	Field (mm) (Video Field)*	Mag.	Field (mm) (Video Field)*	
0.3x	2x - 13.5x	114 - 17 (53.6 - 8)	3x - 20.3x	84 - 13 (53.6 - 8)	4x - 27x	69 - 10.3 (53.6 - 8)	5x - 33.8x	44.8 - 6.7 (53.6 - 8)	287 mm
0.5x	3.4x - 22.5x	69 - 10 (32.4 - 4.7)	5x - 33.8x	51 - 7 (32.4 - 4.7)	6.7x - 45x	42 - 6.2 (32.4 - 4.7)	8.4x - 56.3x	26.9 - 4.0 (32.4 - 4.7)	177 mm
0.75x	5x - 33.8x	45 - 7 (21.1 - 3.3)	7.5x - 50.6x	34 - 5 (21.1 - 3.3)	10x - 67.5x	28 - 4.2 (21.1 - 3.3)	12.6x - 84.4x	17.9 - 2.7 (21.1 - 3.3)	117 mm
1.0x	6.7x - 45x	34 - 5 (16 - 4.7)	10x - 67.5x	25 - 3.7 (16 - 4.7)	13.4x - 90x	21 - 3.1 (16 - 4.7)	16.8x - 112.5x	13.4 - 2.0 (16 - 4.7)	100 mm
1.5x	10x - 67.5x	23 - 3.4 (10.8 - 1.6)	15x - 101.3x	17 - 2.5 (10.8 - 1.6)	20.1x - 135x	14 - 2.1 (10.8 - 1.6)	25.1x - 168.8x	9.0 - 1.3 (10.8 - 1.6)	47 mm
2.0x	13.4x - 90x	12 - 2.5 (5.6 - 1.17)	20.1x - 135x	13 - 1.8 (5.6 - 1.17)	26.8x - 180x	10 - 1.5 (5.6 - 1.17)	33.5x - 225x	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 0.5x camera adapter.

OPTIONAL ACCESSORIES

501352 PZMIII Binocular Body, pair of 10x eyepieces and eyeguards
13338 Ring Light Adapter NOT included

501353 Fan Post Stand with 76mm Focus Mount

502009 Universal Focus Mount, 76 mm ID for PZMIII Body

502004 Boom Stand (Heavy) without Focus Mount

502005 Ball Bearing Boom Stand (Heavy) without Focus Mount

504123 Post Extension for Heavy Boom Stand

502006 Boom Clamp Stand (Heavy) (requires 502009 Focus Mount for PZMIV)

502007 Articulated Arm with Table Clamp, without Focus Mount (50 cm clamp)

502163 Wall-Mount Plate, 6" x 6" (or 15.24 cm x 15.24 cm)

501369 Wide Field 10x Eyepieces (pair)

501370 Wide Field 15x Eyepieces (pair)

501371 Wide Field 20x Eyepieces (pair)

501372 Wide Field 25x Eyepieces (pair)

504128 10x Eyepiece with Reticle (matches 10x eyepiece on PZMIII)

504129 20x Eyepiece with Reticle (matches 20x eyepiece 501371)

501373 0.3x Long Working Distance Objective Lens

501375 0.5x Long Working Distance Objective Lens

501376 0.75x Long Working Distance Objective Lens

501377 1.5x Long Working Distance Objective Lens

501378 2.0x Long Working Distance Objective Lens

501379 PZMIII Trinocular Body, pair of 10x eyepieces and eye guards

13338 Ring Light Adapter NOT included

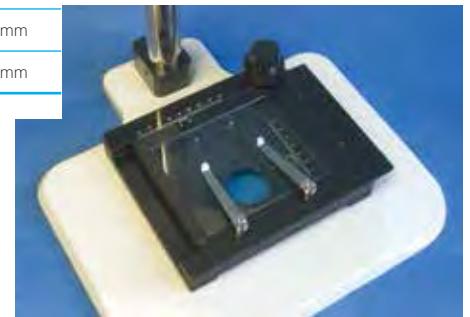
501381 0.5x C-Mount CCD Camera Coupler

13338 Ring Light Adapter for PZMIII Series

(included with all microscope configurations on previous page)

503051 Manual Stage for PZMIII

503102 76mm Rectangular Base Post Stand for PZMIII



#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 SPECIFICATIONS

EYEPIECES	WFH 10x
ZOOM RANGE	0.67x - 4.5x
TOTAL MAGNIFICATION	6.77x - 45x
FIELD OF VIEW	Ø 34 MM - Ø 5 MM
WORKING DISTANCE	100 mm
BINOCULAR TUBE	Inclined 45°
INTERPUPILLARY DISTANCE	Adjustable 47-70 mm
DIOPTRER ADJUSTMENT	±5 Diopter (both eyepiece tubes)
MICROSCOPE BODY	Rotatable 360°
AUXILIARY LENSES	
Total magnification	2x - 22.5x
Biggest Field of View	Ø 110 mm
Working Distance	26-287 mm
SHIPPING WEIGHT	23 lb.

Inverted Trinocular Microscope



Video camera
available separately
— see page 151

Trinocular Head

Ideal for video/photography
Centering eyepiece for phase
objective
EW 10× /22 extra wide field
eyepieces

Condenser

Abbe condenser with
10× / 20× phase

Stage

160×250 mm
Inserts: 35 mm
round, 50 mm round,
87×46 rectangular
Coaxial drive
controls
Mechanical stage:
X-Y coaxial control;
120×78 mm range of
traverse

Nosepiece

Quintuple nosepiece

Objectives

Infinity Optical System
Objectives: Plan 4× and
40×, Plan Phase 10× and
20×

Illumination

6V/30W halogen bulb

Fixed Stage

Optics move during
focusing - excellent for
patch clamp and brain
slice recording

Focus

Coarse adjustment range +8 to -3 mm
Fine adjustment: 0.002 mm

Accessories Included

Green and neutral filters, dust cover.

Options

Multiple photo options

Weight

24 lb (10.9 kg)

INV-101	Trinocular Inverted Microscope
503510	30 mm 10× Eyepiece with 100/10 reticle
503520	Replacement lamp
503512	Deluxe Optical Cleaning Kit

All necessary tools are included for routine adjustments, alignments, and assembly: 8 oz. Air Duster, 280 sheets lint-free lens paper, 1 oz. "no-residue" lens cleaning fluid, 100 cotton-tipped applicators, 9x9 microfiber lens cloth, soft-bristled dusting brush, micro-glide gear lubricant, allen wrenches, double-sided friction collar wrench, precision screwdriver set, nylon carry case

3000-LED Series

Superb Optics, Durable and High Performance Microscopes



3000-LED SERIES SPECIFICATIONS

OPTICAL SYSTEM	Infinity Optical System, f=180mm, Anti-Mold
VIEWING HEAD	Siedentopf type, inclined 30°; interpupillary distance adjustment 48-75mm
EYEPIECES	HWF Plan 10× eyepiece, 20mm 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
STAGE	Stage size 140mm × 132mm with X-Y movement range of 76mm × 50mm
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 × 391mm)
WEIGHT	16 lb (7.26 kg)

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 20mm 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.

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
500828	Stage Micrometer, 1mm scale, 200 div. at 10 μm
504606	Stage Micrometer, 50-0.5mm scale and 10μm scale

W30 Professional-Grade Microscope



The W30 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 anti-fungal coating. The W30 is the choice for superior performance at a great price.

W30S SPECIFICATIONS

HEAD	Binocular (Siedentopf) True Trinocular Inclined 30°, rotates 360° Dual diopter adjustment, Interpupillary range 55-75 mm 10×/18 wide field eyepieces
NOSEPIECE	Quadruple forward-facing nosepiece
OBJECTIVES	DIN Plan, anti-fungal 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) 110V/220V switchable electronics
ACCESSORIES INCLUDED	Replacement 0.5 amp fuses, mirror (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)

W30S-LED	Binocular Microscope
W30ST-LED	Trinocular Microscope
503513	21 mm 10X Eyepiece with 100/10 reticle

MICROSCOPES, CAMERAS

Precision SurgioScope

Ideal for small animal surgery

WPI's improved precision SurgioScope (now 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 "T" version permits operational procedures to be monitored or recorded simultaneously using a video recorder and a COLCAM video camera or digital stills with USBCAM50.

PSMB5N Binocular SurgioScope, F200 objective (Specify post height.)

PSMT5N Trinocular SurgioScope, beam splitter, std video adapter, F200 objective (Specify post height.)

Specify 89 cm or 103 cm post
Specify line voltage

OPTIONS AND ACCESSORIES

501636 1/2" CS-mount Adaptor (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

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 .12V, 100W, with cold reflection

OPTIONAL CAMERA COLCAM, USBCAM50 (1/2" CCD)
USBCAM33 (1/3" CCD)

POWER.....110V, 50-60 Hz, or 220V, 50-60 Hz

SHIPPING WEIGHT.....94 lb (43 kg)

FEATURES:

- Motorized focusing system, allows hands-free operation
- Light weight, compact and easy to maneuver—weighs only 70 lb.
- Dual bulbs prevent illumination failure during surgery
- Optional video adapter
- Improved optics 119 lp/mm
- Convenient handles
- New head tilting mechanism
- **Five magnification steps**



SURGIOSCOPE Specifications

TOTAL MAGNIFICATION (F200).....3.2x — 25x
ADJUSTABLE DIOPTRER ± 6 Diopter
ADJUSTABLE INTERPUPILLARY DISTANCE min. 50 mm — max. 70 mm
EYEPIECE 12.5x

Objective	Working Distance	Magnification step	Visual Field of view (mm)	Camera field 1/2" CCD (mm)	Camera field 1/3" CCD (mm)
F100 #504284	90mm	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)	190mm	3.2, 5, 8, 13, 20x	50, 31, 20, 12, 8	50, 31, 20, 12, 8	35, 23, 14, 9, 5.5
F250 #504285	240mm	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	290mm	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	340mm	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, please go to WPI website—www.wpiinc.com

FINE FOCUS ADJUSTMENT RANGE 30 mm

WORKING HEIGHT (Arm Movement Range Above Floor)

89 cm Post..... Focus on specimens 34.5" (88 cm) to 51" (130 cm) above floor *

103 cm Post Focus on specimens 40.5" (103 cm) to 57" (146 cm) above floor *

* Subtract Working Distance for height above specimen, 103 cm post recommended for F350 objective.

High intensity source for fiber optic 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 needed. Forced air cooling prolongs lamp life. Lamp color temperature is 3350°K. An interlock switch automatically cuts off power when front panel is opened to replace bulb.



Shown with
Bifurcated Light
Guide 500186

Z-LITE Specifications

LAMP	150 W quartz halogen
SIZE	30.5x25x25 cm (12x10x10 in.)
POWER	115 VAC, 50/60 Hz, 3 A
WEIGHT	5.9 kg (13 lb)

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)

LIGHT GUIDES AND ACCESSORIES

500186	Bifurcated Light Guide (with lenses)
R-8-8-WPI01	Ring Light Guide for PZM and PZMIII Series*
13338	Ring Light Adapter (48 mm Ø) for PZM, PZMIII, PZMIII
502015	Ring Light Adapter for PZMIV
5475	Adapter for SMA-terminated Fiber Optic Cables
EJA	Replacement Halogen Lamp, 150W, 3350°K, 40-hour
EKE	Replacement Lamp, 150W, 3250°K, 200-hour

*Ring Light Guide requires adapter #13338 for use with PZM, PZMIII and PZMIII, included with each PZMIII and PZMIV microscope.

LED Ringlight



for PZMIII and PZMIV stereo microscopes

- “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



Light guide
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

504134 LED Ringlight

World Precision Instruments

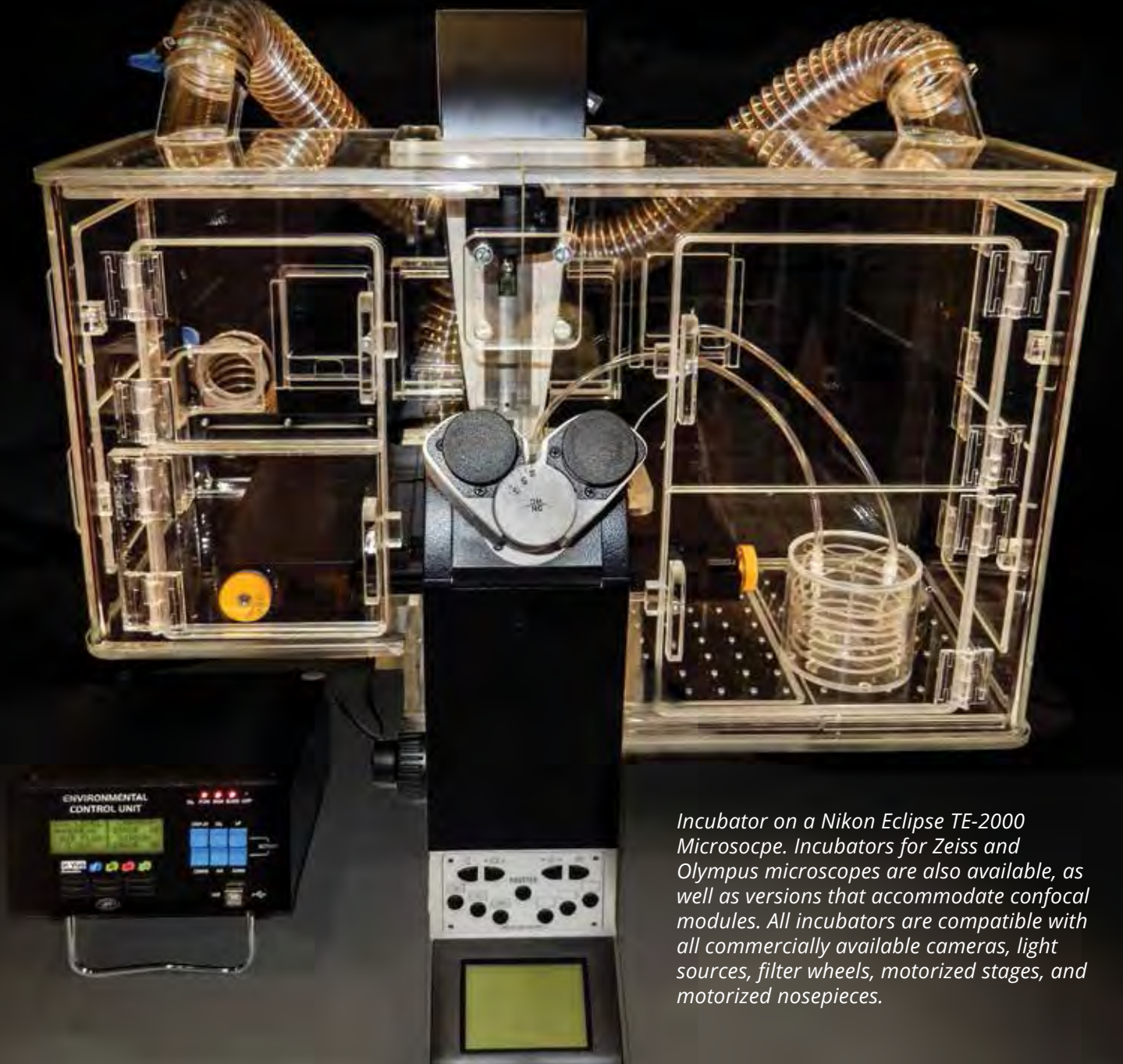
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Incubator on a Nikon Eclipse TE-2000 Microscope. Incubators for Zeiss and Olympus microscopes are also available, as well as versions that accommodate confocal modules. All incubators are compatible with all commercially available cameras, light sources,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

Environmental Control Systems for Live Cell Microscopy

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.

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 $\pm 0.1^{\circ}\text{C}$ 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

Live Cell Microscopy System Components

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

The ECU comes in four 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 and ECU-HCP let you control the CO_2 level. One has an internal sensor, and the other has a remote sensor that can be positioned inside the microscope chamber. Finally, the ECU-HOC adds control of the O_2 level, which is accomplished by displacing the oxygen with nitrogen. The first three ECU units are capable of controlling a simple, external heater, like the AirTherm Satellite (AirTherm-SAT) or a microscope lens warmer. The AirTherm-SMT can monitor and control both temperature and humidity inside the microscope chamber.

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.

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	35mm/60mm	Wells
	Coverslips	



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.

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

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

IV-100SMT Environmental Chamber, Heat controller. Requires pre-mixed 5% CO_2 gas supply

IV-200ECU Environmental Chamber, Heat & CO_2 controller. Requires 100% CO_2 & ambient air supplies. .

IV-200-OX Microscope Environmental Chamber, Heat Controller, CO_2 and O_2 Controller.

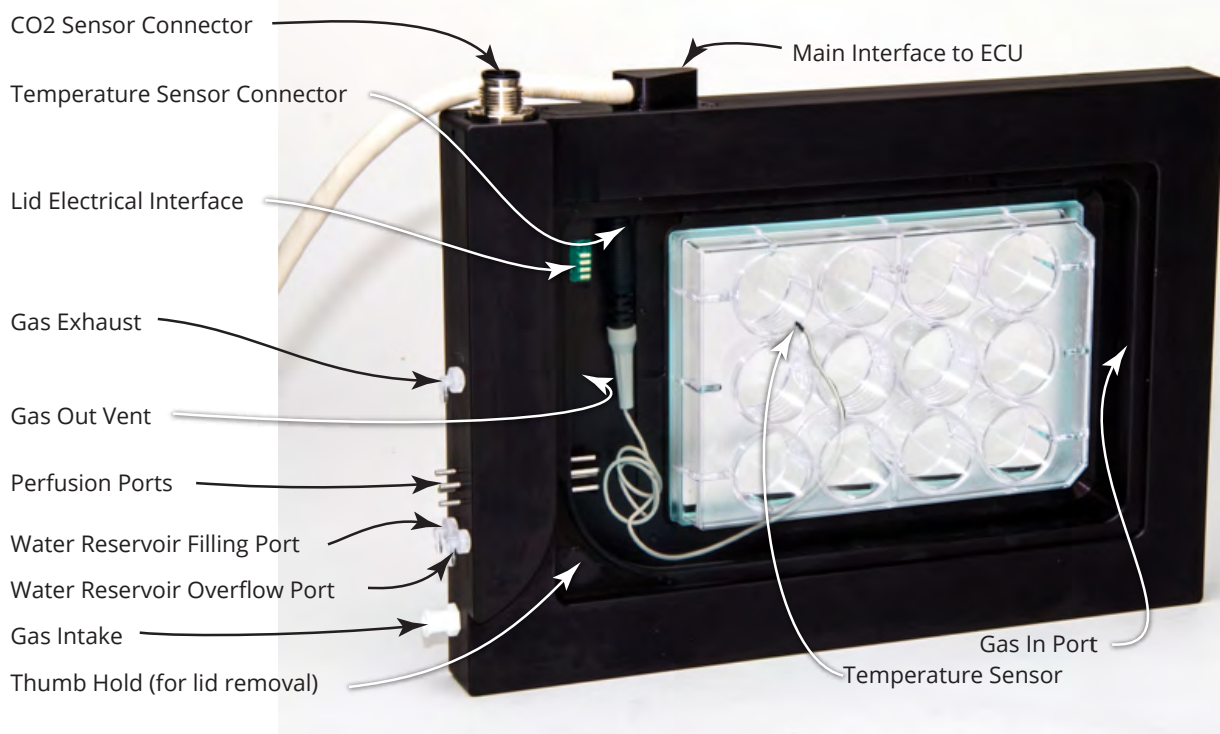
IV-300ECU Environmental Chamber, Heat & CO_2 controller. Requires 100% CO_2 & ambient air supplies. Features a CO_2 probe to detect concentration at the sample.

IV-CUST Custom Design includes but not limited to Tilting Heads, Black Chamber, Confocals, Camera on Right, HMX Lamphouse, and Manipulators. Fee added for design not included in standard system

Stagetop Environmental Control

Control temperature and CO₂ in a microscope stagetop environment

- Four programmable digital control loops
 - Independent incubator base temperature PID control with $\pm 0.1^\circ\text{C}$ precision
 - Independent incubator lid temperature PID control with $\pm 0.1^\circ\text{C}$ precision
 - CO₂ digital PID control with $\pm 0.1\%$ 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



For short term or long term studies of living cell cultures under a microscope or for time lapse video research, a microscope stagetop incubator is essential.

Perfect for Live Cell Imaging, **STEV** (the stagetop environmental control system) is a compact environmental case that houses your culture wells and fits on a microscope stage inside the live cell microscope incubator.



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.

The system includes the **Environmental Control Unit** electronics which use four programmable loops to control the temperatures of the case and the lid, CO₂ within the environmental case and airflow within the incubator.

STAGETOP ENVIRONMENTAL CONTROL SYSTEMS

IV-ECU-H5	Chamber, Controller, Heat, Digital flow control for bottle gas
IV-ECU-HC	Chamber, Controller with CO ₂ and Heat (using CO ₂ internal sensor)
IV-ECU-HCP	Chamber, Controller with CO ₂ and Heat (CO ₂ probe sensor)
IV-ECU-HOC	Chamber, Controller with CO ₂ , O ₂ and Heat (using CO ₂ internal sensor)

Precision Heat Control

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



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, humidity.

The **AirTherm™ SMT** uses a PID control algorithm to maintain tightly controlled loops of heat and humidity environment control.

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.

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

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

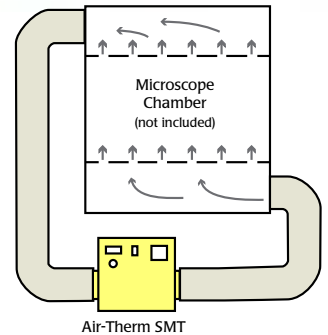
Humidity probe for monitoring chamber humidity available as an option.

AIRTHERM-SMT-1W	Airtherm™ SMT Heater, 110V
AIRTHERM-SMT-2W	Airtherm™ SMT Heater, 230V
AIRTHERM-SAT-1W	AirTherm Satellite Heater, 110V
AIRTHERM-SAT-2W	AirTherm Satellite Heater, 230V

OPTIONAL ACCESSORIES

15590	Replacement Hoses, 2.5" diam., 4.5 ft
300276	Replacement Platinum Temperature Probe
98727	Replacement Temperature Probe
98728	Humidity Probe

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.



AIRTHERM SPECIFICATIONS

AIR FLOW RATE	20–50 CFM (0.55–1.4 m ³ /minute)
CONTROL TEMPERATURE RANGE	Ambient to 60°C
TEMPERATURE RESOLUTION	0.1°C
TEMPERATURE ACCURACY	0.2°C
HUMIDITY CONTROL RANGE	Ambient–90%
HUMIDITY RESOLUTION	0.1%
HUMIDITY ACCURACY	5%
HUMIDITY REPEATABILITY	0.5%
ANALOG OUTPUT	0.5°C resolution;
FOR CHART RE-CORDER	0–10V represents 0–100°C
HEATING VOLUME	Less than 50 CF (1400L), re-circulating
TEMPERATURE SENSOR TYPE	Platinum RTD 1000 W
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)

Digital Microscope Cameras



- Ultra-Compact USB cameras with color CCD
- Hardware & Software Trigger

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, 7mm 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.

USBCAM133 USBCAM152 USBCAM202

USBCAM133	Digital Microscope Camera
USBCAM152	Digital Microscope Camera
USBCAM202	Digital Microscope Camera
504570	Replacement USB Cable, 3m (10 ft)
504574	CONN 6-PIN (external camera triggering control)

	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) μ m, 6mm diagonal	4.65 (H) x 4.65 (V) μ m, 8mm diagonal	4.40 (H) x 4.40 (V) μ m, 7mm 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 45g	Approximately 45g	Approximately 45g
Interface Connector	USB: mini-B USB connector IO signal: 6pin connector (HR10A-7R-6PB or equivalent)	USB: mini-B USB connector IO signal: 6pin connector (HR10A-7R-6PB or equivalent)	USB: mini-B USB connector IO signal: 6pin connector (HR10A-7R-6PB or equivalent)
RoHS	RoHS Compliant	RoHS Compliant	RoHS Compliant

USBCAM33 / USBCAM50

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 1024x768 resolution and 30 frames per second (**USBCAM33**) or one half-inch CCD with 1280x960 resolution and 15 frames per second (**USBCAM50**).



These cameras include **IC Imaging Control 3.0** software that features:

- 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

USBCAM33	Digital Microscope Camera, 1/3-in. CCD
USBCAM50	Digital Microscope Camera, 1/2-in. CCD
503536	Cable, USB Extension (male-female)

	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 μ m x 4.65 μ m, 6mm diam.	4.65 μ m x 4.65 μ m, 8mm diam.
SPEED (PC DEPENDENT)	30fps, 15fps, 7.5fps or 3.75fps	15fps, 7.5fps or 3.75fps
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) or Windows 7 (32 & 64 bit)	Windows Vista (32 & 64 bit) or Windows 7 (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)

Color Video Cameras for Microscopy

● 16:9 Aspect Ratio, 1:1, no scaling

● Low cost alternative to existing HD and 3 CCD cameras, with outstanding image quality

● DVI signal output via HDMI cable

● Improved design of COLCAM-HD with better low light sensitivity



CE

COLCAM-HD and COLCAM-HD1080P

The COLCAM-HD is a CCD-based camera that outputs a true HD 720P at 60fps in the 16x9 format. The COLCAM-HD1080P is a CMOS-based camera that outputs a true HD 1080P or 720P image at 60fps in the 16x9 format. Both models feature the capability to program individual DSP profiles accessed via remote hand held controller.

COLCAM-HD Color Video Camera
Includes 3m DV cable, power supply, C/CS mount.

COLCAM-HD1080P Color Video Camera
Includes 3m DV cable, power supply, C/CS mount.

504136 3 meter HDMI cable

504138 Hand held control pad for COLCAM-HD*

504137 C/CS Adaptor

*Controller for COLCAM-HD1080P available soon.

COLCAM SPECIFICATIONS

	COLCAM-HD	COLCAM-HD1080P
IMAGER	1/3" Interline SXGA CCD: ICX445AQA	1/2.8" 230 Mega pixel CMOS (SONY: IMX136), Rolling Shutter
HD ACTIVE PICTURE ELEMENT	1280 (H) x 720 (V)	1920 (H) x 1080 (V)
CHIP SIZE	6mm diagonal	6.4 mm diagonal
MINIMUM SCENE ILLUMINATION	4 Lux at F1.2	TBD
SYNC SYSTEM	Internal	Internal
VIDEO OUTPUT	DVI 1.0 compliant; 720P RGB, 1280 (H) x 720 (V); 60 Hz / 59.94 Hz / 50 Hz	DVI 1.0 conformity 1080P RGB, 1080P60, 1080P59.94, 1080P50, 1080P30, 1080P29.97, 1080P25, 720P60, 720P59.94, 720P50
GAIN	AGC *	AGC *
SHUTTER SPEED	Auto *	Auto *
GAMMA	AGC or Fixed gain *	AGC or Fixed gain *
WHITE BALANCE	Auto / Manual / Push-to-set *	Auto / Manual / Push-to-set *
POWER	12V power jack; 5.5x2.1mm	12VDC
DIMENSIONS	40 (W) x 40 (H) x 45.8 (D) mm	40 (W) x 40 (H) x 45.8 (D) mm
OPTICAL FILTER	IR cut filter included	IR cut filter included
LENS MOUNT	C/CS mount	C mount
VIDEO OUTPUT	HDMI connector	HDMI connector
WEIGHT	Approximately 120g	TBD
ROHS	RoHS compliant	RoHS compliant

* Selectable via the UART communication

C-Mount Eyepiece Adapters

For 1/4-inch (4mm diagonal), 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 23.2 mm 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. For a list of 1X C-mounts for popular microscopes, visit WPI's website and search for "C-mounts".

503097 Adapter, 0.45X for 1/3-in. and 1/2-in. video cameras, 30 mm Stereo adapter, 1X C-mount adapter

503098 * Adapter, 0.28X for 1/4-in. video cameras, 30 mm Stereo adapter, 1X C-mount adapter

* For adapter 503098 to mount properly, the 1/4-inch CCD camera must have a minimum of 13 mm clearance, measured from the front of the C-mount ring to the CCD surface.

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 trinocular 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 10D Digital camera. (CCD Sensor size = 22.7 x 15.1 mm). 35 mm film reference size is 24 x 36 mm.

Please contact your camera dealer for a suitable T-mount to bayonet adapter for your camera.

503099 Adapter, 2.0X for SLR digital Cameras (includes 30 mm Stereo adapter, 1X C-mount adapter)



FluoroDish™

Cover-glass bottom for observing and growing cells in imaging related research

- **Optical quality glass bottom for better imaging quality (RI=1.525)**
- **Low sample volume for expensive chemicals**
- **Lowest access angle for micropipette**
- **Low toxicity adhesive for embryo research**



WPI's **FluoroDish™** tissue culture dishes are now available in a larger range of sizes and coatings. These dishes provide exceptional imaging quality for many applications requiring the use of inverted microscopes such as high resolution image analysis, microinjection and electrophysiological recording of fluorescently-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 some 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 stays within the 0.17 ±0.01 mm range.

Conventional plastic dishes and chambers limit the utility of the inverted scope for many applications because the thick plastic bottom requires a long working distance objective available only in lower magnifications. Each WPI dish has a flat (0.17 mm thick) optical quality glass bottom, allowing the use of a much shorter objective working distance, larger numerical aperture (NA), and a 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 medium 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, therefore eliminating the air gap that exists with modified plastic dishes in which a glass cover slip has been inserted.

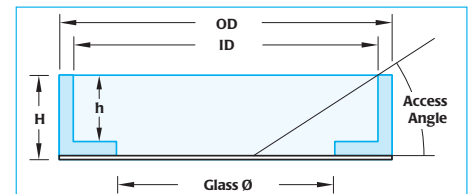
Three different sizes of FluoroDish are offered, one type of 50 mm diameter dish and two types of 35 mm diameter dishes. An inner well is created within the dish by the glass bottom and the tissue culture grade polystyrene which forms the sides of the dish. All WPI dishes have the advantages of low toxicity and good UV transmission bottom glass. 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 will also fit this dish. The 23.5 mm glass window dish is available uncoated or poly-D-lysine-coated. Certain types of cell lines (e.g., PC3 and HEK) adhere well to the uncoated glass bottom dish. The poly-D-lysine coating has been reported to improve the adhesion of neuron cells. The users can also apply to the

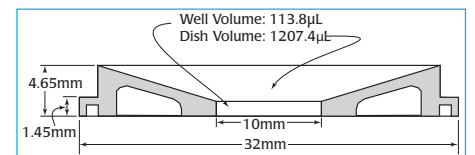
uncoated dish any special coating that is best for their cell line.

The 10 mm glass window dish (**FD3510**) has low sidewall 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 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.



Standard Fluorodish geometry. See the table below.



FD3510

Part Number	ID (mm)	OD (mm)	Glass Ø (mm)	height (inside)	Height (outside)	Access Angle
FD35	33	35.5	23.5	7.8	9	29°
FD3510	10	35.5	10	1.5	4.65	17°
FD5040	47.5	49.82	35	7.25	7.4	17°

● Choose from poly-D-lysine coated or uncoated

FD35-100	FluoroDish Sterile Culture Dish, clear 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
FD5040-100	FluoroDish Sterile Culture Dish, clear wall, 50 mm, 35 mm well, box of 100



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 8 mm size fits inside the 24-well plates.

Order Number	Diam.	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



Entomology Kit

504166 Student Entomology Kit

Kit Contains:

- 2 Teaser Needles Straight
- 2 Teaser Needles Angled
- 1 Iris Scissors, 11.5cm
- 1 Scalpel Handle #3
- 1 Adson Micro Forceps, 12cm
- 1 Dropper
- 2 Micro Dissection Forceps, 12cm Str
- 2 Micro Dissection Forceps, 12cm Cvd
- 2 Entomology Forceps, 10cm
- 1 Tweezers with Magnifying Mirror
- 1 Stainless Steel Scale, 6"
- 10 Blades #10
- 1 Leather Pouch



Anatomy Kit

504164 Student Anatomy kit

Kit Contains:

- 1 Plastic Ruler, 6"
- 1 Mall Probe
- 1 Teaser Needle Angled
- 1 Teaser Needle Straight
- 1 Dressing Forceps, 16cm
- 1 Mosquito Forceps, 12.5cm
- 1 Scalpel Handle #3
- 4 Blades for Scalpel Handle #3
- 1 Scalpel Handle #4
- 4 Blades for Scalpel Handle #4
- 1 Dissecting Scissors, 14cm Sharp/Blunt
- 1 Hooks with Chain
- 1 Leather Pouch



Botanical Kit

504165 Student Botanical Kit

Kit Contains:

- 1 Scissors, 14cm
- 1 Dropper
- 1 Scalpel Handle #3
- 4 Scalpel Blades
- 1 Teaser Needle Angled
- 1 Teaser Needle Straight
- 1 Mariam Tweezers Angled
- 1 Tweezers Straight
- 1 Leather Pouch



503505

503507

503506

503505 Plain Glass Microscope Slides, Box of 144

503506 Frosted Glass Microscope Slides, Box of 144

503507 Red frosted Glass Microscope Slides, Box of 144

Slides

These clean glass microscope slides are 25 x 75 mm, 1.0~1.2 mm thick with 90° grounded edges, and are available plain, 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.

Pumps & Fluid Handling

	Fluid Range	Channels	Special features	Page
Peristaltic Pumps				
MINISTAR	0.006- 37 mL/min	1	Compact design, remote control	157
Peripro-2HS	0.8 - 300 mL/min	2	Calibrated output, replaceable tubing cartridges	157
Peripro-4HS	0.8 - 300 mL/min	4	Calibrated output, replaceable tubing cartridges	158
Peripro-4LS	0.01-80 mL/min	4	Calibrated output, replaceable tubing cartridges	158
Peripro-8LS	0.01-80 mL/min	8	Calibrated output, replaceable tubing cartridges	158
Single-Channel and Whole-Cell Solution Exchange				
MPS2	Up to 250 µL/min	8	Programmable control; low dead volume	160
Laboratory Syringe Pumps				
AL-1000	0.000073-1699 mL/hr	1	Push/pull	161
AL-2000	0.000073-1699 mL/hr	2	Push/pull (2 networked pumps)	161
SPLG100	1.26 pL/min to 88.32 mL/min	1	Infuse only	162
SPLG101	1.26 pL/min to 25.99 mL/min	2	Infuse only	163
SPLG110	1.26 pL/min to 88.28 mL/min	1	Infuse/Withdraw	163
SPLG210	0.5 pL/min to 220.97 mL/min	2	Infuse/withdraw	164
SPLG212	0.5 pL/min to 220.97 mL/min	2	Infuse/withdraw programmable	164
SPLG270	0.5 pL/min to 220.97 mL/min	2	Push-pull	164
SPLG272	0.5 pL/min to 220.97 mL/min	2	Push-pull programmable	164
SPLG200	0.5 pL/min to 220.97 mL/min	2	Infuse only	165
SP100i	0.0001-519 mL/hr	1	Basic single channel	165
SP101i	0.001 µL/hr - 35mL/min	2	Micro dialysis application	166
SP120p	0.1 µL/hr - 127 mL/hr	1+1	Push pull, single cycle	166
SP200i	0.001 µL/hr - 145 mL/min	2	RS232 TTL/Footswitch	166
SP210c	0.001 µL/hr - 86 mL/min	2+2	RS232 push pull, continuous	166
SP210iw	0.001 µL/hr - 145 mL/min	2	RS232 Infuse/Withdraw	167
SP220i	0.001 µL/hr - 21 mL/min	10	RS232 Infuse Only	167
SP230iw	0.001 µL/hr - 21 mL/min	10	RS232 Infuse/Withdraw	167
SP250i	0.001 µL/hr - 21 mL/min	4	RS232 Infuse Only	167
SP260p	0.001 µL/hr - 86 mL/min	2+2	RS232 push pull, single cycle	167
Micro Syringe Pump / Stereotaxic Injection				
UMP3	0.03nL/min - 10 µL/sec	1	Ultra micro infuse/withdraw RS232	172
MMP	Manual 100 µL-1mL syringe	1	Manual	181
DMP	Manual 100 µL-1mL syringe	1	Digital readout micrometer	181
Microinjection				
PV820	Injected volumes from picoliters to nanoliters	1	Injection pressure and holding pressure	173
PV830	Injected volumes from picoliters to nanoliters	1	Injection pressure and holding pressure and vacuum	172
NANOLITER2010	Bolus, 2.3-69 mL/Injection	1	Oocyte injector, infuse only	179
Microinjection Systems (Zebrafish, C. Elegans, Drosophila, Xenopus oocytes)				176
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	183
Mirus	100nL/min – 10mL/min ±1%	8	Infuse only, reversible flow, ~600µL dead volume, PC control	183
Kimo	15 – 35 mL/hr ±4%	1	Infuse only, recirculating pump controlled by iPod Touch, Wi-Fi communication, <300µL dead volume	183
Supplies & Tools				
Pipetters — Standard and Autoclavable				168
Syringes — Microvolume, for UltraMicroPump III				171
Miniature Vacuum Pump				173
Z-MOLDS Microinjection and Transplantation Molds				176
NanoFil™ Specialty Microsyringe				180
NanoFil™ Application Kits				180
Pressure Manometers				181



Mini★Star™

Miniature DC Peristaltic Pump

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

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

MINISTAR SPECIFICATIONS

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

Peri-Star™ Pro

High performance digital peristaltic pump at an affordable price!

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



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

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

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

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

Peri-Star Pro is available in two versions: a

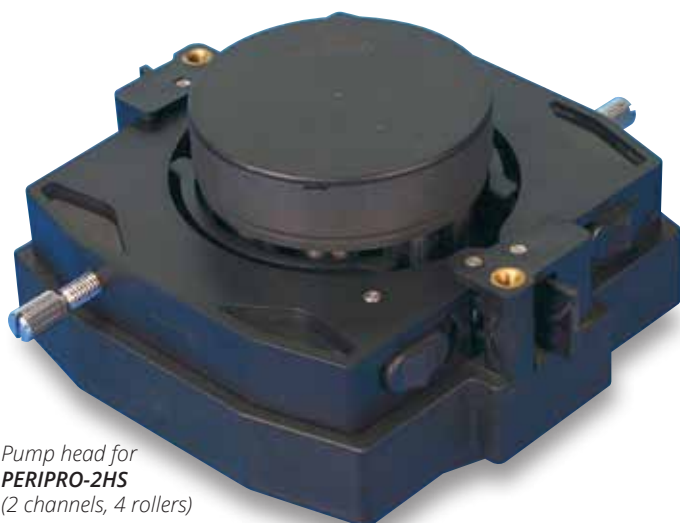
4-roller version for high flow and an 8-roller version for lower volumes which provides high pressure with minimal pulsations.

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

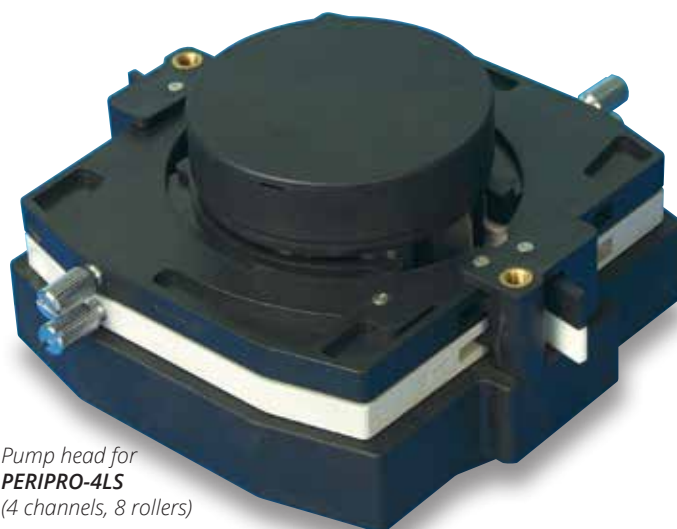
World Precision Instruments

www.wpiinc.com

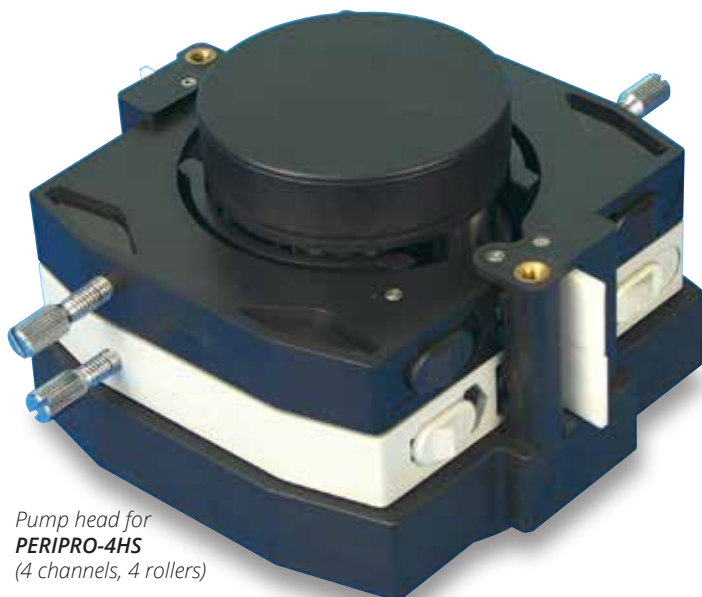
Available in 2-, 4- and 8-channel versions



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



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



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



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

PERI-STAR PRO SPECIFICATIONS

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

NEW PERI-STAR PRO PUMPS

PERIPRO-2HS	Peri-Star™ Pro, 2-channel, High Rate, Large Tubing (110-220V)
PERIPRO-4HS	Peri-Star™ Pro, 4-channel, High Rate, Large Tubing (110-220V)
PERIPRO-4LS	Peri-Star™ Pro, 4-channel, Low Rate, Small Tubing (110-220V)
PERIPRO-8LS	Peri-Star™ Pro, 8-channel, Low Rate, Small Tubing (110-220V)

OPTIONAL ACCESSORIES

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

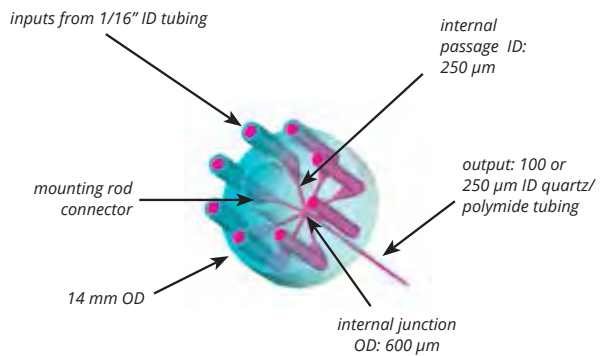
PUMPS, MICROINJECTION

MPS-2 Multichannel Perfusion System

for single ion channel and whole-cell solution exchange



- **Manual or Programmable PC control with user-friendly GUI interface**
- **Fast LAFF solenoid valve**
- **Color-coded polyurethane tubing for easy identification**
- **Super low dead volume (<100 nL) micromanifold**
- **Economically priced**



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

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.

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 the user 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 by the user.

The perfusion fluid flows through specially designed color-coded polyurethane ribbon style tubing. The color-coding allows the user to easily trace each channel for diagnostic checks or set up and the ribbon style of tubing keeps the system very 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.

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. The maximum flow rates are 1 and 16 microliter per second for the 50 mm long 100 micrometers and 250 micrometers ID tips, respectively. Small channels and a unique design at the merging point further reduce the chance of cross contamination. Dead volume is less than 100 nL.

MPS-2 Multichannel Perfusion System & Control Software

REPLACEMENT PARTS

502109-15 Color-coded Polyurethane Tubing, 1/16" ID x 8 Channels, 15 ft

502110 Micromanifold, 100 micrometers ID tip, 2 pcs/pk

502125 Micromanifold, 200 micrometers ID tip, 2 pcs/pk

Specify line voltage and Micromanifold tip OD when ordering.

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
TIP ID	250 micrometers and 100 micrometers.
MAXIMUM FLOW RATES (gravity fed)	100 micrometers ID tip, 8 micrometers L/min. at 50 cm 250 micrometers ID tip, 250-500 micrometers L/min. at 50 cm
DEAD VOLUME	< 100 nL excluding the single outlet tubing

Aladdin

Programmable Syringe Pump



PUMPS, MICROINJECTION

CE

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

ALADDIN SPECIFICATIONS

	AL-1000	AL-1000HP
SYRINGE SIZES	Plastic syringes up to 60 mL and selected glass micro syringes from 0.5 to 500 μ L.	Plastic syringes up to 60 mL and selected glass micro syringes from 0.5 to 500 μ L.
NUMBER OF SYRINGES	1	1
MOTOR TYPE	Step Motor, 1/8 to 1/2 step modes	
STEPS PER REVOLUTIONS	400	200
STEPPING (max./min.)	0.21 μ m to 0.850 μ m	
MOTOR TO DRIVE SCREW RATIO	15/28	15/28
SPEED (max./min.)	5.1 cm/min / 0.0042 cm/hr	18.36964 cm/min / 0.008409 cm/hr
PUMPING RATES	1699 mL/hr with 60 mL syringe, to 0.73 μ L/hr with 1 mL syringe	6120 mL/hr with 60 mL syringe, to 1.459 mL/hr with 1 mL syringe
MAXIMUM FORCE	35 lb at min. speed, 18 lb at maximum speed	100 lb at minimum speed, 18 lb at maximum speed
NUMBER OF PROGRAM PHASES	41	41
RS-232 PUMP NETWORK	100 pumps maximum	100 pumps maximum
POWER SUPPLY	Wall adapter 12V DC @ 850 mA	Wall adapter 12V DC @ 1000 mA
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.)
WEIGHT	1.6 kg (3.6 lb)	1.6 kg (3.6 lb)

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

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

AL-1000	Programmable Syringe Pump
AL-1000HP	Programmable Syringe Pump, High Pressure
AL-2000	Two AL1000 Syringe Pumps

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

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

OPTIONAL ACCESSORIES

GN-PC7	PC to pump cable, 7 ft
GN-PC25	PC to pump cable, 25 ft
GN-NET7	Pump-to-pump network cable, 7 ft
GN-NET25	Pump-to-pump network cable, 25 ft
GN-TTL	Pump-to-pump reciprocating cable
ADPT2	Footswitch

World Precision Instruments

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Legato Syringe Pumps

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 microstepping techniques are employed to further reduce the step angle to eliminate flow pulsation. Accuracy is

$\pm 0.5\%$. A wide dynamic flow range from picoliters per minute to milliliters 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 Infuse-Only Syringe Pump

The **SPLG100** is the world's 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 μ L to 60 mL. Any type of syringe, including glass, plastic or stainless steel, are held securely in place.

SPLG100 Legato 100 Syringe Pump, Infuse-Only
504578 Software Adagio/USB Key

SPLG100 SPECIFICATIONS

SYRINGE SIZE	0.5 μ L 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 ONE REVOLUTION OF LEAD SCREW	15,360
STEP RATE (MINIMUM)	27.5 sec/ μ step
STEP RATE (MAXIMUM)	26 μ sec/ μ step
DRIVE MOTOR	0.9 degree Stepper Motor
PUSHER TRAVEL RATE (MINIMUM)	0.15 μ m/min
PUSHER TRAVEL RATE (MAXIMUM)	159 mm/min
FLOW RATE (MINIMUM)	1.26 pL/min (0.5 μ L syringe)
FLOW RATE (MAXIMUM)	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

Benefits

- Automatic dispensing of small volumes
- Constant delivery of fluids
- Hands free operation

Features

- Better flow performance
- Accuracy $\pm 0.35\%$
- Holds one or two syringes from 0.5 μ L to 140 mL
- High resolution color touch screen
- Real time clock
- Unparalleled ease of use
- Touch pad "lock" feature
- LED light on front panel
- Full metal chassis
- Built in syringe table
- Up to 75 lb linear force
- Advanced microstepping techniques
- Built in RS-485 interface to link multiple pumps
- USB port & RS232 Interface
- I/O & TTL interface
- Continuous mode of operation
- Protection with a spill dam
- Analog control option
- CE, UL, CSA, CB Scheme, EU RoHS

FLOW RATES

Syringe	Diameter	Minimum	Maximum
0.5 μ L	0.103 mm	1.260 pL/min	1.325 μ L/min
1 μ L	0.146 mm	2.520 pL/min	2.651 μ L/min
2 μ L	0.206 mm	5.100 pL/min	5.299 μ L/min
5 μ L	0.343 mm	14.100 pL/min	14.690 μ L/min
10 μ L	0.485 mm	28.260 pL/min	29.380 μ L/min
25 μ L	0.729 mm	63.900 pL/min	66.370 μ L/min
50 μ L	1.03 mm	127.600 pL/min	132.500 μ L/min
100 μ L	1.457 mm	255.20 pL/min	265.100 μ L/min
250 μ L	2.304 mm	638.300 nL/min	662.900 μ L/min
500 μ L	3.256 mm	1.275 nL/min	1.324 mL/min
1000 μ L	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



SPLG101 Dual Infuse-Only Syringe Pump

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

SPLG101	Legato 101 Syringe Pump, Dual Infuse-Only
504578	Software Adagio/USB Key

SPLG110 Infuse/Withdraw Syringe Pump

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 1.26 pL/min to 88.28 mL/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 all multi-mode operation including infusion only, withdrawal only, infusion and withdrawal and withdrawal/infusion modes.

SPLG110	Legato 110 Syringe Pump, Infuse/Withdraw
504578	Software Adagio/USB Key

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 (MAXIMUM)	13.6 kg (30 lbs) @ 100% Force Selection
NUMBER OF MICROSTEPS PER ONE REVOLUTION OF LEAD SCREW	15,360
STEP RATE (MINIMUM)	27.5 sec/µstep
STEP RATE (MAXIMUM)	26 µsec/µstep
DRIVE MOTOR	0.9 degree Stepper Motor
PUSHER TRAVEL RATE (MINIMUM)	0.15 µm/min
PUSHER TRAVEL RATE (MAXIMUM)	159 mm/min
FLOW RATE (MINIMUM)	1.26 pL/ min (0.5 µL syringe)
FLOW RATE (MAXIMUM)	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

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 (MAXIMUM)	13.6 kg (30 lbs) @ 100% Force Selection
NUMBER OF MICROSTEPS PER ONE REVOLUTION OF LEAD SCREW	15,360
STEP RATE (MINIMUM)	27.5 sec/µstep
STEP RATE (MAXIMUM)	26 µsec/µstep
DRIVE MOTOR	0.9 degree Stepper Motor
PUSHER TRAVEL RATE (MINIMUM)	0.15 µm/min
PUSHER TRAVEL RATE (MAXIMUM)	159 mm/min
FLOW RATE (MINIMUM)	1.26 pL/ min (0.5 µl syringe)
FLOW RATE (MAXIMUM)	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 lbs)
CONNECTORS	RS-232 - 9 Pin D-Sub Connector, RS485 - IEEE-1394 6 pos, USB - Type B



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.

Adagio Software

- Low Cost Simple Installation
- Flow Evolution Graph
- Import & Export Programs
- Quick & 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.

System Requirements:

- 1 GHz Pentium processor or higher
- 512 MB of RAM (1 GB recommended)
- Windows XP SP3 or Vista (XP recommended)
- Free RS232 or USB 2.0 ports (depending on the quantity, model and connectivity of the controlled pumps; daisy chained pumps require a single port; direct PC-to-Pump connections require one free port per pump)
- Microsoft Excel 97 or higher

Legato Syringe Pumps

PUMPS, MICROINJECTION



SPLG270

Infuse/Withdraw Continuous

The *SPLG270* is a Push-Pull syringe pump. It accommodates two syringes from 0.5 μ L 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-inch 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	SPL Syringe Pump, Push-Pull
SPLG272	SPL Syringe Pump, Push-Pull Programmable
504576	Small Syringe Multi Rack (for six 30-60mL syringes or ten 0.5 μ L-20mL syringes)
504577	Large Syringe Multi Rack (for up to four 60-140 mL plastic syringes)
504578	Software Adagio/USB Key

SPLG270 SPECIFICATIONS

SYRINGE SIZE	0.5 μ L 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 (MAXIMUM)	34 kg (75 lbs) @ 100% force selection
NUMBER OF MICROSTEPS PER ONE REVOLUTION OF LEAD SCREW	6400
STEP RATE (MINIMUM)	27.5 sec/ μ step
STEP RATE (MAXIMUM)	26 μ sec/ μ step
DRIVE MOTOR	1.8 degree Stepper Motor
PUSHER TRAVEL RATE (MINIMUM)	0.36 μ m/min
PUSHER TRAVEL RATE (MAXIMUM)	190.80 mm/min
FLOW RATE (MINIMUM)	5 μ L/min (0.5 μ L syringe)
FLOW RATE (MAXIMUM)	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

SPLG210

Infuse/Withdraw Syringe Pump

The *SPLG210* Infuse/Withdraw syringe pump offers unparalleled ease of use through the high resolution touch screen. The basic model works with one syringe or two (from 0.5 μ L to 140mL) and can be reconfigured in the field to be used with multiple syringes. rotective 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 in. x 9.75 in. The display also tilts with the change to allow the user 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 in the unit and recalled quickly with the touch of a button.

SPLG210	SPL Syringe Pump, Infuse/Withdraw
SPLG212	SPL Syringe Pump, Infuse/Withdraw Programmable
504576	Small Syringe Multi Rack (for six 30-60mL syringes or ten 0.5 μ L-20mL syringes)
504577	Large Syringe Multi Rack (for up to four 60-140 mL plastic syringes)
504578	Software Adagio/USB Key

SPLG210 SPECIFICATIONS

SYRINGE SIZE	0.5 μ L 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 (MAXIMUM)	34 kg (75 lbs) @ 100% force selection
NUMBER OF MICROSTEPS PER ONE REVOLUTION OF LEAD SCREW	6400
STEP RATE (MINIMUM)	27.5 sec/ μ step
STEP RATE (MAXIMUM)	26 μ sec/ μ step
DRIVE MOTOR	1.8 degree Stepper Motor
PUSHER TRAVEL RATE (MINIMUM)	0.36 μ m/min
PUSHER TRAVEL RATE (MAXIMUM)	190.80 mm/min
FLOW RATE (MINIMUM)	5 μ L/min (0.5 μ L syringe)
FLOW RATE (MAXIMUM)	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



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



SPLG200 Infuse-Only Syringe Pump

The *SPLG200* Infuse only syringe pump offers unparalleled ease of use through the high resolution touch screen. The basic model works with one syringe or two (from 0.5 μ L 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 also tilts with the change to allow the user to operate the pump vertically. User definable flow rates with selectable target volumes or time values to control the total infusion volume. Up to 40 programs of 20 steps each can be configured and stored in the unit and recalled quickly with the touch of a button.

CE

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

SPLG200 SPECIFICATIONS

SYRINGE SIZE	0.5 μ L 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 (MAXIMUM)	34 kg (75 lbs) @ 100% force selection
NUMBER OF MICROSTEPS PER ONE REVOLUTION OF LEAD SCREW	6400
STEP RATE (MINIMUM)	27.5 sec/ μ step
STEP RATE (MAXIMUM)	26 μ sec/ μ step
DRIVE MOTOR	1.8 degree Stepper Motor
PUSHER TRAVEL RATE (MINIMUM)	0.36 μ m/min
PUSHER TRAVEL RATE (MAXIMUM)	190.80 mm/min
FLOW RATE (MINIMUM)	5 pL/min (0.5 μ L syringe)
FLOW RATE (MAXIMUM)	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

SPLG200 FLOW RATES

Syringe	Diameter	Minimum	Maximum
0.5 μ L	0.103 mm	3.12 pL/min	1.589 μ L/min
1 μ L	0.146 mm	6.18 pL/min	3.180 μ L/min
2 μ L	0.206 mm	12.301 pL/min	6.358 μ L/min
5 μ L	0.343 mm	33.96 pL/min	17.630 μ L/min
10 μ L	0.485 mm	67.72 pL/min	35.249 μ L/min
25 μ L	0.729 mm	153.42 pL/min	79.640 μ L/min
50 μ L	1.03 mm	306.24 pL/min	158.984 μ L/min
100 μ L	1.457 mm	612.72 pL/min	318.126 μ L/min
250 μ L	2.304 mm	1.533 nL/min	795.51 μ L/min
500 μ L	3.256 mm	3.06 nL/min	1.588 mL/min
1000 μ L	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

PUMPS, MICROINJECTION

SP Series Syringe Pumps

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

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

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

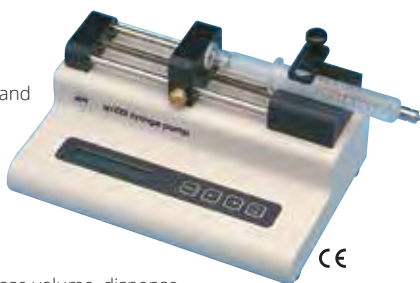
See www.wpiinc.com/sppumps for specifications on the SP Series Syringe Pumps.

Single-Syringe Infusion Pump

SP100i

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

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



Two-Syringe Microdialysis Pump

SP101i

Developed especially for use in microdialysis experiments, this pump produces very fine syringe movement. The modified SP100i gearing features a sixfold gear reduction compared to standard models, allowing pumping at much smaller flow rates. (See the Micro-C for detection of dialysates.)

- Dual barrel infusion only
- Holds two syringes, 10 μ L to 10 mL



Two-Syringe Push-Pull Pump

SP120p



A second syringe mount has been added to the basic SP100i, with both syringes activated by a single pusher block for simultaneous infusion and withdrawal.

- All the features of SP100i
- Holds two syringes, from 10 μ L to 10 mL.

Two-Syringe Infusion Pump

SP200i

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

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



Continuous Cycle Syringe Pump

SP210c

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.

- Holds four syringes, 10 mL to 60 mL each



Two-Syringe Infusion/ Withdrawal Pump

SP210iw

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

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



Multi-Syringe Infusion/ Withdrawal Pump

SP230iw

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

- All features of SP200iw
- Multiple syringe holder accommodates 10 syringes up to 10 mL, or six syringes up to 50 mL, or four syringes up to 140 mL.



Four-Syringe Push-Pull Pump

SP260p *single cycle*

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

- All the features of SP200i
- Holds up to 4 syringes



Multi-Syringe Infusion Pump SP220i

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

- All features of SP200i
- Accommodates 10 syringes up to 10 mL, or six syringes up to 50 mL, or four syringes up to 140 mL.



Four-Syringe Nanoliter Infusion Pump SP250i

Each syringe can be sized differently and is clamped independently.

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



SP100i	Syringe Pump, Infusion (single), 95-135 V
SP100iZ	Syringe Pump, Infusion (single), 220-240 V
SP101i	Syringe Pump, Microdialysis (double, slow speed), 95-135 V
SP101iZ	Syringe Pump, Microdialysis (double, slow speed), 220-240 V
SP120p	Syringe Pump, Infusion-Withdrawal (double), 95-135 V
SP120pZ	Syringe Pump, Infusion-Withdrawal (double), 220-240 V
SP200i	Syringe Pump, Infusion (double), 95-135 V
SP200iZ	Syringe Pump, Infusion (double), 220-240 V
SP210c	Syringe Pump, Infusion & Withdrawal (Continuous Action), 95-135 V
SP210cZ	Syringe Pump, Infusion & Withdrawal (Continuous Action), 220-240 V
SP210iw	Syringe Pump, Infusion & Withdrawal (double), 95-135 V
SP210iwZ	Syringe Pump, Infusion & Withdrawal (double), 220-240 V
SP220i	Syringe Pump, Infusion (multiple), 95-135 V
SP220iZ	Syringe Pump, Infusion (multiple), 220-240 V
SP230iw	Syringe Pump, Infusion & Withdrawal (multiple), 95-135 V
SP230iwZ	Syringe Pump, Infusion & Withdrawal (multiple), 220-240 V
SP250i	Syringe Pump, Infusion (multiple, mixed volumes), 95-135 V
SP250iZ	Syringe Pump, Infusion (multiple, mixed volumes), 220-240 V
SP260p	Syringe Pump, Infusion-Withdrawal (double) Single Cycle Action, 95-135 V
SP260pZ	Syringe Pump, Infusion-Withdrawal (double) Single Cycle Action, 220-240 V

All 240-volt pumps are CE-approved.

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

####-P Programmable Ramp Option (SP200 Series)

OPTIONAL CABLES

15623 Serial cable, SP Pump-to-IBM 9-pin "D" connector

13685 SP Pump-to-Pump "Daisy-Chain" linking cable, 7 ft

13962 Footswitch for SP200 Series Pumps

REGAL pipetters



- **Lightweight and conformable ergonomic design**
- **Easy calibration using provided tool**
- **Made from biologically inactive and chemical inert polymers**
- **Easy for cleaning and parts replacement**
- **CE and ISO13485 Certified**

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



GER55 Regal Pipetters (set of any 5) & stand

GER56 Regal Pipetters (set of any 6) & stand

GER57 Regal Pipetters (set of any 7) & stand

504591 Stand for Regal Pipetters (holds 8)

Universal Pipette Tips

Ultra-clear and certified RNase/DNase-free



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
1000 - 10,000 µL	REG10K	250 (10 racks of 25)	504590

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 *
1000 - 10,000 µL	REG10K	Bag of 1000	504588	250 (10 racks of 25)	504589

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

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

Same as leading brands—
**at about half
the price!**



PUMPS, MICROINJECTION

UltraMicroPump III

**Three-prong
syringe holder
for more stability**

For sub-microliter injection,
see *NanoFil™*, page 178

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

CE

**Manipulator
not included.**

CE

**Now with
microstepping**

**Controller now has higher
resolution and is virtually pulse-free**

This versatile injector uses microsyringes to deliver picoliter volumes

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

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

ULTRAMICROPUMP SPECIFICATIONS

(based on 10 μ L syringe)

NORMAL MODE

TRAVEL	62 mm
MINIMUM DISPENSING VOLUME	0.58 nL / step (10 μ L syringe)
LINEAR MOTION PER STEP	3.175 microns
WEIGHT	325 g (11.5 oz)
MOUNTING ROD DIAMETERS	7.9 mm (0.31 in.)
MAINS POWER SUPPLY	90-264VAC @ 47-63Hz
DIMENSIONS	\varnothing 32 mm x 190 mm (\varnothing 1.3 in. x 7.5 in.)

MICROSTEPPING MODE

Precision is increased eight-fold

World Precision Instruments

www.wpiinc.com

The world's leading ultramicropump!

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



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

UMPIII shown mounted to stereotaxic frame (not included).

Smart Controller

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

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

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

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

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

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

OPTIONS AND ACCESSORIES

15867	Footswitch for Micro4
40500	RS-232 Cable, 9-pin "D" connector
502201	V-clamp for Stereotaxic Frame
503301	Extension Cable, miniDIN (male-female) 10 ft
503207	Small Base Stand and Clamps

Microvolume Syringes

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), 50 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, SGE100RN, 26 ga (0.47 mm) 50 mm long, 5-pack



Pneumatic PicoPumps

Repeatable microinjection in volumes ranging from picoliters to nanoliters

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

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

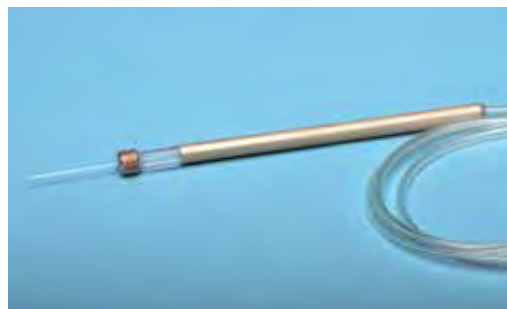
The most recognized picopump in the world!



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

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

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



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

Each PicoPump is supplied with a 5430-ALL kit that includes two PicoNozzles and tubing to connect the holders to the pressure and vacuum ports.

SYS-PV820 PicoPump w/ hold pressure

SYS-PV830 PicoPump w/ hold pressure and vacuum

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

OPTIONAL ACCESSORIES

3260	Foot Switch
2932	Rack Mount Kit, 3½-in. high (PV820)
2933	Rack Mount Kit, 5¼-in. high (PV830)
5430-10	PicoNozzle Kit (MPH6S for 1.0 mm pipette & 5-ft tubing assembly)
5430-12	PicoNozzle Kit (MPH6S for 1.2 mm pipette & 5-ft tubing assembly)
5430-15	PicoNozzle Kit (MPH6S for 1.5 mm pipette & 5-ft tubing assembly)
5430-20	PicoNozzle Kit (MPH6S for 2.0 mm pipette & 5-ft tubing assembly)
5430-ALL	PicoNozzle Kit (for 1.0, 1.2, 1.5, and 1.65 mm pipettes & 5-ft tubing assembly)
75122-110	Replacement Gaskets for PicoNozzle — 1.0 mm, green, package of 10
75122-210	Replacement Gaskets for PicoNozzle — 1.2 mm, black, package of 10
75122-310	Replacement Gaskets for PicoNozzle — 1.5 mm, blue, package of 10
75122-410	Replacement 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



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

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

PICOPUMP SPECIFICATIONS

	PV820	PV830
PRESSURE		
PRESSURE INPUT	0 to 150 psi	0 to 150 psi
PRESSURE OUTPUT	0.3 to 90 psi *	0.3 to 90 psi
PULSE WIDTH (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 (1/4 in. OD Tubing)	Quick Connect (1/4 in. OD Tubing)
OUTPUT CONNECTOR	Barbed (1/8-in. ID Tubing)	Barbed (1/8-in. ID Tubing)
CONTROL	Solenoid	Solenoid
	* Both Hold and Eject Pressures	
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 (1/4 in. OD Tubing)	Quick Connect (1/4 in. OD Tubing)
OUTPUT CONNECTOR	Barbed (1/8 in. ID Tubing)	Barbed (1/8 in. ID Tubing)
CONTROL	Manual	Manual
VENT	Atmosphere	Atmosphere
CONNECTIONS INCLUDED		
INPUT KIT	10-ft nylon tubing (0.25-in. OD, 1000 psi), one 1/2-inch female NPT adapter	
OUTPUT KIT	Two PicoNozzle assemblies, each consisting of one MPH6S pipette holder, 60-in. of PVC tubing (200 psi), and a luer-fitted aluminum handle.	
PHYSICAL SPECIFICATIONS		
POWER	95-135 V or 220-240 V, 50/60 Hz	95-135 V or 220-240 V, 50/60 Hz
DIMENSIONS	17 x 3.5 x 9.5 in. (43 x 9 x 24 cm)	17 x 5.25 x 9.5 in. (43 x 13 x 24 cm)
SHIPPING WEIGHT	11 lb (5 kg)	14 lb (6.3 kg)

Miniature Vacuum Pump

- Oil free
- Maintenance free
- Minimal vibration
- Low noise
- Extremely long life time
- Compact (18 x 7 x 7cm)
- Durable aluminum exterior



This miniature vacuum pump is durable and accurate, ideal for any application requiring a small, reliable pump that provides vacuum pressure up to 250 mbar. 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)
Motor Type	Vibrating	
Power	4.0 W	4.0 W
Free Flow	4.0 L/min.	3.0 L/min.
At -100 mbar	2.0 L/min.	1.5 L/min.
Maximum Pressure	-	-
Maximum Vacuum	-250 mbar	-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	

801566 Mini Vacuum Pump (110V)

801963 Mini Vacuum Pump (220V)

Microinjection System

Zebrafish, C. Elegans, Drosophila, Xenopus Oocytes



System shown here: **5052** Steel base plate, **M10** Magnetic stand, **M3301L** Micromanipulator, **5430-ALL** PicoNozzle kit with a μ Tip, **FD35-100** Fluorodish, **PZMIII** Microscope with optional lighted base, **E210** Micropipette storage jar, **504156** Regine tweezers #5, **14003** Vannas spring scissors, glass capillaries, **77020** glass tweezers, **REG10** Regal 10 μ L pipetter, **PV820** Pneumatic PicoPump and **801566** (**801963**) Miniature Vacuum Pump.

Zebrafish (*Danio Rerio*) are rapidly gaining in popularity as bio-medical research subjects because of the ability to generate high resolution, *in vivo* images of the embryos. Zebrafish are easy to maintain and produce a large number of offspring. Additionally, the embryos have a nearly transparent skin, making their development easily visible. These fish are used for a variety of disciplines, including neuroscience, genetics and aging studies.

Serving scientist for over 45 years, WPI offers a variety of instruments for microinjection including pumps, pipettes, microscopes and more. One of our most popular pumps for microinjection is the PV820 Pneumatic PicoPump.

The **PV820** and **PV830** Pneumatic PicoPumps were designed to simplify intracellular injection. You get repeatable microinjection in volumes ranging from picoliters to nanoliters. **PV820** offers eject and hold pressure. The hold pressure prevents backfilling of the pipette by capillary action. In addition, the **PV830** also has vacuum pressure which allows you to securely hold a cell with one pipette while you inject it with another. The volume injected is controlled by the inside diameter of the glass tip, the pressure and the time.

Recently, WPI introduced its customizable Microinjection System with everything you need to get started. The basic system is shown here. Starting below, you will find many options and accessories to customize your system.

Options for Customizing Your System

INJECTOR

- **PV820** Pneumatic PicoPump with Hold Pressure
- **PV830** Pneumatic PicoPump with Hold Pressure and Vacuum
- **UMPIII** UltraMicroPump
- **Nanoliter2010**



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



The versatile **UMP3** microinjector uses microsyringes to deliver picoliter volumes.



Microprocessor-controlled **Nanoliter 2010** uses direct piston displacement.

Complete system for microinjection

MICROSCOPE

- *PZMIII* Precision Stereo Zoom Microscope on Track Stand
- *PZMIV* Precision Stereo Zoom on Track Stand
- *504928* LED Lighted Microscope Stand, 12.5"
- *504929* LED Lighted Microscope Stand, 10.5"
- *504596* Halogen Lighted Microscope Stand



PZMIII Precision Stereo Zoom Microscope on Track Stand



504928 LED Lighted Microscope Stand



504596 Halogen Lighted Microscope Stand

PULLERS

- *PUL1000* Microprocessor-controlled 4-Step micropipette puller
- *Nanofil* Microliter syringes
- *MicroFil* for backfilling glass needles
- Glass capillaries
- Pipettes
- *MicroTip* pre-pulled pipettes
- *E2XX* Micropipette Storage Jar

Use the **E2XX** jars to store up to 30 micropipettes, filled or unfilled, up to three inches in length.



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. This allows graduated cycles for applications like patch clamp recording.

Nanofil is the world's smallest dead volume injection syringe. (26 ga. to 36 ga. syringes) Custom needle shapes are available — blunt, sharp, beveled.



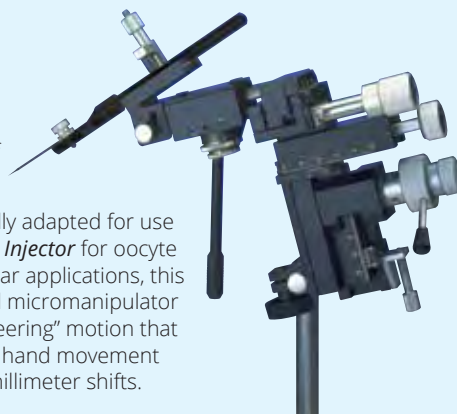
MANIPULATOR

- *M3301* Manual Micromanipulator
- *KITE* Manual Micromanipulator
- *MMJ* Joystick-Controlled Micromanipulator
- *DC3001* Motorized Micromanipulator
- *SN-PCZ-50* Miniature Piezo Micromanipulator with controller



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

The **MMJ** is specially adapted for use with the *Nanoliter Injector* for oocyte injection and similar applications, this joystick-controlled micromanipulator allows an easy "steering" motion that translates normal hand movement into smooth submillimeter shifts.



LIGHTS

- *Z-LITE-186* Fiber Optic Illuminator with (500186) Bifurcated Light Guides
- *LED-Lite* Modular LED Light Source with Exchangeable LEDs



LED-lite is a power supply for WPI's *ELS* LED modules for monochromatic light excitation.



The **Z-LITE** Fiber Optic Illuminator provides reliable high-intensity light for microscopes.

ACCESSORIES

- *801566/801963* Vacuum Pump for use with the PV830
- *Fluorodish* Optical glass bottom dishes
- *504134* LED Ring Light
- *M10* or *M-3* manipulator base
- *Z-MOLDS* Microinjection and Transplantation Molds
- Many surgical instruments, including:
 - **77020** Glass tweezers
 - **500342** Dumont Tweezers #5
 - **504507** Fine pointed Swiss tweezers
 - **14003** Vannas spring scissors



Z-MOLDS Microinjection and Transplantation Molds create grooves in agarose gel. Pipette the embryos into the grooves. The embryos self-align.

PUMPS, MICROINJECTION

Microinjection and Transplantation Molds

Are you looking for a simpler method for handling zebrafish embryos?

To speed up your process and accuracy, try **Z-MOLDS**. 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. Using the molds is easy.

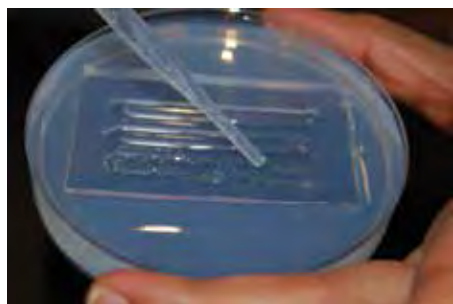
Turn the molds up-side down (ridged side down) and place them in liquid agarose gel.



Allow the agarose to solidify. Then, remove the mold.



Pipette your embryo eggs into the grooves formed by the **Z-MOLDS**. The embryos self-align.



It's truly that easy. Now you are ready for microinjection.

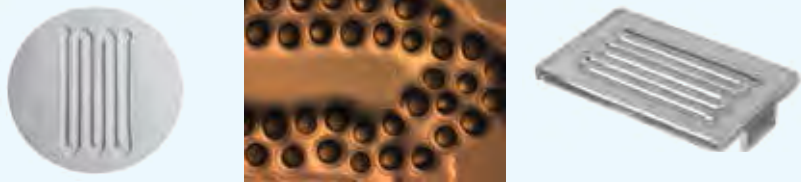
See the video: www.wpiinc.com/z-molds



Z-MOLDS


Proteomics and Large Screening

This mold is designed for injecting 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

This mold is designed for larval injections. The sloped ridges make perfect angles in the agarose gel, which then makes it easier to do microinjections in the larvae.




Transplantation

This mold is designed for increasing the speed of doing microinjections. Simply turn the petri dish as you are injecting.



Standard Microinjection

This mold is designed for blastomere transplantation.



Z-MOLDS Microinjection & Transplantation Molds **\$145**



Nanoliter Injector

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



Micromanipulator not included.

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 footswitch, a calibrated volume will be smoothly injected. The process is quiet and vibration free. Capillary filling and injection speeds are 23 nL/sec and 46 nL/sec (emptying speeds are 92 nL/sec and 230 nL/sec). Maximum fluid ejection is 5 µL. Each unit comes with sufficient glass to pull at least 300 tips. Glass is 1.14 mm O.D. (nominal) and 0.5 mm I.D.

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

Included: 1 vial 3.5 in. capillaries (300); replacement "O" rings; Allen wrench; MicroFil™ MF34G backfilling needle; and two sample µTip™ pre-pulled micropipettes.

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



Optional smart controller for Nanoliter 2010

NANOLITER 2010 SPECIFICATIONS

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

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

NANOLITER2010	Nanoliter 2010
NL2010MC4	Nanoliter Injector & Micro4 Controller (<i>small controller not included</i>)

OPTIONAL ACCESSORIES

13142	Footswitch for Nanoliter 2010
15867	Footswitch for Micro4 Controller
4878	Replacement 3.5-in. glass capillaries (300)
4879	Replacement 7-in. glass capillaries (300)
TIP10XV119	Micropipettes for Nanoliter Injector (10)
SYS-MICRO4	Micro4 Controller, Four-Channel
300033	Adapter for Micro4
300521	Replacement O-rings (five)
500778	Replacement Nanoliter Injector Universal Adapter
500299	Pistons, 5-pack



ferrule: \varnothing 8 mm

glass barrel: \varnothing 7 mm

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

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

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

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

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

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

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

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

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

REPLACEMENT BACKFILL NEEDLES

NF26BV-2	26G Beveled Needle, 460 μ m nominal diameter (package of 2)
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Using NanoFil in different configurations

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

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

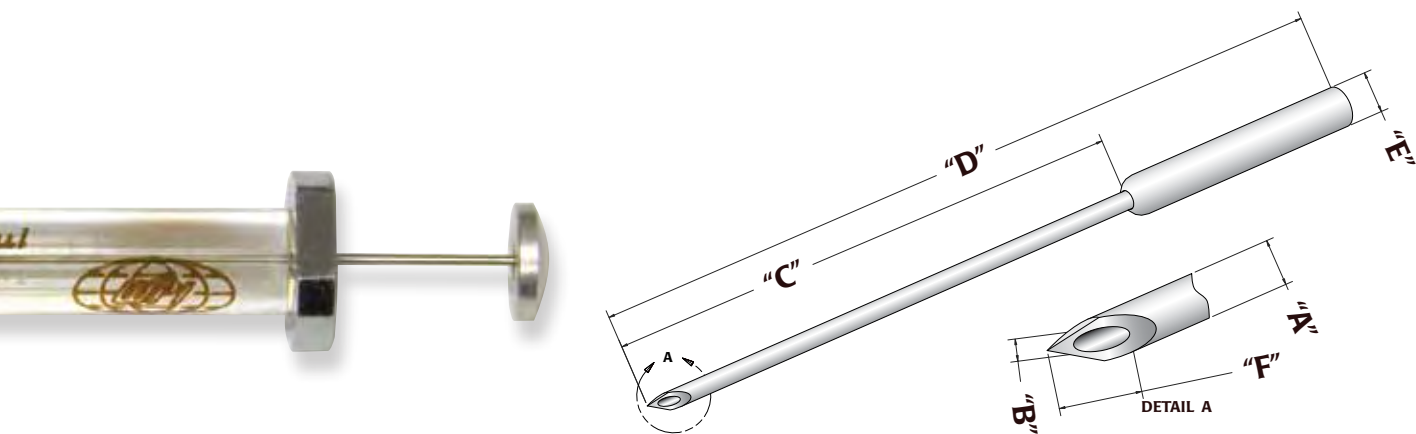
SilFlex tubing and holder: The needle is mounted on a small plastic holder that is connected to the NanoFil by a 35 cm length of flexible tubing. The NanoFil is mounted on the UMP II pump. This configuration allows the user to hold the animal in one hand and insert the needle with the other. When the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

Selecting the correct tip for your application

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

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

All of WPI's beveled tips have a unique 25 degree tri-surface bevel that is optimized for microinjection. A 10 degree single-surface beveled tip penetrates better than one with a 25 degree angle, however the distance between the upper opening to the tip (the dimension "F" in the drawing above) is longer. As a result, it requires a deeper penetration of the tip to achieve the same level of liquid delivery. Deeper penetration means more tissue damage. WPI's unique 25 degree beveled tip solves



this problem with two extra beveled surfaces. The tip of a single surface beveled tip is actually a blade instead of a point. It dulls very quickly. In contrast, the tri-surfaced tip has a real point. It not only penetrates much better but is also much more durable. Our tests show that our 33 gauge, 25 degree beveled tip penetrates easier and lasts longer than other 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 tips undergo a penetration test before leaving the factory to guarantee the best results for our customers.

Available Tips

33 gauge: This tip is similar to Hamilton's 7762 and 7803 series removable needles in both tip length and outer diameter. However, our beveled tip version is shorter, more durable, and penetrates better due to the special tri-surface grinding technique. In the past, 33 gauge tips were the smallest size sold by other manufacturers and were frequently cited in literature. However, our new 35 gauge tip is much better for injections involving small animals, especially mice. Compared with Hamilton's 33 gauge, 10 degree beveled tip, our 35 gauge 25 degree beveled tip can reduce the depth of penetration by almost 80%. The distance between the tip and the upper rim of the opening (dimension F on the drawing) is 348 microns for the 33 gauge tip. The distance for our 35 gauge tip is only 230 microns. In addition, the smaller tip size significantly reduces the required penetration force. In nearly all applications, a 33 gauge tip can be replaced with our 35 gauge tip and produce better results.

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

35 gauge: This was the most popular and preferred tip of most scientists during our field trial. The combination of its strength, length, durability, and clogging resistance creates a balance with very little compromising of the individual properties. It is much smaller than the 33 gauge tip offered by other

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

manufacturers. It is only slightly larger than the 36 gauge tip but is much stronger and less likely to be clogged. Samples can be directly loaded with this tip. Its 5 mm length is sufficient enough for almost all injection applications in mice.

36 gauge: This is the smallest tip that is commercially available. The tip is so small that it can be inserted into the opening of the 33 gauge needle tip. Because this is pushing the limits of what current technology can produce, there are some limitations to consider before using. Its thin diameter makes it necessary to limit its length to 2.5 to 3 mm in order to maintain a usable strength. Since the tip ID is in the 25 to 50 micron range, it is very easily clogged. Therefore, only well filtered solutions can be used. Depending on the viscosity of the

sample, the user might also need to pre-load the syringe with a regular tip before switching to this tip for injection. We recommend using the 35 gauge tip instead of the 36 gauge unless it is absolutely necessary.

Flexible Quartz Tubing: The flexible quartz tubing tip is made of 160 micron OD polyimide coated quartz tubing with a special adapter sleeve mounted at the end. It is designed for filling glass capillary electrodes or pipettes, just like WPI's traditional MF34G Microfil. However, unlike the traditional MicroFil, which has about 50 microliters of dead volume in its luer hub, the dead volume of this tip is less than 0.4 microliters. It is useful for loading electrodes with solutions that have a limited volume or are too expensive to waste.

NANOFIL NEEDLES

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

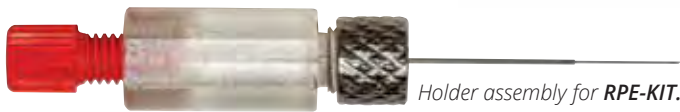
REPLACEMENT PARTS & ACCESSORIES

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 5)

NanoFil Application Kits



The optional **UMP3** stand in the photo below includes the small base (**503084**), open-side clamp (**14073-4**) and 25cm rod (**503070**).



Holder assembly for RPE-KIT.

These kits are specially designed for eye research for injecting retinal pigment epithelium (RPE) and intraocular (IO) in addition to brain injection in mice. They need to be used with a **NanoFil** syringe and **UMP3** to achieve accurate, repetitive, and oil free injection in the submicroliter range. Each kit includes two pieces of Silflex tubing (one for a spare), a holder assembly, spare gaskets, and an assortment of four tips — blunt for the RPE kit and beveled tips for the IO kit. Each kit comes with one each of 33, 34, 35 and 36 gauge tips so that first time users can find the best size for their application.

The Silflex tubing is the most critical component of the kit. This 35 cm long, flexible tubing has a very precise outer diameter for airtight fitting with the syringe. It also has a small inner diameter for minimum dead volume, and is very durable when handled correctly. The SilFlex

is coupled to the injection tip with a mechanism similar to that of the NanoFil. The dead volume of the entire kit (including the tubing) is less than 3 microliters. All of the components in the kit are constructed of inert, solvent resistant materials for easy cleaning after viral injection.

RECOMMENDED ACCESSORIES

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, and beveled tipmix)
503207	Stand & Clamps



Manual Microsyringe Pump

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



solid stainless steel frame

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

DMP & MMP SPECIFICATIONS

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

MMP	Manual Microsyringe Pump
DMP	Manual Microsyringe Pump with Digital Display
ACCESSORIES	
MMP-KIT	Injection Assembly Parts Kit
<i>Not including valve—see #14057-10, page 97</i>	

Pressure Manometer

For measuring hydrostatic pressures



Hand-held and battery operated, PM Series pressure manometers monitor vacuum and pressure in nonaqueous fluids. An integral transducer and digital display allow easy and accurate pressure readings.

Three versions measure pressures in the range of ± 1 psi, ± 15 psi or ± 100 psi.

A range switch allows measurement in units of psi or kPa for the 100 psi version, and psi or 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 $\frac{1}{8}$ -inch ID soft vinyl tubing. A mini-phone-to-BNC cable for the recorder output is also available (Part #CBL102). Standard versions are equipped with a nine-volt alkaline battery.

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

Specify line voltage

*Rechargeable versions come with nickel/cadmium battery and charger

PRESSURE MANOMETER SPECIFICATIONS

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

Microfluidic Pumps

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. 0.5µL; 1µL; 5µL etc. to achieve non-pulsatile stable flow rates in the nanolitre/minute range. By comparison, the ExiGo pump with the flow sensor can use a standard 250µL glass syringe to produce stable non-pulsatile flow rates of 10nL/min – 1ml/min; or a 5mL plastic syringe to produce stable non-pulsatile flow rates of 100nL/min – 20mL/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.

Mirus is a precision syringe pump, which uses the combination of the expandable (flexible) element and fluidic resistance in order to dampen the pulsation of the syringe pump stepping. The main difference is that the ExiGo has feedback control; the Mirus does not. Because the Mirus does not have feedback control, it also does not have a fast reaction time and so takes a long time to change flow rates. Conversely due to the expandable element, 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(8 parallel experiments) simultaneously.

Kima pump is a microfluidic pump designed to aid cell culture (e.g. endothelial cells) under physiological conditions (shear flow) in various biochips and flow chambers, including Cellix's Vena8 Endothelial+ biochips where it is possible to culture 8 cell monolayers simultaneously over 24–48 hours. The pump is a solenoid pump and so it is not pulse-free. This pump delivers a preset volume of liquid as programmed.



CX-EXIGO-PFS Microfluidic syringe pump with precise flow control with active feedback via integrated flow sensor.

Flow rate: 50 nL/min – 10 mL/min \pm 0.5%

Includes: iPad mini which can control/program up to 4 pump modules independently

CX-E1000 Microfluidic syringe pump with precise flow control. For customers who have bought ExiGo Pro 1.0 and already have iPad mini.

DOES NOT INCLUDE IPAD MINI.

CX-EXIGO-P Microfluidic syringe pump with precise flow control. Includes: iPad mini which can control/program up to 4 pump modules independently

CX-E2000 Microfluidic syringe pump with precise flow control with active feedback via integrated flow sensor.

Pump only — for customers who have bought ExiGo Pro 1.0 and already have iPad mini.



CX-MIRUS-P Microfluidic syringe pump for shear flow studies. Includes: tubing kit, VenaFlux Assay Software PC control and MultiFlow8

CX-M1000 Microfluidic syringe pump for shear flow studies. Includes: tubing kit, VenaFlux Assay Software PC control and MultiFlow8. Not included: MultiFlow8.






CX-M8000 MultiFlow8 attachment for Mirus Evo Nanopump: for higher throughput enabling 8 assays in parallel in the microfluidic biochips.



CX-KIMA-P Microfluidic pump for continuous cell culture under shear flow mimicking physiological flow in the human vasculature. Includes: iPod Touch and controller.

CX-K1000 Microfluidic pump for continuous cell culture under shear flow mimicking physiological flow in the human vasculature. KIMA pump only.

Biochips

	Vena8 Fluoro+	Vena8 Endothelial+	VenaT4	Vena8 Glass Coverslip		Vena Delta	
				Low Flow Rates	High Flow Rates	Y1	Y2
Dimensions							
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 \$768	CX-004 \$768					
Pack of 10	CX-001 \$1532	CX-003 \$1532	CX-005 \$1532	CX-009 \$1532	CX-010 \$1532	CX-007 \$1532	CX-008 \$1532

Specifications

Brightfield, phase contrast & immunostaining	✓	✓	✓	✓	✓	✓	✓
Confocal microscopy	✓			✓	✓		
Cell types: whole blood (human, animal); PRP; platelets; PBMC; monocytes; T-cells (primary & 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 & thrombi formation; Leukocyte rolling, adhesion & migration; Thrombosis; Immunology (Inflammation); Infectious diseases (e.g. Malaria); Sickle cell disease; Respiratory (Asthma & COPD)	✓			✓	✓		
Cell adhesion and culture under perfusion / shear flow; Leukocyte cell-cell rolling, adhesion & migration; Oncology (Melanoma, Breast Cancer etc.); Cardiovascular (Atherosclerosis, Drug eluting stents); Immunology (Inflammation); Respiratory (Asthma & COPD)		✓					
Biofilm assays, microbe seeding & 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 coverslips.
- 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 & play connection with tubing connections which are autoclaveable and reuseable.

World Precision Instruments

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Optical Detection Systems

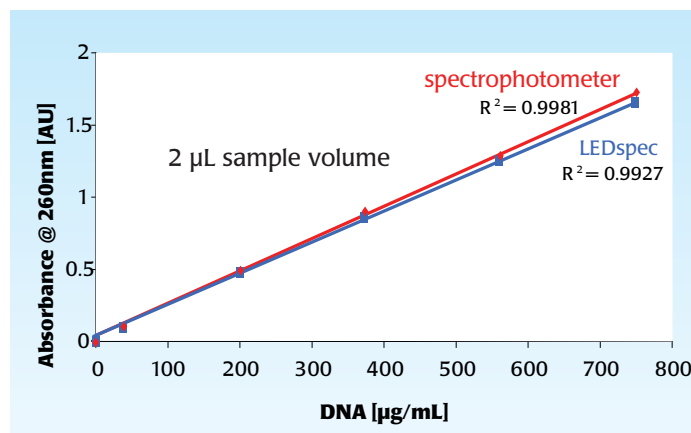


Bio Photometric Detection System

Choose the wavelength data you want to see. In many nutrient, water purity and process applications, full spectrum analysis is not required. With LEDspec you can eliminate the extraneous data and focus on those wavelengths you need to see. You can conduct flow analysis and single-scan applications with high precision over a large dynamic range.

- Affordable spectroscopy
- Dynamic range and baseline noise outperform CCD and photodiode array based spectrometers
- LED light source eliminates costly replacement lamps
- Integrated reference channel eliminates signal drift
- Full computer control
- Integrated math functions allow for baseline correction at a second wavelength, signal ratio and more
- Simplified display with just the data you want to view
- Your choice of three wavelengths included

Two models are available: 2-channel and 4-channel. LEDspec-2 (2-channel) comes with your choice of three LED modules (wavelengths). LEDspec-4 (4-channel) also includes your choice of three LED modules, however, up to four additional wavelengths can be added, if desired.



DNA Calibration Curve using WPI's V-Vette combined with a LEDspecUV and pharmaceutical compliant spectrophotometer.

LEDspec

- Measures visible wavelengths
- Sample cells: LWCC, Fiber Optic Cuvette Holders, V-Vette
- Wavelength range (nm): 400, 450, 540, 560, 600, 650, 700, custom
- Applications include:

Environmental/Oceanography

Ammonia at 650nm
Iron at 560nm
Nitrite/Nitrate at 540nm
Phosphate at 700nm

Pharmaceutical

Process Control

Semiconductors

Water purity, trace metal analysis (Fe, Pd, Cu, U)

Data You Want to See

Many **biochemistry** applications require information at specific, important wavelengths, instead of a full spectrum analysis. For example, the Bradford, BCA and Lowry assays for protein analysis rely on specific wavelengths.

LEDspec is ideally suited for **oceanographic** applications such as detecting nM concentrations of nitrite/nitrate, phosphate and iron using WPI's LWCC sample cells. Two or four independent channel FIA detection systems can be assembled using a **LEDspec-2** or **LEDspec-4**, respectively.

LEDspec is a stand-alone LED-based bio-photometric detection system designed to give you the information you want to see. Now you can conduct flow analysis and single-scan applications with **high precision** and a large **dynamic range**.

LEDspec can be equipped with **up to 7 LEDs** of different wavelengths.

Its noise (< 0.1 mAU peak to peak) and drift performance (<0.5 mAU/h) exceeds that of a CCD or photodiode array detection system **at a fraction of the cost**.

LEDspec uses dual-beams to **reduce light source drift**. Conventional single beam spectrometers notice baseline drift caused by warm up, temperature stability and bulb aging. An internal reference channel in the LEDspec corrects for baseline while you make sample measurements.

Data Collection and Analysis

Now, you can analyze output data with **LEDspec's** easy-to-use software and export chromatographs directly to your PC (via USB) in Microsoft® Excel format. Software provides:

- Full computer control of **LEDspec**
- Continuous flow or single-shot analysis of up to four independent channels simultaneously or sequentially.
- Immediate calibration and analysis (mean and standard deviation) of up to four channels

INTRODUCTORY PRICE

LEDspec-2	LEDspec biophotometric detection system, 2 channel, 3 VIS LED modules (choose when ordering)
LEDspec-4	LEDspec biophotometric detection system, 4 channel, 3 VIS LED modules (choose when ordering)
89273	UV LED module, 260 nm
89272	UV LED module, 280 nm
89274	UV LED module, 340 nm
89245	VIS LED module, 400 nm
89246	VIS LED module, 450 nm
89247	VIS LED module, 540 nm
89248	VIS LED module, 560 nm
89275	VIS LED module, 600 nm
89276	VIS LED module, 650 nm
89249	VIS LED module, 700 nm
PERIPRO-4LS	Peri-Star Pro, 4-channel, low rate, small tubing (see page 162)
MINISTAR	Miniature Peristaltic Pump, 1-channel (see page 164)



LEDSPEC SPECIFICATIONS

OPTICAL BASICS	LED-based multiple wavelength detector with build-in reference channel
CHANNELS	2 or 4
DETECTOR	Photodiode
SPECTRAL BANDWIDTH (FWHM)	10 nm (LEDs >400nm) 4 nm (260, 280, 340nm LEDs)
DYNAMIC RANGE	0-3 AU
DETECTOR RESOLUTION	24 Bit
NOISE (PEAK TO PEAK)	< 0.1 mAU
WARMUP TIME	Instant
FIBER OPTIC INPUT	600 µm
DRIFT	< 0.5 mAU/h
DIGITAL INPUTS AND OUTPUTS	8/8
ANALOG OUTPUT	+/- 10 V, scaleable output
DIMENSIONS (W*H*D)	290 x 80 x 250 mm (11.4" x 3.2" x 9.9")
WEIGHT	2 kg (2.2 lbs)
INTERFACE	USB 2.0
MAINS	100 - 240 V / 50 - 60 Hz



Optical Detection Systems

UltraPath™

A unique multiple long pathlength sample cell for absorbance spectroscopy



- 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

UltraPath™ is a unique high-performance spectrophotometer system offering user-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.

Background

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).

Design

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 user-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: the risk of trapping dust particles, fibers or particulate matter inside the cell. The UltraPath system includes a low noise photodiode array-based spectrometer module (TIDAS I: FWHM = 5 nm, noise <0.2 mAU) and a light source (D4H with UPUV; FO6000 with UPVIS) to measure sample absorption. Light is coupled from the light source to the sample cell and from the sample cell to the detector via two fused silica fibers. A peristaltic pump (PeriPro-4LS) is utilized to draw the sample into the UltraPath sample cell.

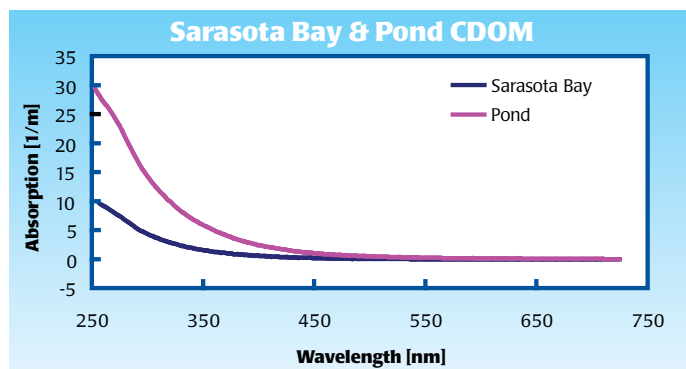


Fig. 1 — Two typical absorption spectra measured using UltraPath. The sample labeled "Sarasota Bay" is a CDOM sample with 34 PSU salinity collected from Sarasota Bay (Nov. 2007), and the sample labeled "Pond" is a highly concentrated CDOM sample collected from a local pond in Sarasota, Florida (Nov. 2007).

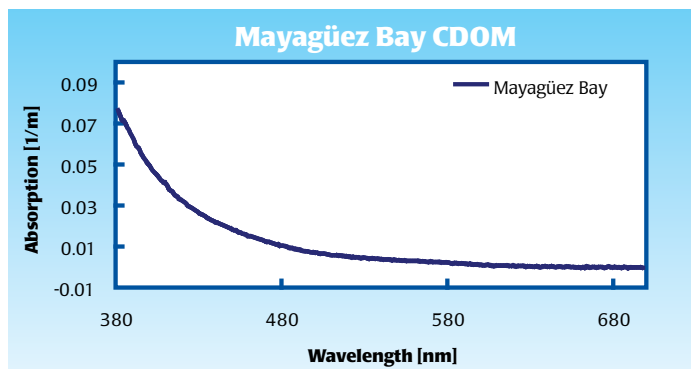


Fig. 2 — CDOM Sample “Mayagüez Bay” was collected from the high salinity oligotrophic waters of Mayagüez Bay on the west coast of Puerto Rico (2001). Data courtesy of NASA Stennis Space Center.

A standard PC or laptop (not included) is connected to the TIDAS E via a RJ-45 Ethernet interface. For spectrometer requirements and software options, see **TIDAS-E**.

Mobility

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.

Samples

Two typical absorption spectra recorded with an UltraPath (UPUV) of a seawater and a fresh water sample collected in November 2007 are shown in Fig. 1. Due to their high absorbance, both samples were analyzed in the 10 cm pathlength. The CDOM sample labeled Mayagüez Bay in Fig. 2 is from oligotrophic, low productive waters with high salinity collected off the west coast of Puerto Rico in the Mayagüez Bay. 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.

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 206) which can be used with the spectrometer (**TIDAS E**) 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.

Reference

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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>

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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.

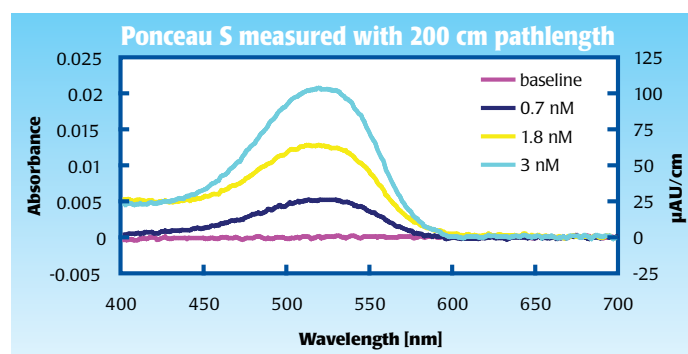


Fig. 3 – Ponceau S absorbance measured with UltraPath (200 cm cell). Ponceau S was dissolved in Millipore water.

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)

UPVIS Ultrath path System, Visible Light

UPUV Ultrath path System, Ultraviolet & Visible Light

The UltraPath system includes: Multiple pathlength cell, Tidas E with TidasDAQ/SpectraView software, FO-6000 light source (UPVIS) or D2H light source (UPUV), two FO-600-SMA1M optical fibers, PeriStar Pro peristaltic pump, silicone tubing, sample injector and Waveguide Cleaning Kit.

Specify line voltage

501609	Waveguide Cleaning Kit
KIT-UPVIS-STARTUP	FO-600-SMA1M, 501609, 72100, 800120, 15807
KIT-UPUV-STARTUP	FO-600-SMA1M, 501609, 72100, D2H-DB, D2H-HB, 15807
89575	QFT1, Fiber Optic Holder for Glass Fiber Filters

Optical Detectors



- **Photodiode array spectrometer module**
- **Low noise detection (<0.1 mAU peak to peak)**
- **Wavelength range 190 nm to 720 nm**
- **Fiber optic design**



Tidas E

High performance fiber optic spectrometer systems

WPI's **Tidas E** is a high end photodiode array-based spectrophotometer including a light source, a cuvette holder and fiber optic coupling. Its companion is the **TIDAS E Base**, a fiber optic spectrometer module with a fiber optic connector for modular spectrometer systems. The Tidas family of spectrophotometers and spectrometer modules outperforms conventional bench-based spectrophotometers and CCD-based spectrometer modules, when it comes to high precision fiber

optic sampling. It relies 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 E is designed for fiber optic sampling cells. Using suitable light sources and sample cells, spectral detection in the wavelength range of 190 to 720 nm can be performed at noise levels <0.04 mAU peak to peak.

Applications

The Tidas E is 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 **V-Vette** or **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.

Wavelength Range	Resolution	Wavelength Accuracy	TIDAS E BASE	Light Source	TIDAS E	Light Source
UV 190-390 nm	< 3 nm	±1 nm	504717	no	504720	UV
UV/VIS 190-720 nm	< 7 nm	±1 nm	504718	no	504721	UV / VIS
VIS/NIR 300-1100 nm	< 10 nm	< 3 nm	504719	no	504722	VIS
Integrated Cuvette Holder			no			yes
Number of Pixels	256					
Dimensions	260 x 150 x 140 mm					
Weight	2.5 kg					
Power Supply	100 - 240 VAC / 47 - 63 Hz					
Digital I/O	2 x IN / 2 x OUT					
Optical Fiber Connection	SMA 905					

Includes power supply, TIDAS DAQ software, RJ-45 cable, and manual

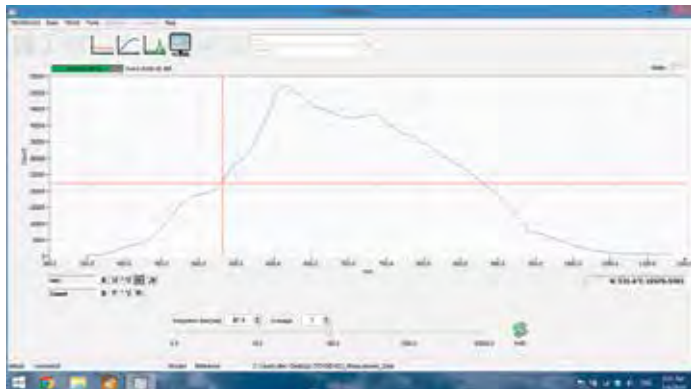


Figure 1: TIDASDAQ acquisition window, showing an absorbance baseline.

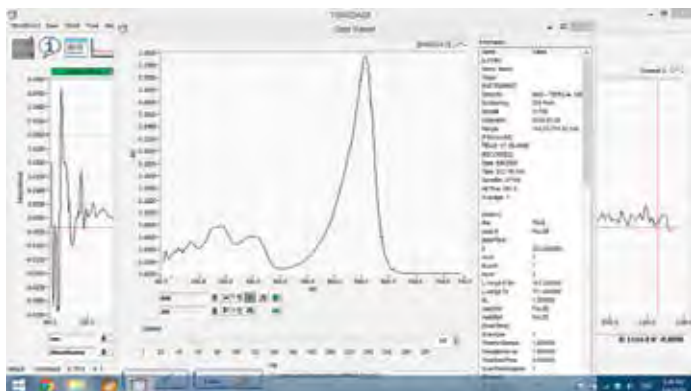


Figure 2: Spectra can be displayed and analyzed in 2D and 3D format. This allows the user to conveniently interpret "time acquisition" data typically done with a TIDAS-E-BASE-LWCC flow system.

TIDAS E SPECIFICATIONS

OPTICAL BASICS	Monolithic Spectrometer Module; Concave Aberration Corrected Holographic Grating; Fiber optic cross section converter for increased light throughput; 2nd order multilayer filter	
DETECTOR ARRAY	Hamamatsu photodiode array, 256 pixel	
DETECTOR RESOLUTION	16 Bit	
NOISE (PEAK TO PEAK)*	< 0.04 mAU @ 254 nm	
WAVELENGTH ACCURACY	< 1 nm	
WAVELENGTH REPRODUCIBILITY	< 0.1 nm	
FIBER OPTIC INPUT	600 µm	
SYSTEM REQUIREMENTS	Windows XP, 7, 8	
SOFTWARE (INCLUDED)	TIDASDAQ	
DIMENSIONS (WxHxD)	260 mm × 150 mm × 140 mm 5.9" × 5.5"	(10.25" ×
WEIGHT	2.5 kg (5.5 lb)	
INTERFACE	External (RJ-45)	
POWER	100 - 240 V / 50 - 60 Hz	

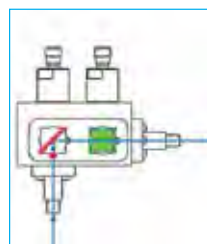
TidasDAQ: Data Collection & Instrument Control

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, as well as data collection can be triggered by TTL leveled external inputs of the TIDAS E.

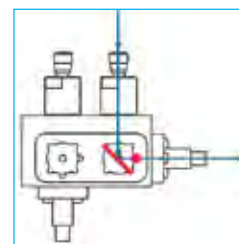
Spectra can be recorded in 2D and 3D view. Mathematical computation, Derivation, Smoothing, Quantification and other functions are available to work with your data. The Quantification module allows single point and multiple point analysis, multiple linear regression, partial least square and principle component analysis. Data can be exported out of a 3D analysis file into separate scans. Further, chromatograms as well as spectrograms can be copied directly into Excel for further data analysis.

The TIDAS E Optical Path

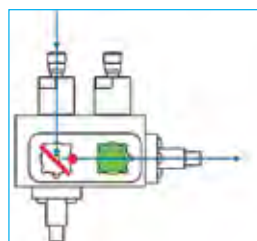
With help of the patented cuvette holder and the mirror cuvette, various measurement setups are possible in conjunction with either internal or external light source. The patented cuvette holder and the external measurement setup can be simultaneously used. The flexibility of the design of TIDAS E is manifested below in various possible options of measurements using different optical paths formed by combinations of cuvette holder, mirror cuvette, optical fiber and light sources.



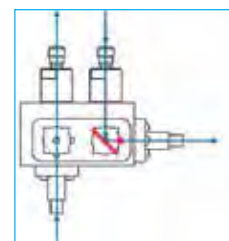
The light radiates from the internal light source, and is conducted from the redirected mirror, through the cuvette holder, into the correct detector. The measuring sample can be located in the second cuvette chamber.



From the internal light source, radiated light passes through the cuvette holder and illuminates through the external measuring cell. The light is redirected through the cuvette holder and channelled through the detector.



The light from the external light source is coupled over the cuvette holder and redirected over the mirror cuvette to the detector; thereby the sample in the standard cuvette chamber can be measured.



The light from the external light source is coupled over the cuvette holder and redirected over the mirror cuvette to the detector.

Biofluorometer



Now more reliable, simplified and affordable

Perfect for:
Ratiometric
Calcium &
ATPase

The new **SI-BF100** is an LED-based fluorometer for life science applications. It is ideally suited for ratiometric calcium detection (FURA-2) and ATPase detection (via NADH fluorescence). With up to seven LED modules (wavelengths), the **SI-BF100** covers many fluorometric applications in neuroscience and cell biology. 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-BF100** to use wavelengths below 380nm and produce more light in those spectra. This technology significantly cuts the cost of photometric calcium imaging without sacrificing resolution or quality.

LED light sources require less power, give off less heat and are more compact and affordable

Sampling rates up to 1kHz (1,000 ratios/second maximum). At lower speeds, signal averaging is used for noise reduction.

Two auto ranging photomultiplier inputs allow you to monitor multiple wavelengths from a single emission output that can be comprised of any wavelength of light for which an LED module is available

Using a separate reference channel, ultra-stable, continuous ratio calculations automatically compensate for LED intensity drift. This ensures less noise and produces more accurate measurements.

Application-specific probes are available for existing tissue baths and cuvette systems.

Ratio noise is <0.05 peak to peak, drift is less than 0.1 unit/hour

The warm up time of less than one minute is a dramatic improvement over the common 20-60 minutes required by xenon or mercury light sources

Replace the emission filter easily or change the LED modules to transform the **SI-BF100** into a general purpose fluorometer for many other applications

How it Works

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-BF100** is its simplicity. The elegance of its design reduces the noise introduced into the system and the errors inherent in traditional systems.

Monochromatic LED light sources using WPI patented technology eliminate the need for complex and expensive white light sources and filter wheels.

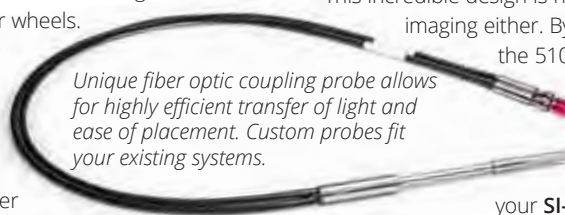
Because the LED modules can be pulsed, sampling frequencies up to 1,000 cycles per second are possible.

The LED light source emits specific excitation frequencies which travel through the probe. The excitation light can be comprised of any wavelength of light for which an LED module is available. The probe returns a single emission

output to one or two photomultiplier inputs on the front of the **SI-BF100**, which are independently filtered for specific wavelengths. This design allows you to monitor multiple wavelengths from a single emission output.

The LED light source in the WPI design makes this ratiometric fluorometer more compact, energy efficient and affordable. As added benefits, the low-power light source produces much less heat, and it warms up in less than one minute!

This incredible design is not limited to calcium imaging either. By simply replacing the 510nm emission filters in front of the photomultipliers with the desired wavelength filters, your **SI-BF100** becomes a general purpose fluorometer for any application you can imagine. Changing a filter involves removing the two screws that hold the filter carriage on the face of the **SI-BF100**, swapping the filter and reinstalling the integral SMA/filter carriage.



SI-BF-100 Biofluorometer

OPTIONAL COMPONENTS

M3301 Manual Manipulator for securing the probe
M10 Magnetic Base

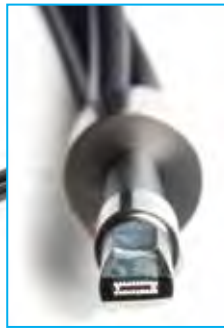
SI-BF100 Specifications

CALL FOR APPLICATION

FIBER OPTIC LIGHT INPUT/OUTPUT SMA terminated
BANDWIDTH 1000 ratios/second
RATIO NOISE < 0.1 peak to peak
ANALOG OUTPUT RANGE 0-10V (continuous, equivalent to a ratio 0-10)
ANALOG OUTPUT IMPEDANCE 100W
POWER 12VDC, 0.5A, (universal power supply, 110/240VAC)
WARM UP TIME < 1 minute
DIMENSIONS 3.5"H x 17"W x 13"D (88 x 431 x 330 mm)

Excitation and Emission fibers in a single probe

Single and dual emission configurations available for both the small probe and the tissue probe



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

94650

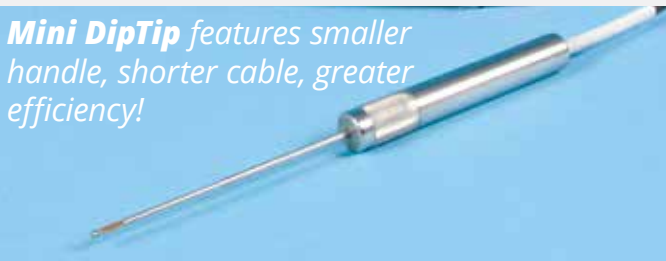
All probes use fibers with a 300µm core diameter. Excitation fibers have 1000 micrometer SMA connectors for Excitation and Double Emission Probes and 1500 micrometer SMA connectors for Single Emission Probes.

A smaller probe, optimized for use with small tissues like trabecula or in multi-well plates, is in development.

94650	Single Emission, Small Tissue Probe
94689	Dual Emission, Small Tissue Probe

World's Smallest Fiber Optic Dipping Probe for UV/Vis Spectroscopy

Mini DipTip features smaller handle, shorter cable, greater efficiency!



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 and is a useful tool for measuring protein and DNA samples. It can also be used for a dissolution system.

Microliter samples can be analyzed cost effectively when you combine the Mini DipTip with one of the following:

- The Fiber optic-based spectrometer (Tidas I) and a light source (D4H and FO-6000)
- WPI's biophotometric detection system (LEDspec)

The **Mini DipTip** is ideal for multi-channel applications.

- Compatible with many standard spectrophotometers (600µm fiber optic coupler connections)

10 mm light pathlength



5 mm light pathlength



2 mm light pathlength



DIPTIP Specifications

	DIP-UV-MINI
TIP DIAMETER	1.5 mm
LIGHT PATHLENGTH	2, 5, 10mm
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 200µm)	680 µm*
RETURN FIBER BUNDLE (7 x 200µm)	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.

DIP-UV-MINI-2	Mini DipTip™ for UV/VIS/NIR (2mm path)
DIP-UV-MINI-5	Mini DipTip™ for UV/VIS/NIR (5mm path)
DIP-UV-MINI-10	Mini DipTip™ for UV/VIS/NIR (10mm path)

SPECTROSCOPY

Light Sources

Deuterium halogen light source with integrated TTL shutter

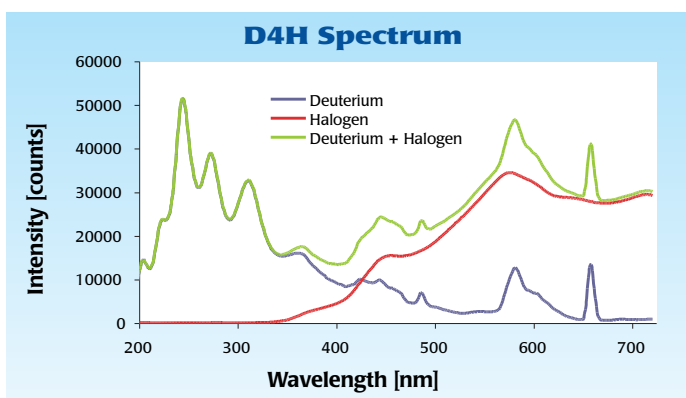


Replacement Deuterium Lamp 503847



Replacement Halogen Lamp 503848

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.



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, 50-60Hz, 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.

Replacement Lamps for Tidas II

TIDAS-D2 Replacement Deuterium Lamp

TIDAS-H Replacement Halogen Lamp (Type 1)

TIDAS-H2 Replacement Halogen Lamp (Type 2)

Replacement Lamps for D2H

D2H-DB Replacement Deuterium Lamp

D2H-HB Replacement Halogen Lamp

D2H-HBER Replacement Deuterium Lamp, Extended Range

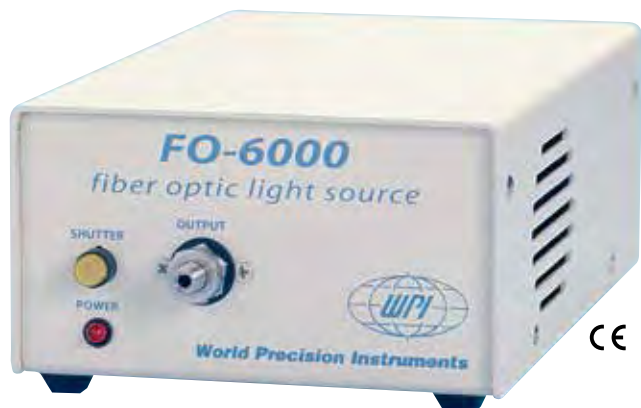
D4H Deuterium Halogen Light Source (200 nm-1100 nm)

503848 Halogen Replacement Lamp for D4H

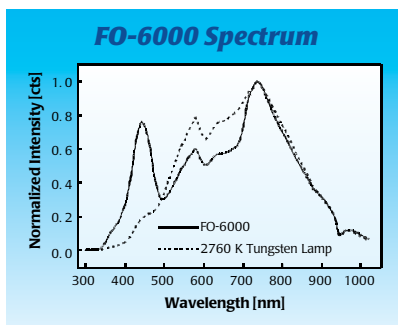
503847 Deuterium Replacement Lamp for D4H (> 215 nm)

FO-6000

High color temperature tungsten light source



This new miniature tungsten light source has been developed for high precision portable and low-power spectroscopy applications. Its advantage lies in its high light power output, its effective color temperature of 6000K and its exceptionally low drift below 0.5 mAU/h. The FO-6000 is a light source for the extended visible part of the light spectrum (380 nm – 1700 nm). It has a SMA type output connector. Both shutter and lamp can be operated via TTL external triggering. This light source offers a wide assortment of field applications in analytical chemistry as well as environmental and life science.



A significant problem with tungsten light bulbs is their inherent low light output at wavelengths below 430 nm. The FO-6000 was developed to overcome this limitation. The light intensity of a tungsten light bulb (2760K) drops below 10% at 420 nm wavelength. However, using FO-6000, the light intensity drops below 10% at 370 nm, where the intensity of the conventional tungsten light bulb is at approximately 2% relative light output. The inherent low noise and low drift of the FO-6000 makes it particularly suitable for low-noise detection systems.

FO-6000-FILT

The FO-6000-FILT inline filter holder directly attaches to the FO-6000 light source. This allows a virtual light loss free insertion of optical filters with outer diameters from 8 to 25.4 mm and thickness ranging from 2 to 10 mm into the light path of the FO-6000. With this filter holder and an optical filter, a highly stable monochromatic light source can be assembled.



FO-6000	Fiber Optic Light Source
FO-6000FILT	Inline Filter Holder Adapter for FO-6000
800120	Replacement Lamp for FO-6000

LED-Lite™

Modular LED Light source with exchangeable LEDs

The LED-lite is a power supply for WPI's ELS LED modules for monochromatic light excitation. Each ELS module has an SMA bulk head fitting and allows direct attachment of SMA terminated fibers.



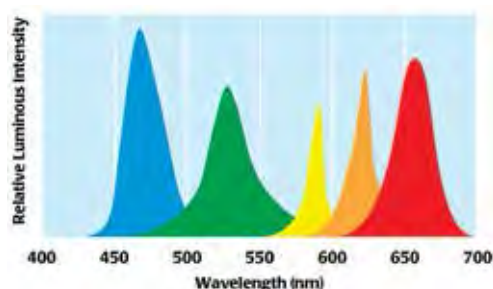
ELS Spectral Distributions

Color	λ_{max}	Spectral Line Half Width	Estimated Output
UV	370 nm	12 nm	85 μ W
Blue	430 nm	65 nm	15 μ W
Blue	450 nm	70 nm	119 μ W
Blue	470 nm	20 nm	140 μ W
Blue-Green	495 nm	35 nm	227 μ W
Green	525 nm	40 nm	80 μ W
Yellow	590 nm	13 nm	60 μ W
Orange	623 nm	15 nm	114 μ W
Red	660 nm	35 nm	275 μ W

Estimated output is after light has passed through a 1 mm fiber.

LED-LITE	ELS Power Supply (requires ELS module) <i>Includes transformer and AC adapter.</i> Specify line voltage
ELS-xxx	External Light Source Module (specify wavelength)
ELS-370	ELS Module (370 nm)
300051	Fiber Optic Collimator (SMA)
300052	Fiber Optic Collimator (ST)

To order ELS, use wavelength as suffix to part number (e.g. ELS-430).



Flow Cells

See LEDspec
on page 182

See Mini★Star
on page 155



Improved UV
Transmission

Liquid Waveguide Capillary Cell

Liquid Waveguide Capillary Cells (LWCC) are fiber optic cells that combine an increased optical pathlength (50–500 cm) with small sample volumes (125–1250 µL). 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. According to Beer's Law the absorbance signal is proportional to chemical concentration and light path length. Compared with a standard 1 cm cell, a 1 mAU signal is enhanced fifty-fold with a

50 cm cell to 50 mAU, using WPI's patented aqueous waveguide technology*. The LWCC can be connected directly to a pump or can

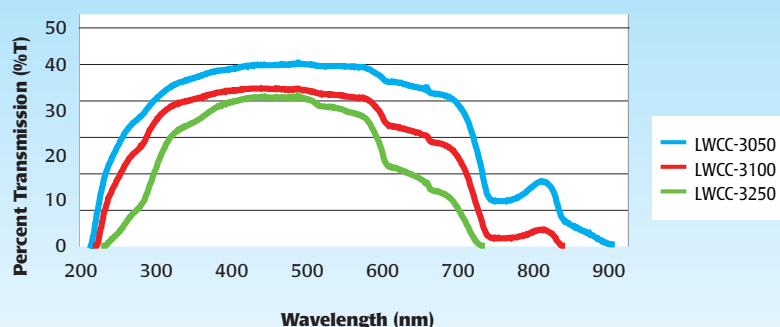
even be filled using a syringe. Based on fiber optics, the LWCC is designed for use with WPI's LEDspec photometric detector (see page 182).

LWCC Key Features

Pathlength, internal volume, and wavelength range (measured with ultrapure water and a Tidas II spectrophotometer)

	Pathlength [cm]	Internal Volume [µL]	Wavelength Range [nm] <i>measured with Tidas II</i>
LWCC-3050	50	125	230-800
LWCC-3100	100	250	230-730
LWCC-3250	250	625	250-730
LWCC-3500	500	1250	280-730

Typical Efficiency Curves for LWCC



These spectra show the optimal detection limits for LWCCs of varying pathlength.

LWCC specifications

WAVEGUIDE MATERIAL	Fused silica tubing coated with a low refractive index polymer
OPTICAL PATHLENGTH	50-500 cm
INNER DIAMETER	550 µm
INTERNAL VOLUME	≈ 125 - 1250 µL
SAMPLE INLET/OUTLET COMPRESSION FITTING	1/16", 1/32"
FIBER INPUT	SMA, ID = 400 µm
MINIMUM PRESSURE*	1.5 - 3 PSI
SOLVENT RESISTANCE	Most organic & inorganic solvents
SHIPPING WEIGHT	1.4 kg (3 lb)

*A one-meter Type II waveguide of 550 µm ID requires about 1.5 PSI for water flow of 1 mL/min.

World Precision Instruments

www.wpiinc.com

Ultra-sensitive Microliter UV/Vis Spectroscopy with 2 to 500 cm optical pathlength!



Mote Marine Laboratories in Sarasota, Florida has partnered with WPI, using the Company's waveguide technology. WPI customized the LWCC installed in the instrument package inside these AUV's (Autonomous Underwater Vehicles). The LWCCs are used to monitor the color of seawater in the Gulf of Mexico. One of the primary interest areas of this research is red tide algae blooms.



Further, modular spectrophotometric sample systems can be assembled using a **TIDAS E** spectrometer and a UV/VIS light source such as **D4H** and **FO-6000** (see pages 190-191).

Applications

LWCCs have been used in a variety of applications, such as liquid chromatography, stopped-flow and colorimetric detection, drinking water analysis, as well as environmental and oceanographic monitoring systems (see References on www.wpiinc.com). WPI's Liquid Waveguide Capillary Cells are made of fused silica tubing with an outer coating of a low refractive index polymer. This results in high signal stability and easy removal of air bubbles trapped in the sensor cell due to the hydrophilic character of the cell wall.

LWCC Injection System

For flow analysis, including simple fluid injection analysis (FIA) setups, add WPI's LWCC injection system (WPI **#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.

✦ 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



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 (#FO-600-SMA1M), Sample Injector Assembly (#58006), MiniStar™ Peristaltic Pump, and WaveGuide Cleaning Kit (#501609).



LWCC-3050	Liquid Waveguide Capillary Cell, pathlength = 50 cm
LWCC-3100	Liquid Waveguide Capillary Cell, pathlength = 100 cm
LWCC-3250	Liquid Waveguide Capillary Cell, pathlength = 250 cm
LWCC-3500	Liquid Waveguide Capillary Cell, pathlength = 500 cm
LWCC-4010	Liquid Waveguide Capillary Cell, pathlength = 10 cm
LWCC-4050	Liquid Waveguide Capillary Cell, pathlength = 50cm, 2mm ID
LWCC-4100	Liquid Waveguide Capillary Cell, pathlength = 100cm, 2mm ID

ACCESSORIES

A sample injector assembly can be used to conveniently fill an LWCC with sample solution using a peristaltic pump. Please note that the LWCC requires two optical fibers to connect to spectrophotometer system. Choose between anti-solarized 400 micron core or UV-enhanced cables (may be ordered in 1 or 3 meter lengths).

89372	LWCC Injection System
58006	Sample Injector Attachment
PERIPRO-4LS	Peri-Star™ Pro Peristaltic Pump (see page 162)
MINISTAR	Miniature Peristaltic Pump, 1-channel (see page 164)
FO-600-SMA1M	Fiber Optic cable, 1m, 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 FO-600-SMA1M (two), 58006, MINISTAR, 501609

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US: Tel: 941-371-1003 • sales@wpiinc.com

Optical Glass and Quartz Cuvettes for

- **High Quality Glass Cuvettes**
- **Standard Quartz Cuvettes**
- **Now offering an expanded line of standard, self-masking, and flow cuvettes!**

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 in Fig. 1 (cuvettes were empty, thickness 1.25 mm x 2, including surface reflections, measured with a TIDAS II against air as reference).

TECHNICAL CHARACTERISTICS

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%

A complete transmission spectrum from 190 nm to 4 μm is shown in Fig. 2 (cuvettes were empty, thickness 1.25 mm x 2, including surface reflections).

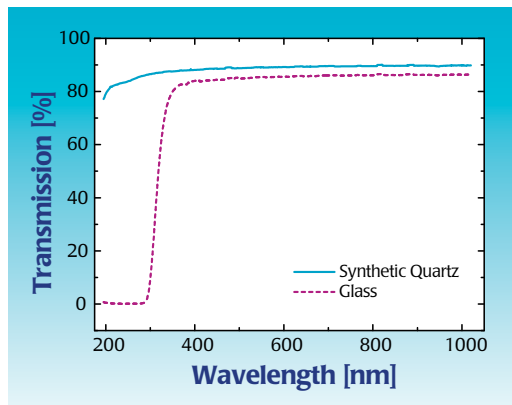


Fig. 1—Transmission curves of Glass and Synthetic Quartz Cuvettes



Style A



Style B



Style C

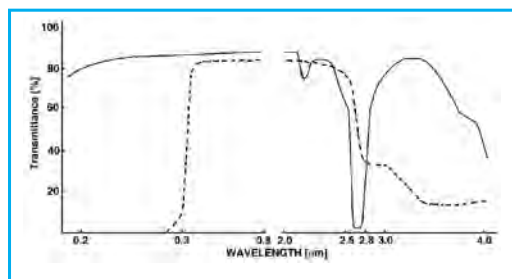


Fig. 2—Complete transmission curves of Glass and Synthetic Quartz Cuvettes



Style D



Style E



Style F

Spectrophotometry and Fluorometry

WPI PN	Style	material	Polished windows	path [mm]	Dimen-sions [mm]	volume [mL]	Beam width [mm]	Price per cell
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	
CUV2028-1	D	Quartz	2	50	52.5x12.5x45	7	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	∅ 3	
CUV2061-1	E	Quartz	2	10	12.5x12.5x45	0.07	∅ 3	
CUV2065-1	E	Quartz	2	20	22.6x12.5x45	0.14	∅ 3	
CUV2066-1	E	Quartz	2	30	32.6x12.4x45	0.21	∅ 3	
CUV2062-1	F	Quartz	2	10	12.5x12.5x45	0.48	4x12	

Self masking continuous flow through cell, small input, large output Z=8.5mm

CUV2614-1	H	Quartz	2	10	12.4x12.4x35.6	0.03	∅ 2	
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Micro Cell with black walls

CUV2674-1	J	Quartz	2	10	12.5x12.5x45	0.05	2	
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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 ∅	28	19	
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Style G



Style H



Style J

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 15mm, and sometimes 20mm. 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.

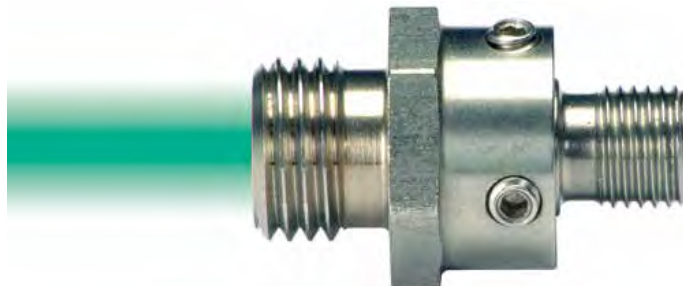
Manufacturer	Z-Dimension
Agilent®	15 mm
Avantes®	15 mm
Beckman®	8.5 mm
Bio-Rad®	8.5 mm
Cecil®	15 mm
Eppendorf®	8.5 mm
Hewlett – Packard®	15 mm
Hitachi®	8.5 mm
Jasco®	11 mm
J & M®	8.5 mm
Ocean Optics®	15 mm
Perkin – Elmer®	15 mm
Pharmacia®	15 mm
Shimadzu®	15 mm
Spectronics®	8.5 mm
Stellarnet®	15 mm
Turner®	8.5 mm
Varian®	20 mm
WPI	15mm

To determine the Z-dimension of a cuvette holder:

- Use strips of heavy paper that will fit neatly into a cuvette (for example, 12mm x 50mm) 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 8.5mm, one at 15mm, one at 20mm.
- 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 technicalsupport@wpiinc.com.

Fiber Optic Collimator



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

300051 Fiber Optic Collimator (SMA)

300052 Fiber Optic Collimator (ST)

OPTIONAL ACCESSORIES

13395 SMA Bulkhead Feedthru connector/coupler, D-hole

13370 SMA half-length Bulkhead coupler/connector

CC-3-UV Cosine Corrector



CC-3-UV



13395



13370

Filter Holder for Glass Fiber Filters

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 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.

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 $a_p(\lambda)$ 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).

Detector and light source requirements

The optical throughput of QFT1 equipped with a classical GF/F filter is very low and requires a matched light source / spectrometer system. WPI's TIDAS E in combination with WPI's FO-6000 tungsten light source or D4H deuterium/halogen light source can be used in the 380–730 nm and 280–730 nm wavelength range, respectively. The QFT1 can also be interfaced to any



QFT1

other CCD, PDA or scanning type spectrometer with fiber optic capabilities.

Performance

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.

Specifications

GF/F Filter Diameter	25 mm
Wavelength Range	280-730 nm *
Fiber Optic Connection	Ø 600 µm / SMA
Material in contact with filter pad	Delrin
Weight	.....0.5 kg (1 lb)

* Using a TIDAS E spectrometer and D4H UV/VIS light source.

References

- Mitchell, B. G., "Algorithms for Determining the Absorption Coefficient of Aquatic Particles Using the Quantitative Filter Technique (QFT)", SPIE Vol. 1302 *Ocean Optics X* (1990), 137-148.
- Sosik, H. M., "Storage of marine particulate samples for light-absorption measurements", *Limnol. Oceanogr.*, 44(4), 1999, 1139-1141
- 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

89575 QFT1, Fiber Optic Holder for Glass Fiber Filters

In-Line Fiber Optic Filter Holder



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 or ST connectors.

Filters with outer diameters from 8 to 25.4 mm and thicknesses from 2 to 10 mm can be accommodated. 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).

56200 In-Line Fiber Optic Filter Holder (SMA)

V-Vette

Sample holder for spectroscopic analysis of microliter volume samples

- 2 microliter sample
- 1 mm pathlength
- No moving parts
- Baseline repeatability < 2 mAU
- Patent pending

V-Vette is a fiber optic sample cell with a pathlength of 1 mm for spectroscopic analysis of microliter volume samples. Light is coupled into and out of the sample cell via optical fibers. A 2 µL sample droplet can be conveniently placed into the v-shaped sample compartment from a pipetter. Absorbance of the sample is measured between the input and output fiber after a cover is placed on the sample compartment to minimize stray light. The sample can be picked up and reused or removed by blowing it off with dry air or wiping it off.

V-VETTE V-Vette Microliter Sample Holder



V-VETTE SPECIFICATIONS

FUNCTIONALITY	.....Absorbance
COVER	.....Included
PATHLENGTH	.....1 mm
WAVELENGTH RANGE	.....200 – 1000 nm
FIBER CONNECTION	.....600 µm (SMA)
SAMPLE VOLUME	.....2-5 µL
BASELINE REPEATABILITY	.....< 2 mAU peak to peak

MicroLWCC

Low volume flow cell for FIA, HPLC and Process Analysis

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	50mm	100mm
INTERNAL VOLUME	2.4 µL	12 µL	24 µL
REFRACTIVE INDEX @ 280 nm**	< 7 mAU	< 15 mAU	< 30 mAU
WAVELENGTH RANGE	.....200 – 1000 nm		
FIBER CONNECTION [µm]	.....500 (SMA)		
TRANSMISSION @ 254 nm *	.....> 40%		
MAXIMUM PRESSURE	.....> 1000 psi		
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.



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

References

M. Belz, "Simple and sensitive protein detection system using UV LEDs and liquid core waveguides", Advanced Environmental, Chemical, and Biological Sensing Technologies V, Optics East, Oct 2007, Proc. SPIE, Vol. 6755, 675505

M. Belz, F. A. Klein, H. S. Eckhardt, K. Klein, D. Dinges, K. T. V. Grattan, "Optical Detection Techniques and Light Delivery with UV LEDs and Optical Fibres", Third International Conference on Optical and Laser Diagnostics, Proc. IOP, City University, London, UK, May 2007.

M. Belz, P. Dress, A. Sukhitskiy, S. Liu, "Linearity and effective optical pathlength of liquid waveguide capillary cells", Part of the SPIE Conference on Internal Standardization and Calibration; Architectures for Chemical Sensors, Boston Massachusetts, September 1999, SPIE Vol. 3856, 271-281.

Optical Fibers

Bifurcated Fiber Optic Assemblies

Use to combine similar intensity light from differing sources or to split a light source into two fibers. For use with a dual spectrometer as a reference.



BIF22	Split or combine similar intensities (200/200)
BIF44	Split or combine similar intensities (400/400)
BIF41	Combine UV (400) + VIS (100)
BIF62	Combine UV (600) + VIS (200)
BIF66	Split or Combine Similar Intensities (600/600)

WPI can build custom fiber optic assemblies for many UV/VIS/NIR applications. Call for more information.

Plastic Fiber Optic Cables

More flexible than glass fibers, these inexpensive PMMA plastic fibers can be used for illumination and scientific applications. They are excellent for light transfer between 350 nm and 1000 nm. Their maximum temperature should be kept below 80° C.

PLASTIC FIBER OPTIC CABLES (NON UV), 400 TO 1000 NM

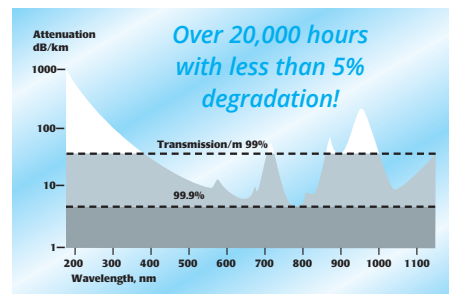
FOP1-SMA	Plastic Fiber Optic Cable, SMA connectors, 1 mm x 2 m
FOP1-SMA/ST	Plastic Fiber Optic Cable, ST/SMA connectors, 1 mm x 2 m
FOP1-ST	Plastic Fiber Optic Cable, ST connectors, 1 mm x 2 m

UV-enhanced fiber optic cables



generation of color centers in the fiber material. The lifetime of such a fiber, defined by the 1/e reduction in transmission at 240 nm, is normally less than 200 minutes. This effect renders them unsuitable for UV spectroscopy below 240 nm.

Anti-solarization fibers suitable for deep UV spectroscopy solve this problem. These fibers stabilize to less than 5% degradation over a period of 20,000 hours after an initial transmission "burn-in" loss of less than 25%. Additionally, this anti-solarization characteristic will not degrade over time.



Features

- Broad UV/Vis spectral range
- Laser damage resistant
- High core to clad ratios
- Broad temperature range
- Bio-compatible materials
- Radiation resistant
- Sterilizable by ETO and gamma radiation
- Higher transmission than PCS between 180-nm and 300 nm

Properties

- Multimode • Pure silica core • Numerical aperture: 0.22 ± 0.02 (standard)
- Standard proof test: 70 kpsi • Minimum bend radius: 100x clad radius (momentary), 600x clad radius (long term)

Anti-Solarization

The transmission of conventional UV-enhanced silica/silica fiber decreases rapidly at wavelengths below 240 nm when exposed to high intensities of a deuterium lamp. This effect is called "UV-solarization" and results from the

UV-ENHANCED FIBER OPTIC CABLES, 230 - 1000 NM

FO-50-SMA1M	Fiber Optic Cable, 1 m, SMA, 50 µm Core, UV-Enhanced
FO-50-SMA	Fiber Optic Cable, 3 m, SMA, 50 µm Core, UV-Enhanced
FO-100-SMA1M	Fiber Optic Cable, 1 m, SMA, 100 µm Core, UV-Enhanced
FO-100-SMA	Fiber Optic Cable, 3 m, SMA, 100 µm Core, UV-Enhanced
FO-200-SMA1M	Fiber Optic Cable, 1 m, SMA, 200 µm Core, UV-Enhanced
FO-200-SMA	Fiber Optic Cable, 3 m, SMA, 200 µm Core, UV-Enhanced
FO-400-SMA1M	Fiber Optic Cable, 1 m, SMA, 400 µm Core, UV-Enhanced
FO-400-SMA	Fiber Optic Cable, 3 m, SMA, 400 µm Core, UV-Enhanced
FO-400SMA/ST	Fiber Optic cable, 1 m, SMA/ST connector, 400 µm core, UV-Enhanced
FO-600-SMA1M	Fiber Optic Cable, 1 m, SMA, 600 µm Core, UV-Enhanced
FO-600-SMA	Fiber Optic Cable, 3 m, SMA, 600 µm Core, UV-Enhanced
FO-1000-SMA1M	Fiber Optic Cable, 1 m, SMA, 1000 µm Core, UV-Enhanced
FO-1000-SMA	Fiber Optic Cable, 3 m, SMA, 1000 µm Core, UV-Enhanced

ANTI SOLARIZATION FIBER OPTIC CABLES, 190 - 1000 NM

FO-200AS-SMA	Fiber Optic Cable, 1 m, SMA, 200 µm Core, Anti-Solarization
FO-400AS-SMA	Fiber Optic Cable, 1 m, SMA, 400 µm Core, Anti-Solarization
FO-600AS-SMA	Fiber Optic Cable, 1 m, SMA, 600 µm Core, Anti-Solarization

SPECTROSCOPY

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1B200-4	112	5233	85	14012	98	40500	171	500197	169
1B200-6	112	5361	85	14034-40	99	48000	121	500198	169
1B200F-4	112	5362	85	14035-10	99	48014	121	500199	169
1B200F-6	112	5371	101	14036-15	99	48014-05	121	500200	169
2B150F-4	114	5372	101	14038-10	99	48014-10	121	500216	22
2B150F-6	114	5373	101	14039-10	99	48014-30	121	500216-G	22
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