

# Microforges, Pullers & Bevelers

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## Application Guide

P/N	Description	Application	Features
<b>DMF1000</b>	Complete Microforge System; includes Programmable Digital Controller and Microscope	Fabrication of special shapes of glass micropipettes, e.g., pressure polishing of patch clamp pipettes and making of holding pipettes. Unique for pipette tip calibration and microinjection pipettes.	Most sophisticated and only microforge on the market with built-in pressure polishing capability. Programmable controller with 10 user-selectable memory storage (of heat and time) for reproducibility.
<b>MF200</b>	Complete Microforge System, with analog controller	Use to fire polish glass micropipettes and prepare special shapes	Comes with <b>W30S</b> Microscope, a 40x objective and three filament sizes. Uses exclusive Kohler illuminator instead of industry standard frosted glass illuminator for less glare and sharper image.
<b>48000</b>	Microbeveler System	Bevels micropipette tips larger than 1 micron at 4000 rpm for applications such as microinjection.	Solid surface unit beveler with rotating disk. Includes basic kit with abrasive alumina lapping film.
<b>1300M</b>	Microelectrode Beveler and Start-up kit	Glass micropipette beveler for submicron tips. Not for cell injection.	Includes <b>M3301R</b> Manipulator and <b>M10</b> magnetic stand.
<b>MBS</b>	Microelectrode Beveler System	Glass micropipette beveler for submicron tips. Not for cell injection. Includes all necessary accessories.	
<b>Omega-Z</b>	Omega-Tip-Z with Probe and Holder	Measures impedance of metal and glass capillary microelectrodes.	Comes with probe, probe handle and cables.
<b>PMP-107</b>	Programmable Multipipette Puller	Produces two symmetrical 4- or 7-barrel glass pipettes	Upgrade from model <b>PMP-100</b> . Equipped with microcomputer, pneumatic pulling arm, pneumatic rotator, optical-digital ruler. Pulling process is programmable and under control of a preset sequence.

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

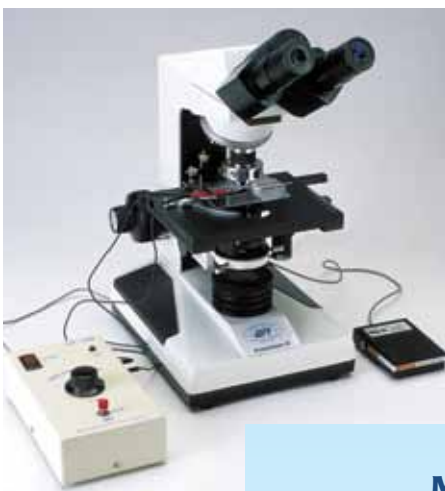
# Sometimes the simplest designs work best.

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.

## MF200 Microforge

### Features of the MF200

The MF200 system includes: An easy to use analog temperature controller, a specially configured WPI model W30S 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  $\mu\text{m}$ ) 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.



MICROFORGES, PULLERS, BEVELERS

<b>MF200-1</b>	Complete Microforge System, incl. W30S Microscope (110 v)
<b>MF200-2</b>	Complete Microforge System, incl. W30S Microscope (220 v)
<b>MF200-M1</b>	MF 200 without microscope (110v)
<b>MF200-M2</b>	MF 200 without microscope (220v)

*\*Above MF200 microforges include 40X long working distance objective*

### OPTIONAL ACCESSORIES

<b>500292</b>	Optional 15x Eyepieces (pair) <i>Note: No reticle available for 15x eyepieces</i>
<b>500329</b>	25x Long-Working Distance Objective <i>(fits most microscopes with a 160 mm Focal Length)</i>
<b>13142</b>	Optional foot switch

### REPLACEMENT ACCESSORIES

<b>MF200-H2</b>	Replacement heating filament (large gauge)
<b>MF200-H3</b>	Replacement heating filament (medium gauge)
<b>MF200-H4</b>	Replacement heating filament (small gauge)
<b>75070</b>	Filament Adjustment Assembly for 22mm OD Objectives
<b>75050</b>	Replacement Micropipette Slide
<b>75040</b>	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 $\mu\text{m}/\text{division}$ (at 40x) 0-90° Angle at 5°/division
OPTIONAL EYEPIECE	15x (pair)
GLASS HOLDER	Mounts on Microscope Stage
DIMENSIONS: Control Unit	4 × 7 × 1 1/2 in. (10.2 × 17.8 × 4.8 cm)
SHIPPING WEIGHT	3 lb. (1.4 kg)
<b>MICROSCOPE</b>	See W30S
SHIPPING WEIGHT	16 lb. (7.3 kg)

## MICROFORGE FEATURE COMPARISON

	MF200	DMF1000
W30S 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	—	✓

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

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# 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.

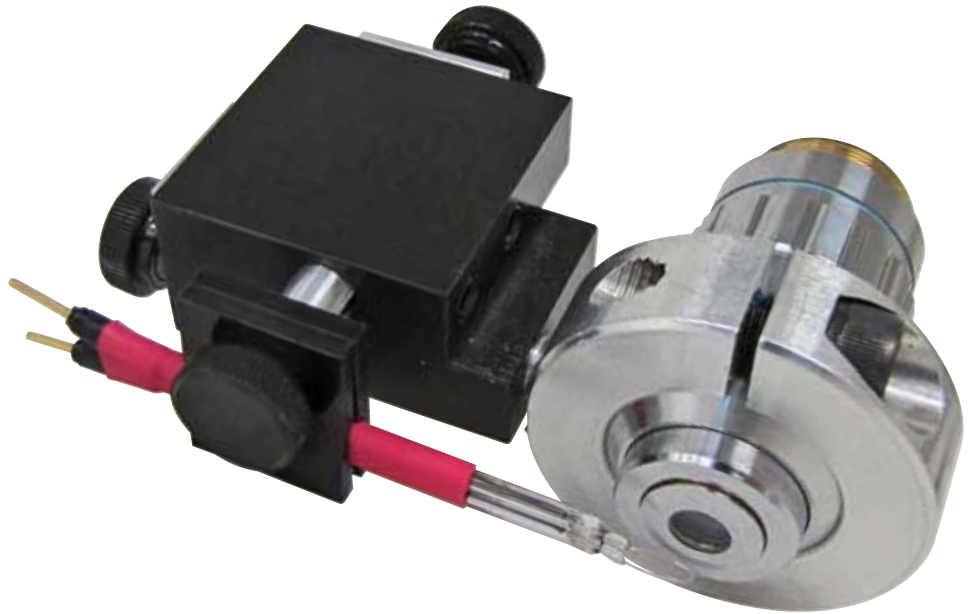
## Unique Features of the DMF1000 System

The DMF1000 system includes a specially configured WPI model W30S research grade compound microscope equipped with a high quality metallurgical 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  $\mu\text{m}$ ) 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



**Filament Holder mounts directly to objective to provide precise control of heating element position.**

# DMF1000

during patch-clamp recordings (Goodman & Lockery, 2000).

## 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.

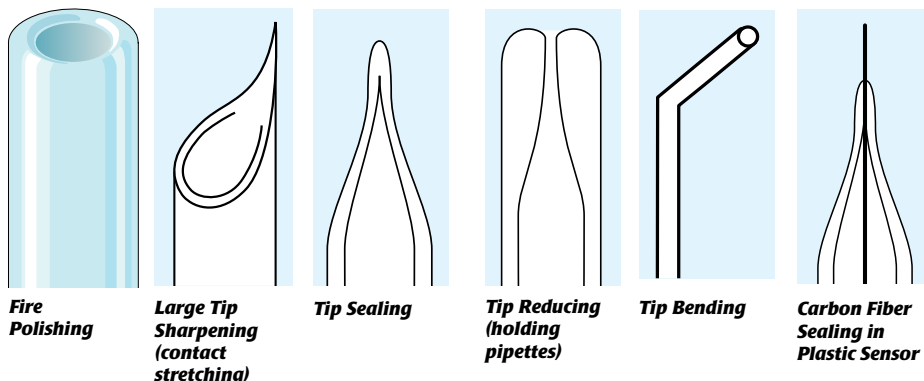
The low heat capacity and low thermal

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.



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

## 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.



<b>DMF1000-1</b>	Complete Microforge, incl W30S Microscope (110 v)
<b>DMF1000-2</b>	Complete Microforge, incl W30S Microscope (220 v)
<b>DMF1000-M1</b>	Microforge without microscope (110v)
<b>DMF1000-M2</b>	Microforge without microscope (220v)

\*Above DMF1000 microforges include 40X long working distance objective

#### OPTIONAL ACCESSORIES

<b>500329</b>	25x Long Working Distance Objective, 5 mm 0.50NA
<b>500292</b>	Optional 15x Eyepiece (pair)
<b>13142</b>	Optional foot switch

#### REPLACEMENT ACCESSORIES

<b>800292</b>	40x Long Working Distance Objective, 3 mm 0.25NA
<b>503513</b>	21 mm 10X Eyepiece with 100/10 reticle
<b>DMF1000-H5</b>	Replacement heating filament (large gauge)
<b>MF200-H4</b>	Replacement heating filament (small gauge)
<b>75050</b>	Replacement Micropipette Slide
<b>75040</b>	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.



<b>W30S</b>	Binocular Microscope
<b>W30ST</b>	Trinocular Microscope
<b>503513</b>	21 mm 10X Eyepiece with 100/10 reticle
<b>503514</b>	Replacement Lamp

### 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	<b>H4</b> – Small filament for working with 40x long working distance objective. <b>H5</b> – 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 × 7 × 1 7/8 in. (10.2 × 17.8 × 4.8 cm)
SHIPPING WEIGHT	4 lb. (1.8 kg)
MICROSCOPE	See W30S, page 205
SHIPPING WEIGHT	16 lb. (7.3 kg)

### W30S 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 halogen light source (12V/20W 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)

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# 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 **Omega-Tip-Z™** megohm meter (see page 31). 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  $\mu\text{m}$  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

<b>2478</b>	Replacement Mirrored Disk
<b>3531</b>	Alumina Abrasive, 0.05 $\mu\text{m}$ (5 g) fine
<b>3551</b>	Alumina Abrasive, 0.30 $\mu\text{m}$ (5 g)
<b>2479</b>	Replacement "O" Ring
<b>SYS-OMEGA-Z</b>	Omega-Tip-Z with Probe & Holder
<b>711P</b>	Replacement Probe
<b>5468</b>	Adapter to connect metal microelectrodes to probe, 2 mm socket to .031 in. receptacle
<b>NOVA</b>	Novaflex Fiber Optic Illuminator (115v, 60HZ)
<b>NOVA-Z</b>	Novaflex Fiber Optic Illuminator (230v, 80HZ)
<b>500186</b>	Bifurcated Light Guide with lenses
<b>NOVA-186</b>	Novaflex Illuminator and bifurcated light guide
<b>MES</b>	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 $\mu\text{m}$ , I.D.
ALUMINA ABRASIVE POWDER	0.05 $\mu\text{m}$ size supplied (0.3 $\mu\text{m}$ 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)

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

# The only microbeveler system with Guided Light!



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 6,000 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 6000 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 × 11 × 0.4 in. (22 × 28 × 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

Includes all components pictured above: 48000 MicroBeveler, NOVA 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.

### SYS-48000 MicroBeveler

Specify line voltage

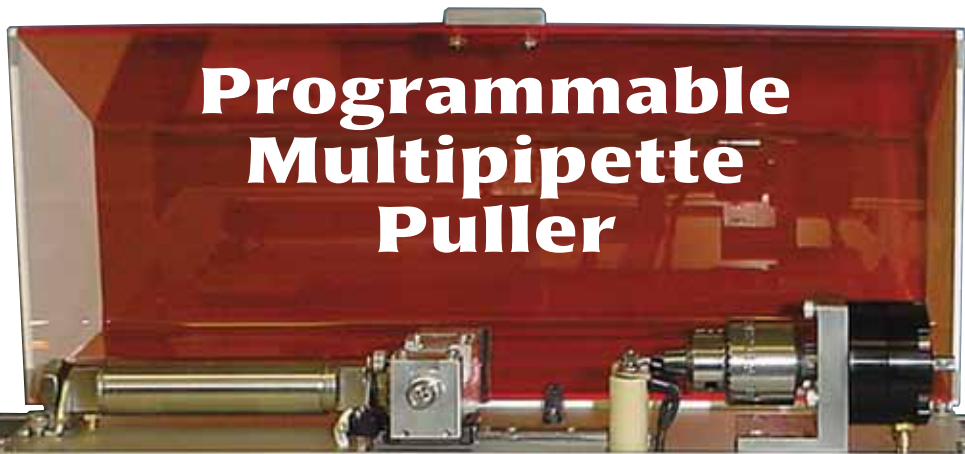
### OPTIONAL ACCESSORIES

<b>48015-03</b>	Lapping Film, Alumina, 0.3 micron (50-pack)
<b>48015-10</b>	Lapping Film, Alumina, 1 micron (50-pack)
<b>48015-30</b>	Lapping Film, Alumina, 3 microns (50-pack)
<b>48014-01</b>	Lapping Film, Diamond, 0.1 micron (3-pack)
<b>48014-05</b>	Lapping Film, Diamond, 0.5 micron (3-pack)
<b>48014-10</b>	Lapping Film, Diamond, 1 micron (3-pack)
<b>48014-30</b>	Lapping Film, Diamond, 3 microns (3-pack)
<b>48025</b>	Fiber Optic Cable for Pipette Illumination
<b>15934</b>	Replacement Beveler Disk Plate
<b>48300</b>	Tilt Base Assembly for PZMIII binocular head
<b>48200</b>	PZM Tool Holder

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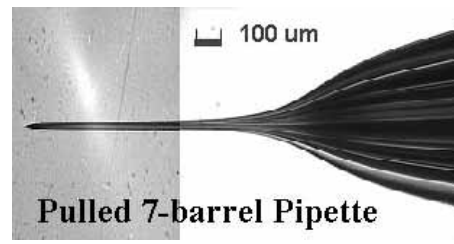
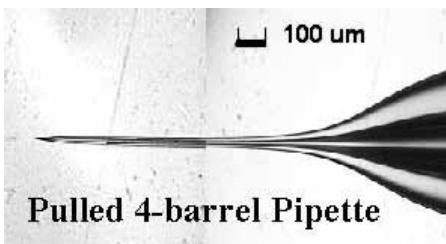
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**PMP-107**

CE

- Double top panel structure.
- Automatic 4-Barrel or 7-Barrel Pipette Puller.
- Exclusive Optical-Digital Ruler Measurement.
- Computerized Real-Time Feedback Heater Control.
- Pneumatic Pulling Force and Compact Size.
- Programmable and Savable Sequences for Creation and Reproduction.
- Manufacture Preset Pulling Programs for 4 and 7-Barrel



The **PMP-107** Programmable Multipipette puller can pull a one to 7-barrel pipette with easy push-button processing. Equipped with a microcomputer, pneumatic pulling arm, pneumatic rotator, optical-digital ruler and specially designed clamp, the PMP-107 can automatically heat, twist and pull a multibarrel pipette. There is no need for any manual rotation or any inconsistent timing interrupt control. The whole pulling process is programmable and under control of a preset sequence. The PMP-107 is a new upgrade model from the PMP-100 multipipette puller. The rotation (twist) speed is adjustable.

**PMP-107 SPECIFICATIONS**

PIPETTES	Single- to 7-Barrel
EACH BARREL O.D.	1 mm (2 mm for single-barrel)
PULLING FORCE	Pneumatic
HEATER	Nichrome coil or foil
HEATER CONTROL	Microcontroller
HEATING	74 general heat levels (24-99), 64 automatic heat levels (45-98)
NUMBER OF SEQUENCES	25
STEPS PER SEQUENCE	18
TAPER LENGTH SETTING	0.5 - 20 mm
PRESSURE 1	Adjustable 0.1 - 10 psi
PRESSURE 2	Adjustable 0.1 - 60 psi
COOLING PRESSURE	Adjustable for rotation speed
GAS INPUT PRESSURE	30-60 psi
ACTIONS	Pull 1, Pull 2, Pull2/Cool, Rotation, Cool Air, Return
DISPLAY	20x4 LCD
POWER INPUT	110 / 240 VAC
POWER CONSUMPTION	Maximum 150 watts
DIMENSIONS	14 x 11 x 7 in. (35.6 x 27.9 x 17.8 cm)
WEIGHT	15 lb (6.8 kg)

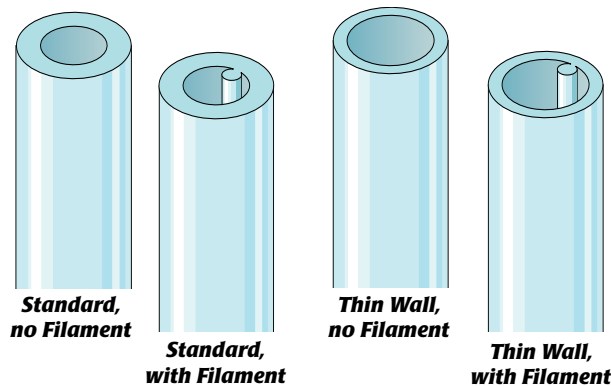
**PMP-107** Programmable Multipipette Puller (110 V)

**PMP-107-Z** Programmable Multipipette Puller (240 V)

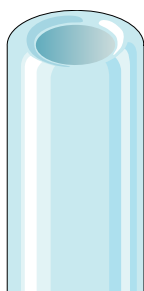
Prices shown are in U.S. dollars. Actual charges will vary because of import duty, freight, and currency fluctuations. To obtain an exact quotation, contact your WPI office.

# Sharp Electrode 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 either Corning 7740 or N51A, depending on the part number. Contact WPI Technical Support for specifications for your part number.

**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	Price
3 in. (76 mm)	1.0	0.58	✓		500	<b>1B100F-3</b>	US\$52
3 in. (76 mm)	1.0	0.58			500	<b>1B100-3</b>	US\$52
3 in. (76 mm)	1.2	0.68	✓		350	<b>1B120F-3</b>	US\$52
3 in. (76 mm)	1.2	0.68			350	<b>1B120-3</b>	US\$52
3 in. (76 mm)	1.5	0.84	✓		225	<b>1B150F-3</b>	US\$52
3 in. (76 mm)	1.5	0.84		✓	300	<b>1B150-3</b>	US\$52
4 in. (100 mm)	1.0	0.58	✓	✓	500	<b>1B100F-4</b>	US\$56
4 in. (100 mm)	1.0	0.58		✓	500	<b>1B100-4</b>	US\$56
4 in. (100 mm)	1.2	0.68	✓	✓	400	<b>1B120F-4</b>	US\$56
4 in. (100 mm)	1.2	0.68		✓	350	<b>1B120-4</b>	US\$56
4 in. (100 mm)	1.5	0.84	✓	✓	300	<b>1B150F-4</b>	US\$56
4 in. (100 mm)	1.5	0.84		✓	300	<b>1B150-4</b>	US\$56
4 in. (100 mm)	2.0	1.12	✓		125	<b>1B200F-4</b>	US\$56
4 in. (100 mm)	2.0	1.12		✓	200	<b>1B200-4</b>	US\$56
6 in. (152 mm)	1.0	0.58	✓		500	<b>1B100F-6</b>	US\$68
6 in. (152 mm)	1.0	0.58			500	<b>1B100-6</b>	US\$68
6 in. (152 mm)	1.2	0.68	✓		350	<b>1B120F-6</b>	US\$68
6 in. (152 mm)	1.2	0.68			350	<b>1B120-6</b>	US\$68
6 in. (152 mm)	1.5	0.84	✓		225	<b>1B150F-6</b>	US\$68
6 in. (152 mm)	1.5	0.84			225	<b>1B150-6</b>	US\$68
6 in. (152 mm)	2.0	1.12	✓		125	<b>1B200F-6</b>	US\$68
6 in. (152 mm)	2.0	1.12			125	<b>1B200-6</b>	US\$68

## Thin-Wall Single-Barrel Standard Borosilicate (Schott Duran) Glass Tubing

OD (mm)	ID (mm)	FIL	Fire-Polished	Length	Quantity	Item	Price
1.0	0.75	✓		3 in. (76 mm)	500	<b>TW100F-3</b>	US\$52
1.0	0.75			3 in. (76 mm)	500	<b>TW100-3</b>	US\$52
1.2	0.90	✓	✓	3 in. (76 mm)	350	<b>TW120F-3</b>	US\$52
1.2	0.90			3 in. (76 mm)	350	<b>TW120-3</b>	US\$52
1.5	1.12	✓		3 in. (76 mm)	225	<b>TW150F-3</b>	US\$52
1.5	1.12		✓	3 in. (76 mm)	300	<b>TW150-3</b>	US\$52
1.0	0.75	✓		4 in. (100 mm)	500	<b>TW100F-4</b>	US\$56
1.0	0.75		✓	4 in. (100 mm)	500	<b>TW100-4</b>	US\$56
1.2	0.90	✓		4 in. (100 mm)	350	<b>TW120F-4</b>	US\$56
1.2	0.90			4 in. (100 mm)	350	<b>TW120-4</b>	US\$56
1.5	1.12	✓		4 in. (100 mm)	300	<b>TW150F-4</b>	US\$56
1.5	1.12		✓	4 in. (100 mm)	300	<b>TW150-4</b>	US\$56
1.0	0.75	✓		6 in. (152 mm)	500	<b>TW100F-6</b>	US\$68
1.0	0.75		✓	6 in. (152 mm)	500	<b>TW100-6</b>	US\$68
1.2	0.90	✓	✓	6 in. (152 mm)	350	<b>TW120F-6</b>	US\$68
1.2	0.90			6 in. (152 mm)	350	<b>TW120-6</b>	US\$68
1.5	1.12	✓		6 in. (152 mm)	225	<b>TW150F-6</b>	US\$68
1.5	1.12		✓	6 in. (152 mm)	300	<b>TW150-6</b>	US\$68

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

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