Microforges, Pullers & Bevelers

Microforges

Microbevelers

Impedance Meters

Pullers

Application Guide

P/N	Description	Application	Features
DMF1000	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.
MF200	Complete Microforge System, with analog controller	Use to fire polish glass micropipettes and prepare special shapes	Comes with **W30S-LED** 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.
48000	Microbeveler System	Bevels micropipette tips larger than 1 micron at 5400 rpm for applications such as microinjection.	Solid surface unit beveler with rotating disk. Includes basic kit with abrasive alumina lapping film.
1300M	Microelectrode Beveler and Start-up kit	Glass micropipette beveler for submicron tips.	Includes **M3301R** Manipulator and **M10** magnetic stand.
MBS	Microelectrode Beveler System	Bevels micropipette tips larger than 1 micron at 5400 rpm for applications such as microinjection.	Includes 48000 Microbeveler, NOVA illuminator, fiber optic cable, PZMIII stereo zoom microscope with special tilt base, two 20X eyepieces, one 20x eyepiece with reticle, tool holder and pipette holder FOIMPH
MES	Microelectrode Beveler System	Glass micropipette beveler for submicron tips.	Includes **1300M** Microelectrode Beveler, **1350M** Micropositioner and magnetic stand, **OmegaZ**, **5052** Steel base plate, **5468** adapter and **3485** Ringstand mount
Omega-Z	Omega-Tip-Z with Probe and Holder	Measures impedance of metal and glass capillary microelectrodes.	Comes with probe, probe handle and cables.
PMP-107	Programmable Multipipette Puller	Produces 4- or 7-barrel glass pipettes.	Equipped with microcomputer, pneumatic pulling arm, pneumatic rotator, optical--digital ruler. Pulling process is programmable and under control of a preset sequence.

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.

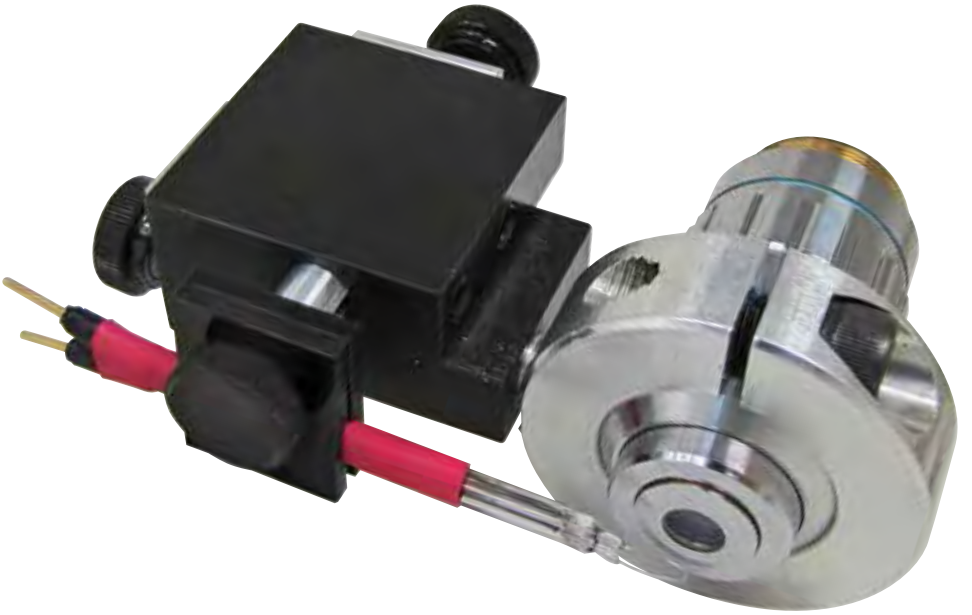
Unique Features of the DMF1000 System

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

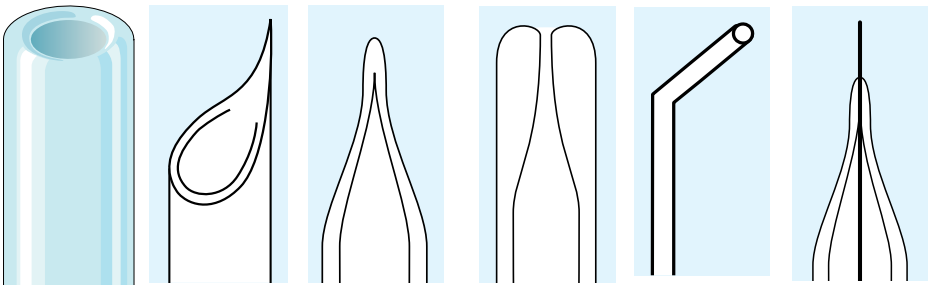
With a conventional microforge often the most difficult and time-consuming part of using a high magnification objective is being able to move both the heating filament and the pipette into the same viewing area. Finding and moving both the heating filament and the pipette without collision can be a challenge. 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 reseach 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 MEMORYS	10
PRESSURE ADJUSTING RANGE	0.5 – 60 PSI (3.5 – 414 kPa
PRESSURE RESOLUTION	0.1 PSI (0.7 kPa)
FILAMENTS	**H4** — Small filament for working with 40× long working distance objective. **H5** — Large filament for working with 10× 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 × 1⅞ in. (10.2 × 17.8 × 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)

Sometimes the simplest designs work best.

MF200 Microforge

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.

MF200-1	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 15× Eyepieces (pair) *Note: No reticle available for 15× eyepieces*
500329	25× 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

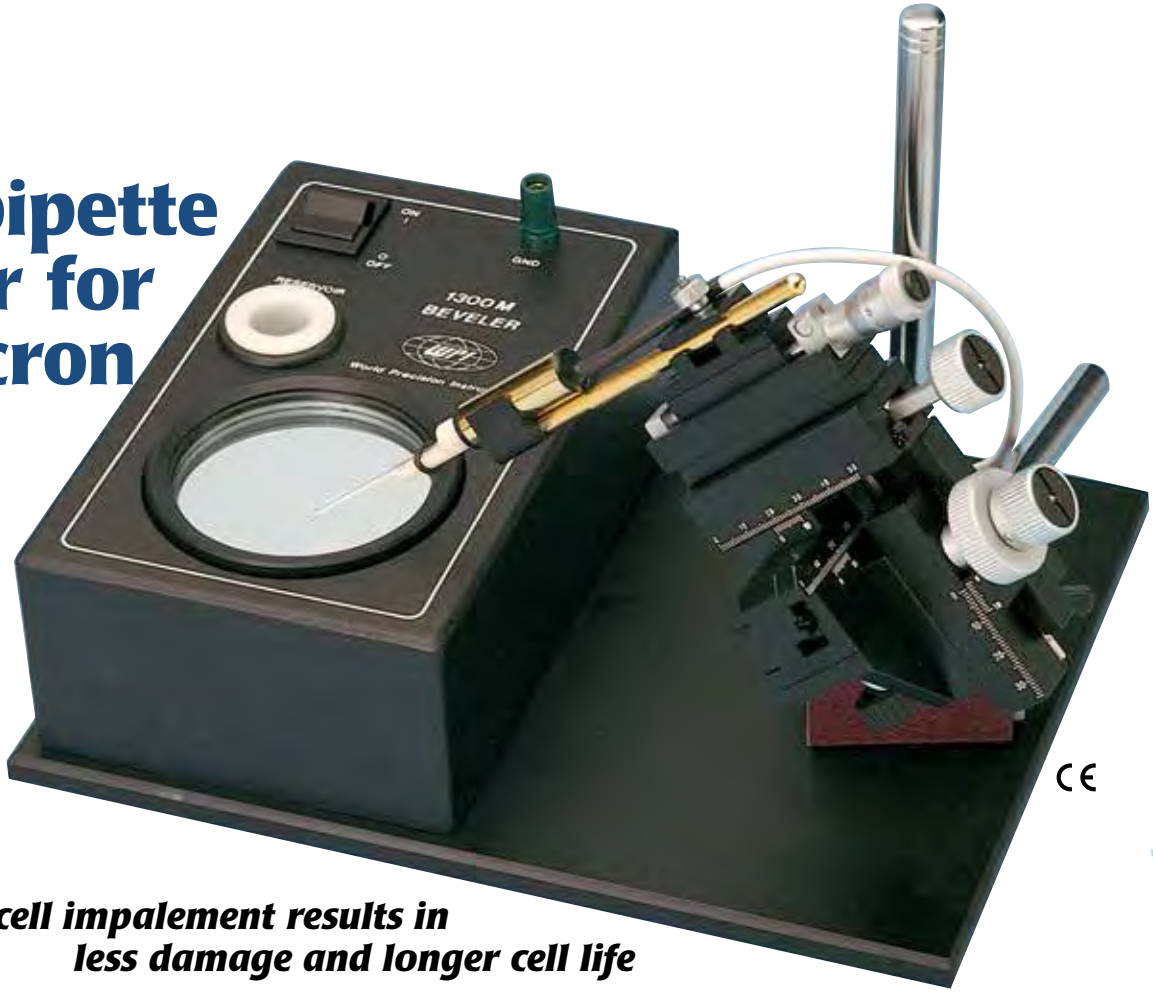
MF200 SPECIFICATIONS

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 40× and 25× Long-Working Distance Objectives: mounts on objective
OBJECTIVE	40× Long-Working Distance (3 mm)
OPTIONAL	25× Long-Working Distance (5 mm)
EYEPIECE	10× (pair)
RETICLE (10× eyepiece only)	1.25 µm/division (at 40×) 0-90° Angle at 5°/division
OPTIONAL EYEPIECE	15× (pair)
GLASS HOLDER	Mounts on Microscope Stage
DIMENSIONS: Control Unit	4 × 7 × 1⅞ in. (10.2 × 17.8 × 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	—	✔

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 **Ωmega-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 µm 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 µm (5 g) fine
3551	Alumina Abrasive, 0.30 µm (5 g)
2479	Replacement "O" Ring
SYS-OMEGAZ	Ωmega-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!

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 × 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 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.

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

Programmable Multipipette Puller

PMP-107

- 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	Programmable Multipipette Puller (110 V)
PMP-107Z	Programmable Multipipette Puller (240 V)

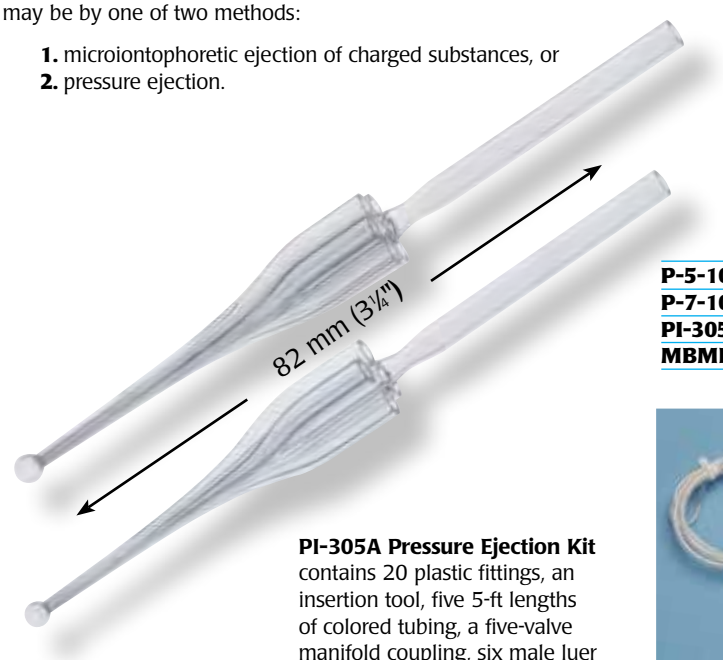
Five-and Seven-Barrel Micropipette Blanks

High quality multi-barrel micropipette blanks for pressure injection

The **P-5** and **P-7** micropipettes are designed for precise local application of chemicals in extracellular electrophysiological studies. Drug application may be by one of two methods:

1. microiontophoretic ejection of charged substances, or
2. pressure ejection.

P-5 and **P-7** pipette blanks exhibit levels of quality and reproducibility impossible to match in handmade pipettes. They are compatible with most vertical pipette pullers that accommodate 3.00 mm diameter glass. P-5 and P-7 blanks have a solid ball pulling tip and are fabricated from 3.00 mm Kwik-Fil tubing. All barrels except the large central one have filaments.



P-5-10	5-Barrel Micropipette Blank (pkg of 10)
P-7-10	7-Barrel Micropipette Blank (pkg of 10)
PI-305A	Pressure Ejection Kit (1 kit)
MBMPH5-7	Holder for P-5 & P-7 Pipettes

PI-305A Pressure Ejection Kit contains 20 plastic fittings, an insertion tool, five 5-ft lengths of colored tubing, a five-valve manifold coupling, six male luer adapters and one male/female luered line. These Pressure Ejection fittings connect the pressure ejection tubing to the **P-5** and **P-7** pipette barrels quickly and securely.