Microforges, Pullers & Bevelers

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Application Guide

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<tr>
<th>P/N</th>
<th>Description</th>
<th>Application</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMF1000</td>
<td>Complete Microforge System; includes Programmable Digital Controller and Microscope</td>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td>MF200</td>
<td>Complete Microforge System, with analog controller</td>
<td>Use to fire polish glass micropipettes and prepare special shapes</td>
<td>Comes with W30S 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.</td>
</tr>
<tr>
<td>48000</td>
<td>Microbeveler System</td>
<td>Bevels micropipette tips larger than 1 micron at 4000 rpm for applications such as microinjection.</td>
<td>Solid surface unit beveler with rotating disk. Includes basic kit with abrasive alumina lapping film.</td>
</tr>
<tr>
<td>1300M</td>
<td>Microelectrode Beveler and Start-up kit</td>
<td>Glass micropipette beveler for submicron tips. Not for cell injection.</td>
<td>Includes M3301R Manipulator and M10 magnetic stand.</td>
</tr>
<tr>
<td>MBS</td>
<td>Microelectrode Beveler System</td>
<td>Glass micropipette beveler for submicron tips. Not for cell injection. Includes all necessary accessories.</td>
<td></td>
</tr>
<tr>
<td>Omega-Z</td>
<td>Omega-Tip-Z with Probe and Holder</td>
<td>Measures impedance of metal and glass capillary microelectrodes.</td>
<td>Comes with probe, probe handle and cables.</td>
</tr>
<tr>
<td>PMP-107</td>
<td>Programmable Multipipette Puller</td>
<td>Produces two symmetrical 4- or 7-barrel glass pipettes</td>
<td>Upgrade from model PMP-100. Equipped with microcomputer, pneumatic pulling arm, pneumatic rotator, optical-digital ruler. Pulling process is programmable and under control of a preset sequence.</td>
</tr>
</tbody>
</table>

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.

UK: Tel: 01438-880025 • wptuk@wpi-europe.com  Germany: Tel: 030-6188845 • wpide@wpi-europe.com  China: Tel: 21 6885517 • chinasales@china.wpiinc.com
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 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.

**Features of the MF200**

<table>
<thead>
<tr>
<th>Feature</th>
<th>MF200-1</th>
<th>MF200-2</th>
<th>MF200-M1</th>
<th>MF200-M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF200 complete Microforge System incl. W30S Microscope</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>MF200 complete Microforge System incl. W30S Microscope (220 v)</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>MF200-1 without microscope (110v)</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MF200-2 without microscope (220v)</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>

*Above MF200 microforges include 40X long working distance objective

**Optional Accessories**

<table>
<thead>
<tr>
<th>Code</th>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>500292</td>
<td>Optional 15x Eyepieces (pair)</td>
</tr>
<tr>
<td>500329</td>
<td>25x Long-Working Distance Objective (fitted most microscopes with a 160 mm Focal Length)</td>
</tr>
<tr>
<td>13142</td>
<td>Optional foot switch</td>
</tr>
</tbody>
</table>

**Replacement Accessories**

<table>
<thead>
<tr>
<th>Code</th>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF200-H2</td>
<td>Replacement heating filament (large gauge)</td>
</tr>
<tr>
<td>MF200-H3</td>
<td>Replacement heating filament (medium gauge)</td>
</tr>
<tr>
<td>MF200-H4</td>
<td>Replacement heating filament (small gauge)</td>
</tr>
<tr>
<td>75070</td>
<td>Filament Adjustment Assembly for 22mm OD Objectives</td>
</tr>
<tr>
<td>75050</td>
<td>Replacement Micropipette Slide</td>
</tr>
<tr>
<td>75040</td>
<td>Replacement Filament Cable</td>
</tr>
</tbody>
</table>

**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 Objective**: 25x Long-Working Distance (5 mm)
- **Eyepiece**: 10x (pair)
- **Reticle (10x eyepiece only)**: 1.25 µm/division (at 40x)
- **0-90º Angle at 5º/division**
- **Optional Eyepiece**: 15x (pair)
- **Glass Holder**: Mounts on Microscope Stage
- **Dimensions: Control Unit**: 4 x 7 x 1 ½ 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)

**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.**

*World Precision Instruments • Tel: 941-371-1003 • Fax: 941-377-5428 • E-mail: sales@wpiinc.com • Internet: wwww.wpiinc.com*
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 W305 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 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).

**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 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 expansion characteristic of the filament ensures minimal displacement of 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.

<table>
<thead>
<tr>
<th>Fire Polishing</th>
<th>Large Tip Sharpening (contact stretching)</th>
<th>Tip Sealing</th>
<th>Tip Reducing (holding pipettes)</th>
<th>Tip Bending</th>
<th>Carbon Fiber Sealing in Plastic Sensor</th>
</tr>
</thead>
</table>

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

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UK: Tel: 01438-880025 • wpiuk@wpi-europe.com  
Germany: Tel: 030-6188845 • wpide@wpi-europe.com  
China: Tel: 21 68885517 • chinasales@china.wpiinc.com
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 Silgard 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.

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.

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 ½ in. (10.2 x 17.8 x 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
- X/Y 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)

Optional Accessories
- Replacement Lamp
- Accessory Objective 25X (no cover) MWD
- Optional 15X Eyepiece (pair)
- 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-HS Replacement heating filament (large gauge)
- MF200-H4 Replacement heating filament (small gauge)
- 75050 Replacement Micropipette Slide
- 75040 Replacement Filament Cable

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.

World Precision Instruments • Tel: 941-371-1003 • Fax: 941-377-5428 • E-mail: sales@wpiinc.com • Internet: www.wpiinc.com
Glass Micropipette Beveler for submicron tips

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. 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

**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-OMEGAΩ Omega-Tip-Z with Probe & Holder
- 711P Replacement Probe
- 5468 Adapter to connect metal microelectrodes to probe, 2 mm socket to .031 in. receptacle
- NOVA NovaFlex Fiber Optic Illuminator (115v, 60HZ)
- NOVA-Z NovaFlex Fiber Optic Illuminator (230v, 80HZ)
- 500186 Bifurcated Light Guide with lenses
- NOVA-186 NovaFlex illuminator and bifurcated light guide
- MES Microelectrode Beveler System

**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)

**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!

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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beveling Surface</td>
<td>3.5 inch diameter disk</td>
</tr>
<tr>
<td>Abrasive Material</td>
<td>alumina, diamond</td>
</tr>
<tr>
<td>Speed of Rotation</td>
<td>100 to 6000 rpm</td>
</tr>
<tr>
<td>Motor</td>
<td>Reversible Direction</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>120 volts, 60 Hz or 240 volts, 50 Hz, 20 VA to supplied power supply</td>
</tr>
<tr>
<td>Dimensions</td>
<td></td>
</tr>
<tr>
<td>Base Plate</td>
<td>8.7 x 11 x 0.4 in. (22 x 28 x 1 cm)</td>
</tr>
<tr>
<td>Overall Height</td>
<td>3 in. (8 cm)</td>
</tr>
<tr>
<td>Shipping Weight (48000)</td>
<td>16 lbs. (7.6 kg)</td>
</tr>
<tr>
<td>Shipping Weight (MBS)</td>
<td>35 lbs. (16 Kg)</td>
</tr>
</tbody>
</table>

**SYSTEM NOW INCLUDES PZMIII STEREO MICROSCOPE**

- 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

**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**

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

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 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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pipettes</strong></td>
<td>Single to 7-Barrel</td>
</tr>
<tr>
<td><strong>Each Barrel O.D.</strong></td>
<td>1 mm (2 mm for single-barrel)</td>
</tr>
<tr>
<td><strong>Pulling Force</strong></td>
<td>Pneumatic</td>
</tr>
<tr>
<td><strong>Heater</strong></td>
<td>Nichrome coil or foil</td>
</tr>
<tr>
<td><strong>Heater Control</strong></td>
<td>Microcontroller</td>
</tr>
<tr>
<td><strong>Heating</strong></td>
<td>74 general heat levels (24-99), 64 automatic heat levels (45-98)</td>
</tr>
<tr>
<td><strong>Number of Sequences</strong></td>
<td>25</td>
</tr>
<tr>
<td><strong>Steps per Sequence</strong></td>
<td>18</td>
</tr>
<tr>
<td><strong>Taper Length Setting</strong></td>
<td>0.5 - 20 mm</td>
</tr>
<tr>
<td><strong>Pressure 1</strong></td>
<td>Adjustable 0.1 - 10 psi</td>
</tr>
<tr>
<td><strong>Pressure 2</strong></td>
<td>Adjustable 0.1 - 60 psi</td>
</tr>
<tr>
<td><strong>Cooling Pressure</strong></td>
<td>Adjustable for rotation speed</td>
</tr>
<tr>
<td><strong>Gas Input Pressure</strong></td>
<td>30-60 psi</td>
</tr>
<tr>
<td><strong>Actions</strong></td>
<td>Pull 1, Pull 2, Pull2/Cool, Rotation, Cool Air, Return</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>20x4 LCD</td>
</tr>
<tr>
<td><strong>Power Input</strong></td>
<td>110 / 240 VAC</td>
</tr>
<tr>
<td><strong>Power Consumption</strong></td>
<td>Maximum 150 watts</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>14 x 11 x 7 in. (35.6 x 27.9 x 17.8 cm)</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>15 lb (6.8 kg)</td>
</tr>
</tbody>
</table>

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