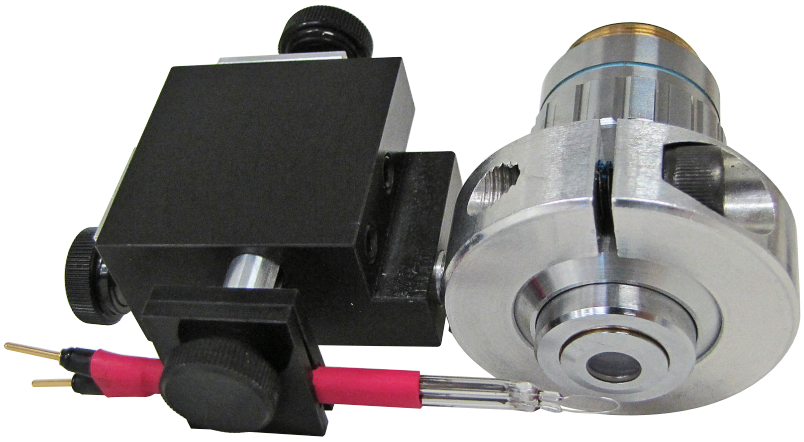
WORLD
PRECISION
INSTRUMENTS
Instrumenting scientific ideas

DMF1000

microprocessor-controlled microforge



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

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).

Ease of use

The Heating Filament

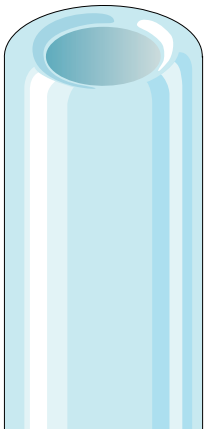
With a conventional microforge often the most difficult and time-consuming part of using a high magnification objective is being able to move both the heating filament and the pipette into the same viewing area. Finding and moving both the heating filament and the pipette without collision can be a challenge. 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.

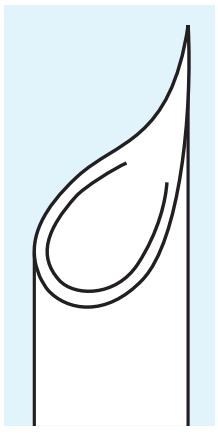
Two different heating filaments are provided with the DMF1000 to accommodate various applications. The **H5** filament is large gauge and can be reformed into a "U" for fabrication of pipettes, air forming of patch pipettes and other applications. The **H4** is a smaller gauge filament and is ideal for polishing patch clamp pipettes.

The Pipette and Microscope Stage

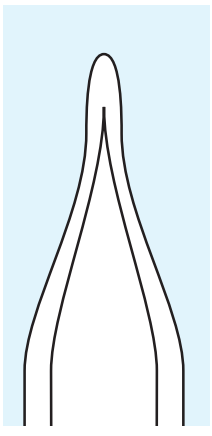
The pipette rests on a specially designed holder that sits on top of the microscope stage. The position of the pipette, relative to the heating filament, is controlled by the (X, Y, Z) adjustment of the stage. This unique design makes locating and polishing



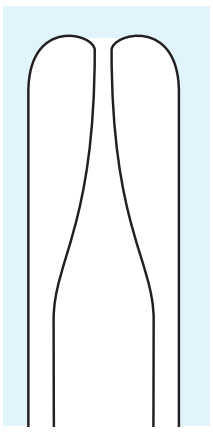
Fire Polishing



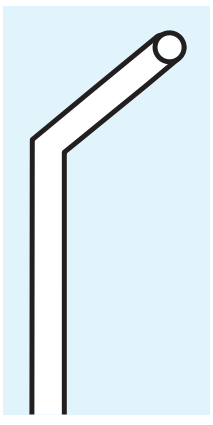
Large Tip Sharpening (contact stretching)



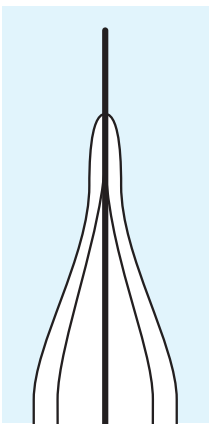
Tip Sealing



Tip Reducing (holding pipettes)



Tip Bending



Carbon Fiber Sealing in Plastic Sensor

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.

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

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	21mm 10X Eyepiece with 100/10 reticle

W30S-LED SPECIFICATIONS

HEAD	Binocular (Seidentopf) Inclined 30°, rotates 360° Dual diopter adjustment, Interpupillary distance range 55-75 mm 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 (140 x 140 mm) 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	38cm x 23cm x 17.8cm 15" x 9" x 7"
WEIGHT	6.4 kg (14 lb)

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 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**
SHIPPING WEIGHT	16 lb. (7.3 kg)

ORDERING INFORMATION

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)
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

WORLD PRECISION INSTRUMENTS

USA: International Trade Center, 175 Sarasota Center Boulevard, Sarasota FL 34240-9258 USA **Tel:** 941-371-1003 • **Fax:** 941-377-5428 • **E-mail:** wpi@wpiinc.com • **Internet:** www.wpiinc.com

UK: 1 Hunting Gate, Hitchin, Hertfordshire SG4 0TJ England • Tel: 44 (0)1462 424700 • E-mail: wpiuk@wpi-europe.com
Germany: Zossener Str. 55, 10961 Berlin, Germany • Tel: 030-6188845 • Fax: 030-6188670 • E-mail: wpide@wpi-europe.com
China & Hong Kong: Rm 29a, No8 Donfang Rd., Pudong District, Shanghai 200120 PRC • Tel: +86 688 85517 • E-mail: ChinaSales@china.wpiinc.com
Brazil: Conselheiro Nabias, 756 sala2611, Santos-Sao Paulo 11045-002 Brazil • E-mail: info@brazil.wpiinc.com