



- **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 (package of 2)

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 UMPII 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 ($(100 \text{ micron})^3 = 1 \text{ nanoliter}$). 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 (see section "F" in Fig. 2) 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 manufacturer's 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.

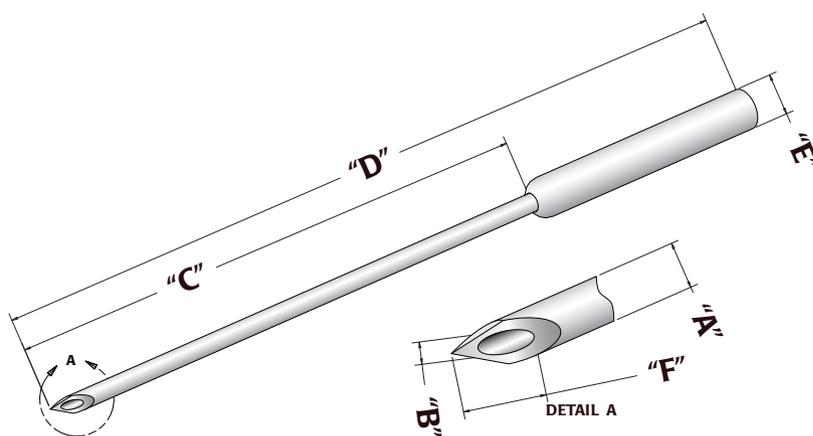
Available Tips

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' 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 (section F on Figure 2) is 1024 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 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 3.0 mm and still maintain a usable strength. Since the tip ID is in the 25 to 50 micron range, it is very easily



Tip Order Number	Tip O.D. "A"	Tip I.D. "B"	Tip Length "C"	Total Length "D"	Shank O.D. "E"	Bevel Length "F"	Tip Material
NF33BV-2	210 µm	115 µm	10.0 mm	40.0 mm	460 µm	≈348 µm	Stainless Steel
NF34BV-2	185 µm	85 µm	5.0 mm	35.0 mm	460 µm	≈290 µm	Stainless Steel
NF35BV-2	135 µm	55 µm	5.0 mm	35.0 mm	460 µm	≈204 µm	Stainless Steel
NF36BV-2	110 µm	35 µm	3.0 mm	33.0 mm	460 µm	≈156 µm	Stainless Steel
NF33FBV-2	200 µm	100 µm	5.0 mm	35.0 mm	460 µm	≈322 µm	Titanium Alloy
NFQ34-5	160 µm	100 µm	55.0 mm	75.0 mm	460 µm	≈280 µm	Quartz
NF33BL-2	210 µm	115 µm	10.0 mm	34.0 mm	460 µm	≈348 µm	Stainless Steel
NF34BL-2	185 µm	85 µm	5.0 mm	29.0 mm	460 µm	≈290 µm	Stainless Steel
NF35BL-2	135 µm	55 µm	5.0 mm	29.0 mm	460 µm	≈204 µm	Stainless Steel
NF36BL-2	110 µm	35 µm	3.0 mm	27.0 mm	460 µm	≈156 µm	Stainless Steel
NF33FBL-2	200 µm	100 µm	5.0 mm	29.0 mm	460 µm	≈322 µm	Titanium Alloy

Above dimensions apply to blunt tips also.

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.

Flexifil: The Flexifil tip is made of a titanium alloy. The advantage of this tubing is its durability. This "semi-flexible" tip can be bent up to 90 degrees without damage. It is also much more corrosion resistant than the stainless steel tip. Saline solutions left in the tip will be less likely to clog it. Although this tip is specified as a 33 gauge tip, its outer diameter is slightly

smaller than our 33 gauge stainless steel tip.

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 0.6 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)
NF33FBL-2	33 G Flexifil blunt NanoFil needle (pkg of 2)
NF33FBV-2	33 G Flexifil 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



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 UMP2 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, and autoclaveable materials for easy cleaning after viral injection.

The UMP3 stand in the photo (right) includes the small base (503084), open-side clamp (14073-4) and 25cm rod (503070).



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)

Microvolume Syringes

Syringes with Luer Fitting (no needle)

WPI P/N	Volume	Description	O.D.	UMP2	UMP3
ILS005LT	5 µL	ILS 5 µL Gas-tight Luer tip	6.5 mm	Y	Y
ILS010LT	10 µL	ILS 10 µL Gas-tight Luer tip	6.5 mm	Y	Y
ILS025LT	25 µL	ILS 25 µL Gas-tight Luer tip	8.0 mm	Y	Y
SGE050TLL	50 µL	SGE 50 µL Gas-tight Teflon Luer Lock	8.0 mm	Y	Y
SGE100TLL	100 µL	SGE 100 µL Gas-tight Teflon Luer Lock	8.0 mm	Y	Y
SGE250TLL	250 µL	SGE 250 µL Gas-tight Teflon Luer Lock	8.0 mm	N	Y

Syringes with Replaceable Beveled Needles

WPI P/N	Volume	Description	O.D.	UMP2	UMP3
SGE0005RN*	0.5 µL	SGE 0.5 µL 23 ga (0.63 mm) 70 mm long	8.0 mm	Y	Y
SGE001RN*	1.0 µL	SGE 1.0 µL 26 ga (0.47 mm) 70 mm long	8.0 mm	Y	Y
SGE005RN	5 µL	SGE 5 µL 23 ga (0.63 mm) 50 mm long	8.0 mm	Y	Y
SGE010RNS	10 µL	SGE 10 µL 26 ga (0.47 mm) 50 mm long	8.0 mm	Y	Y
SGE025RN	25 µL	SGE 25 µL 25 ga (0.50 mm) 50 mm long	8.0 mm	Y	Y
SGE050RN	50 µL	SGE 50 µL 25 ga (0.50 mm) 50 mm long	8.0 mm	Y	Y
SGE100RN	100 µL	SGE 100 µL 25 ga (0.50 mm) 50 mm long	8.0 mm	Y	Y

* The plunger extends to the tip of the needle, displacing the full sample during injection - which gives the syringe zero dead volume.

The barrel length of this syringe is 17 cm long vs. the usual 8-9 cm.

SGE and ILS are respective trademarks of Scientific Glass Engineering and Innovative Labor System.

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, SGE0100RN, 26 ga (0.47 mm) 50 mm long, 5-pack



UltraMicroPump III

This versatile injector uses microsyringes to deliver picoliter volumes

With its digital controller, **UltraMicroPump III** can dispense as little as 600 picoliters per incremental advance of the syringe piston (using a 5- μ L 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.

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 shown mounted to stereotaxic frame (not included).

Three prong syringe holder for more stability

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.

Now with microstepping

Controller now has higher resolution and is virtually pulse-free

UMPII ACCEPTS: glass syringes with barrel diameters 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) 8 ft

ULTRAMICROPUMP SPECIFICATIONS

(based on 10 μ L syringe)

NORMAL MODE

TOTAL # OF STEPS	20,000 (63 mm travel)
MINIMUM DISPENSING VOLUME	0.58nL / step
LINEAR MOTION PER STEP	3.175 microns
WEIGHT	325g (11.5 oz)
MOUNTING ROD DIAMETERS	7.9mm (0.31 in.)
MAINS POWER SUPPLY	90-264VAC @ 47-63Hz
DIMENSIONS	\varnothing 32mm x 190mm (\varnothing 1.3in. x 7.5in.)

MICROSTEPPING MODE

Precision is increased eight fold

Perfect for a wide range of applications including intracellular injection, micro delivery of biochemical agents or dyes, cell separation, and in vitro fertilization.



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