

Tips on Tips - Offline PicoTips®

Thank you for ordering from New Objective's line of PicoTip® emitters for offline nanospray. Consisting of GlassTips™, EconoTips™, and QuartzTips™, they represent the most advanced precision emitters available for nanospray.

Given the wide variety of electrospray ionization (ESI) sources produced by different manufacturers, the exact implementation of the PicoTip emitters on your system may affect utility and performance. This "tip sheet" gives a few pointers on the successful use of PicoTips. Please observe all manufacturer safety recommendations and read the safety statement at the end of this document.

Unpacking and handling your PicoTips®

NOTE: Please wear ANSI-approved safety glasses when handling PicoTip® emitters.

Coated PicoTips® have a special enhanced conductive multilayer coating (U.S. Patent 5,788,166) that provides for excellent electrochemical stability and durability against ESI solvent exposure and arcing. Coated tips should be handled with care, as mechanical abrasion can remove the coatings. No attempt should ever be made to handle the tips with bare hands. The highest quality fine, non-serrated forceps are recommended. New Objective sells an accessory kit containing all the high-quality tools (cleaver, special forceps, ruler, etc.) you will need to properly handle PicoTips. Please see our catalog or Web site for a full description of our accessory kit (stock number TIP-KIT).

Inside the box, the PicoTips are held down by adhesion. When ready to use, pull the PicoTip off with a pair of fine forceps, taking care not to touch the tip or scrape off the conductive coating, as the coating can be ruined by improper or rough handling. Lift from the tip end of the emitter, keeping the tip away from the base of the packaging. The emitter is fairly durable, but the end of the tip must not make physical contact with any surface.

Sample loading and coupling

Given the wide variety of applications, there is no one best method for the loading of samples into a PicoTip® emitter. Since PicoTips have open tips, filling with a tabletop centrifuge is not recommended. Unless rotor rpm is kept very low, your sample will be ejected from the tip as the rotor spins up. If you must utilize this procedure, test your filling technique with a blank solution. Offline PicoTips are fabricated from tubing with a special cross-sectional shape that greatly enhances filling by capillary action. This shape assists in the filling of the tapered region of the tip, preventing "vapor lock" from occurring by allowing the liquid to flow around any air bubbles. Fused-silica needles and gel-loading tips are two of the most common devices used for sample introduction and will be detailed in this Technical Note.

Fused-silica needles

PicoTips® can be conveniently filled with conventional syringes that substitute a fused-silica needle for a stainless-steel needle. These syringes are available from Hamilton and other suppliers. (Order needle style “RNFS” from Hamilton -- for example, Hamilton syringe model 1701-RNFS, part number 87404, which has a 10 cm long, 170 um OD flexible fused-silica needle.) Fused-silica syringe needles can reach within 0.2 mm of the tip. The OD of the filling needle must be less than the ID of the PicoTip glass tubing.

Insert the filling needle into the distal end of the PicoTip, as seen in Figure 1. Push the needle as far into the PicoTip as possible without damaging either the filling needle or the PicoTip. (It is not critical to reach far into the tapered region, since capillary action will fill the tip. The closer the initial loading of sample is to the taper region, however, the faster the filling action.)

Slowly inject the liquid into the PicoTip. Careless, rapid injection can lead to an excessive number of air bubbles, or “foaming” of the sample. This foaming is especially problematic with concentrated protein and peptide samples. (To prevent this, 1-5 uL of sample should be injected over approximately 5 seconds.) Most syringes are limited to a maximum volume of 10 uL.

Slowly withdraw the filling needle from the PicoTip. The tip will fill by capillary action. Do not be alarmed if you see air bubbles along the shank of the tip. As the sample sprays from the tip, capillary action will provide a continuous feed and eliminate air bubbles in the taper region, as shown in Figure 2.

Gel-loader tips

Another device convenient for tip filling is a gel-loader type disposable pipette tip. Choose the smallest OD gel-loader tip available for your pipetter. Gel-loader tips with an OD of less than or equal to 0.35 mm are particularly good for filling offline PicoTips®. Micro-gel loader tips designed for loading samples onto thin gels are available from Eppendorf(R) (pipette tip number 2235-165-6) and other suppliers.

Insert the pipette as far as possible into the distal end of the PicoTip and deliver 1-5 uL of the liquid slowly into the emitter while removing the pipette tip. A typical gel-loader tip is not long enough to extend all the way to the tip of the emitter. The sample will fill only the back end of the PicoTip, but capillary action will bring the sample into the tip. It is a good practice to wait a few minutes for this filling action to take place. Inspection for proper filling with a transmitted light (rather than reflected light) microscope at 50-100x is recommended.

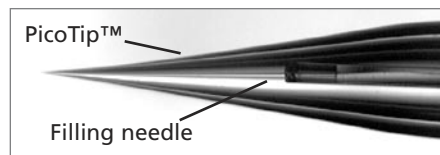


FIGURE 1 Loading an offline PicoTip™ with a fused-silica needle



Spraying

CAUTION: Make certain that all electrical voltages are at ground potential before attempting to insert or remove a PicoTip® on your inlet system.

Before use, PicoTips® should be properly and safely mounted on your emitter mounting system. Make sure there is robust electrical contact between the conductive coating on the coated PicoTip and your applied voltage “contact point.” The final position of the tip should be 1-5 mm from the mass spectrometer inlet.

Since PicoTips (U.S. Patent 5,788,166) are fabricated with a precision geometry specifically tailored for low-flow ESI, there is no need to break the tip end into the inlet prior to use. Such actions result in uncontrolled tip diameter, wall thickness, and tip shape. We do not recommend or endorse this practice with PicoTips.

Applying high voltage

Starting from zero (ground) potential, slowly increase the voltage of the ESI system while monitoring ion or spray current, if your system provides a monitoring point. Although it varies greatly depending upon the exact geometry of your ESI system, spray should initiate at a potential difference between 600 and 1000 volts. To optimize the applied voltage, monitor ion current while increasing the ESI potential(s). With most systems, a plateau in current is obtainable. The optimal set-point is generally found at a voltage just before the onset of the plateau. Occasionally, and especially when spraying solutions that carry no organic solvent, the voltage required to initiate ESI current is quite high (greater than 1.5 kV); such a high voltage generally wastes sample. The voltage can usually be lowered after initiation of stable spray with no expense in ion current and a concurrent reduction in sample flow rate.

In general, the maximum voltage the tips can handle before a stable corona occurs is 1.6-2.5 kV. The fine wall structure of the glass tip and conductive coating generally cannot withstand prolonged arcing between the tip and inlet. Potentials that cause arcing should be avoided when using PicoTips®. Excessive potentials will only result in a rapid consumption of sample with little gain in total ion current.

Solvents

The proportion of organic solvent can be reduced to 0-30% from “conventional” levels of 70-80%. A lower proportion of organic cosolvent generally results in a slower rate of residue buildup at the tip and hence extended tip lifetime.

With pure, particle-free water (2% acetic acid, no protein or other analyte), tip lifetime is generally more than 50 hours of continuous spray-time. HPLC-grade or better solvents are recommended for optimal performance.

Flow rates

Performance varies greatly from instrument to instrument and is highly dependent upon solution characteristics. The approximate range of optimal flow rates are:

Stock Number	Optimal Flow (nL/min)
Econo10	20-80
Econo12	20-80
BG##-##-2-CE	20-80
BG##-##-4-CE	40-100
QT##-##-2-CE	20-80

The most significant influences on flow rate performance are solvent composition, electric field strength, and backing pressure. For operation at lower flow rates, choose smaller diameter PicoTips®. Consult our product literature or Web site for a listing of tip sizes.

PicoTips can generally support stable ESI over a range of flow rates. For example, a 4 um tip can operate at rates from less than 25 nL/min to nearly 100 nL/min.

Product specifications



Safety precautions

CAUTION: Electrospray ionization involves the use of potentially lethal high-voltage electrical current. Observe all manufacturers' safety recommendations in the use of such equipment. No equipment modifications should be made except as authorized by the manufacturer in accordance with all safety requirements. Never use this product in defective, damaged, or faulty equipment. Serious personal injury or death could result.

Installation of such equipment should be performed by a qualified contractor in accordance with all applicable electrical codes. This product should be used only by experienced personnel.

Provide a safe workplace and all necessary safety equipment. Follow all safety recommendations of the equipment manufacturer(s). Inspect all equipment and ionization emitters carefully prior to use. Any damaged, chipped, or cracked emitters should not be used. Handling of glass tubing and emitters can result in serious personal injury, including skin and eye injury. Use safety glasses or goggles meeting ANSI Z87.1-1989 requirements or the equivalent. Puncture- and chemical-resistant gloves should be worn at all times.

The information contained in this circular is believed reliable and accurate; however, nothing set forth herein constitutes a warranty or representation of any kind or nature. Given the variety of experimental conditions, New Objective cannot guarantee performance at a given flow rate for a given tip size. Your best guide to tip selection is empirical testing. A statement of product specifications, warranties, and safety information will be supplied upon request. CAUTION: Particular end-user applications for these products may be restricted by existing patents. Complying with any such patent is the sole responsibility of the user. Eppendorf is a registered trademark for Eppendorf-Netheler-Hinz GmbH. PicoTip, GlasTip, EconoTip, QuartzTip, and PicoTip Powered are trademarks or registered trademarks of New Objective, Inc. New Objective reserves the right to change product specifications without notice.
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