Savillex
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Savillex Technical Note
C-Flow S-Type PFA Nebulizer Range

Summary

Savillex C-Flow s-type PFA concentric nebulizers are unique in combining the sensitivity and washout performance of an integrated uptake line nebulizer with the convenience of a demountable type nebulizer. The range comprises of three versions: the C50s, C100s and C250s, with nominal free aspiration uptake rates of 50, 100 and 250 µL/min, respectively. The s-type features a new inner body design that has significantly improved nebulization efficiency and, therefore, sensitivity. Sensitivity is 10% higher in normal plasma and 15% higher in cool plasma compared to previous generation C-Flows, as well as, all other PFA concentric nebulizers. The s-type nebulizers all have demountable uptake lines, featuring a unique Savillex zero dead volume connector.

C-Flow S-Type PFA Microconcentric Nebulizer

The benefit of a demountable uptake line means that if the uptake line is damaged, the nebulizer is not destroyed: the uptake line is simply replaced. Other demountable-type nebulizers have degraded washout performance due to carryover; however, Savillex's s-type nebulizers have equivalent washout performance to nebulizers with integrated uptake lines.

Savillex designs, molds and manufactures all its sample introduction products in-house using only the highest purity grade PFA resins. C-Flow s-type nebulizers have no measurable elemental background contribution.
Savillex C-Flow s-type nebulizers are the highest performing, most reproducible and reliable nebulizers available for semiconductor and low sample volume ICP-MS applications.

C-Flow S-Type Design

The key requirements for high performance concentric nebulizers (for ICP-MS) are:

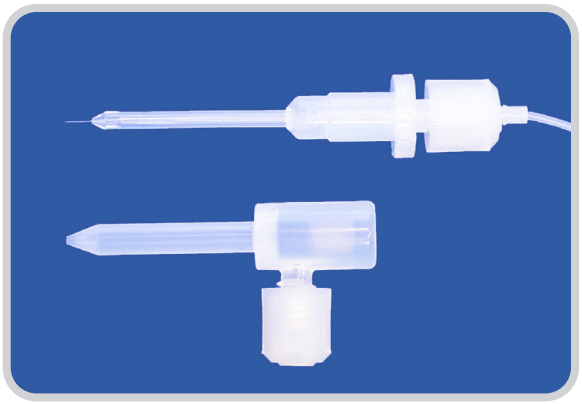
- High sensitivity in both normal and cool plasma modes
- Low RSDs
- Low oxide and doubly charged ion formation
- Free aspiration sample uptake rate accuracy: actual uptake rate vs. target uptake rate
- Nebulizer-to-nebulizer performance reproducibility
- If necessary, easy to unclog by backflushing

The C-Flow features a unique two-piece construction that consists of a PFA outer body and PFA inner body that supports the capillary. This design allows for very precise assembly and optimization of argon back pressure, which is key because back pressure directly impacts droplet size and signal sensitivity. The design also provides the best performance reproducibility compared to any other concentric nebulizer. This is especially important for the lowest uptake rate nebulizers, which are the most challenging to manufacture. As a result, C-Flow uptake rate ranges are narrower than any other concentric nebulizers.

The image below shows outer and inner C-Flow bodies prior to assembly: the quality of the molding and finish can clearly be seen. A 4 mm nebulizer gas fitting is molded into the outer body. The design allows for precise adjustment and optimization of free aspiration uptake rate during assembly. Once the uptake rate is within specification, the two parts are locked together, and the uptake rate is fixed prior to shipment. The two-piece C-Flow design also offers additional benefits: because the capillary is supported all the way to the tip, all C-Flows can be backflushed safely without risk of damaging the capillary, and lifetime is significantly increased compared to other PFA nebulizers.

Cleanliness and Chemical Compatibility

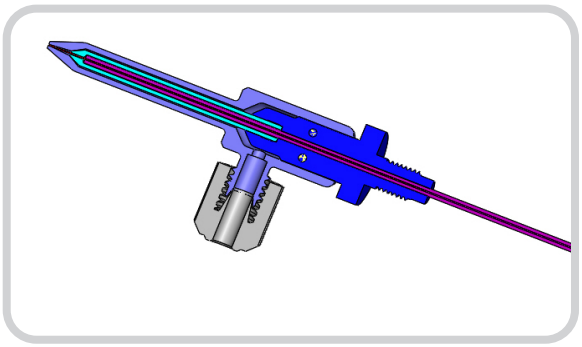
The C-Flow range is designed, molded and manufactured in house at Savillex. Savillex uses only the highest grade PFA resins. These grades have the lowest leachable trace metals levels of any grade PFA resin. For the analysis of samples containing 1-2% HNO_3, a new C-Flow can be used immediately without any precleaning. For the analysis of high concentrations of HNO_3 and other mineral acids, it is preferable to aspirate 5% HNO_3 or 5% HNO_3/2% HF through the nebulizer for 3-4 hours to remove any trace metal contamination from the uptake line. This need only be performed the first time a new nebulizer is used. The uptake line and capillary inside the nebulizer body of the C-Flow s-type nebulizers are manufactured from PFA, unlike other microconcentric nebulizers, which feature uptake lines made from different fluoropolymers. PFA is the most chemically resistant fluoropolymer, and is resistant even to concentrated TMAH, in addition to the commonly used concentrated mineral acids. The C-Flow s-type is resistant to any sample that can be analyzed by ICP-MS.



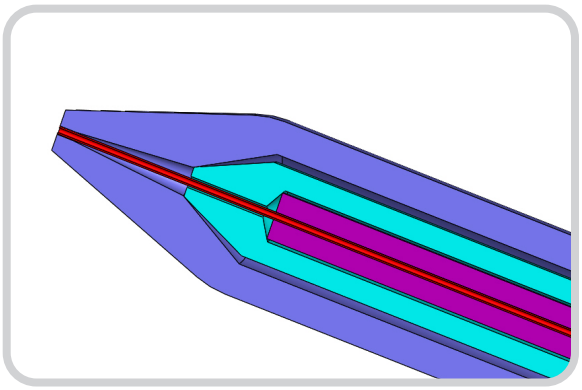
C-Flow S-Type Nebulizer Prior to Assembly; Showing Outer Body and Inner Capillary Support

Demountable Uptake Line

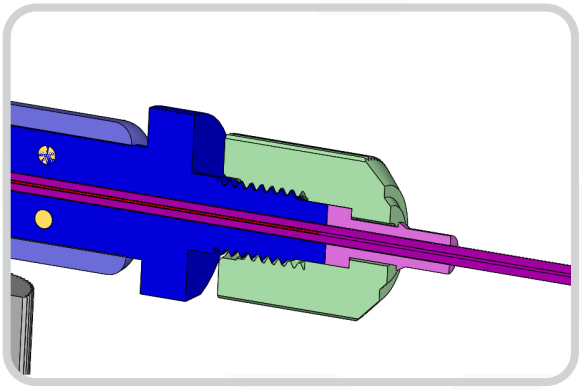
Another advantage of the s-type nebulizers is that they have demountable uptake lines, featuring a unique Savillex zero dead volume connector. Inside the connector, two mating surfaces are precisely machined to ensure a reproducible and reliable zero dead volume connection. All liquid contact surfaces are PFA. The design of the connector eliminates the possibility of any voids or dead space, which means washout is not compromised, and is equivalent to that of an integrated uptake line. The connector is captive on the uptake line for convenience, and the 1/4 - 28 thread on the nebulizer body also allows the s-type to be connected directly to an ESI FAST system. The benefit of a demountable uptake line is that if the uptake line is damaged, the nebulizer is not destroyed: the uptake line is simply replaced. Unlike other demountable type nebulizers which have poorer washout performance due to carryover, s-type nebulizers have equivalent washout performance to those with integrated uptake lines. A range of uptake lines with different nebulizer probes are available. Note that uptake rate specification is not guaranteed when the uptake line is changed but normally the uptake rate will remain in specification.



C-Flow - Inner Support Shown in Blue



Nebulizer Tip - Capillary Shown in Red



Savillex S-Type, Zero Dead Volume Connector

Uptake Rate Specifications

Because the C-Flow s-type nebulizers are manufactured to very tight tolerances, their free aspiration uptake rate specification range is tighter than other PFA nebulizers, which means the C-Flows perform reproducibly from nebulizer-to-nebulizer. The uptake rate specifications are as follows:

Nebulizer	Uptake Rate Specification	Uptake Rate Range
C50s	50 µL/min +/-20%	40-60 µL/min
C100s	100 µL/min +/-20%	80-120 µL/min
C250s	250 µL/min +/-20%	200-300 µL/min
(all at 0.7 SLPM nebulizer gas flow)		

Backflushing a Nebulizer

A limitation of concentric nebulizers is the potential for blockages due to particulates in the sample. If a blockage did ever occur, the C-Flow can be easily cleared by backflushing with nebulizer gas. With nebulizer gas switched on, a gloved finger is placed over the nebulizer tip which forces gas back down the uptake tube. Because the capillary is supported at the tip, it is not damaged by backflushing.

Clearing a blockage by backflushing a C-Flow – no need for tools or wires. Simply place a gloved finger over the tip while argon nebulizer gas is flowing.

C-Flow S-Type Versions

All versions feature a demountable uptake line with a Savillex zero dead volume connector. Each of the three nebulizer versions can be ordered with no probe on the uptake line or with a range of different probes to fit commonly used autosamplers. Note that uptake rate specification is not guaranteed when the uptake line is changed but normally the nebulizer does remain in specification, as long as the appropriate uptake line is used (i.e. a C250s nebulizer body should be used only with C250s uptake lines). Custom uptake line lengths and probe lengths are available. All C-Flows can also be pumped but they are normally used in free aspiration mode.

C250s

The C250s is the standard version for ICP-MS use with semiconductor samples – e.g. process chemicals.

C100s

The C100s is designed for applications that require a lower uptake rate, e.g. when sample volume is limited.

C50s

The C50s is designed for applications where sample volume is extremely limited, or where the sample matrix would overload the plasma if aspirated at a higher uptake rate (e.g. VPD samples).

Note: The C-Flow s-type nebulizers are not designed for use with desolvators. Savillex offers dedicated versions for desolvators. These versions are assembled and tested at 110°C and cannot be used at ~2°C in a conventional spray chamber.

Savillex
10321 West 70th St. | Eden Prairie, MN 55344-3446 USA | Phone: 952.935.4100
Email: info@savillex.com | www.savillex.com