GLASS EXPANSION

Quality By Design

Innovations for ICP-OES & ICP-MS

Contents

How is Glass Expansion Different?

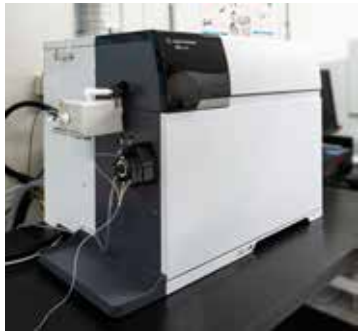
Our products are designed by our own experienced R+D team

- Well thought out
- Meticulously designed
- Precisely manufactured

We provide our customers with full technical support

- Experienced applications scientists
- 5 in-house ICP spectrometers

We have our own lab equipped with 4 ICP-OES & an ICP-MS



At our corporate headquarters in Melbourne, Australia, our test laboratory is equipped with PE AVIO 200 and Optima 2100DV, Agilent 5100 SVDV and Thermo Scientific iCAP 6500 Duo ICP-OES instruments as well as an Agilent 7900 ICP-MS. This allows us to do real-world testing of new products so there is no doubt they will perform optimally in your instrument.

Notes

Technical Support – Full staff of technical people to assist you







All of the people shown have years of experience and a wealth of technical information to assist you to choose the best sample introduction system for your samples.

Top row:
(left to right)
Jost Kaiser – CEO,
Danny Brezni – COO

Middle Row:
(left to right)
Glyn Russell – Sales and Marketing Manager,
Ryan Brennan – President, GE Inc.
Brian Boyd – Regional Marketing Manager,
Yoshi Yamano – Regional Sales Manager,

Bottom Row:
(left to right)
Justin Masone – Product Manager, GE Inc.
Terrance Hettipathirana – Applications Chemist/ ICP Specialist,
Vesna Dolic – Applications Chemist/ ICP Specialist

Notes

Many original GE designs are now industry standards

Our innovations include:

- Cyclonic spray chamber
- VitriCone nebulizer construction
- Helix interface
- D-Torch
- IsoMist XR Programmable Temperature Spray Chamber
- TruFlo Sample Monitor

Cyclonic spray chamber

VitriCone nebulizer construction

Helix interface

D-Torch

IsoMist XR

TruFlo

Many ICP users are not aware that the products that they routinely use with their ICP were actually designed by Glass Expansion. For more than 30 years, we have been developing products to make life easier for ICP users and our innovations include:

- **Cyclonic spray chamber**
  Before we introduced the cyclonic spray chamber, most ICPs used Scott style spray chambers.
- **VitriCone nebulizer construction**
  We are still the only manufacturer making nebulizers using the solid VitriCone sample channel. All other companies use fragile drawn-glass capillaries.
- **Helix CT interface**
  Before we introduced the Helix CT, o-rings were used to seal the nebulizer in the spray chamber. Some companies still use this out-moded method today.
- **D-Torch**
  The D-Torch makes a demountable torch affordable and significantly reduces ongoing torch costs.
- **IsoMist XR**
  This is still the only system offering fully programmable control of spray chamber temperature.
- **TruFlo**
  This is the only product providing real-time measurement of the sample flow.

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A wealth of useful information for the ICP user

- Application notes
- Newsletters
- Catalogs
- Product flyers
- Website
- Product care advice
- Operating instructions
- Videos

Flyers

Catalogs

Newsletters

Instructions

Website

Application notes

Glass Expansion's experienced ICP experts have published a wealth of useful information for ICP users. Most users regard our catalog and website as essential references, but some may not be aware of the other material available. This material is available on request or through our website. And if the required information cannot be found in our published materials, our technical support team is happy to assist.

Glass Expansion Warranty

All Glass Expansion products are supplied with our **NO-RISK GUARANTEE**. If the performance of the product is unsatisfactory or if it is unsuitable in any way, we will provide a credit or refund, provided it is returned in original condition within 14 days of receipt.

Customers sometimes ask if they can have a product on loan in order to evaluate its suitability for their application. With our NO-RISK GUARANTEE, this is not necessary. If a customer purchases one of our products and finds that it is not suitable for any reason, they can simply return the product for a refund or credit.

Notes

GE Value Proposition – Highest Value for Money

- **Reproducibility** – Never a need to re-optimize the parameters when new component installed
  * Saves time
  * Essential for experiments
- **Long life** – High quality and innovative design reduce wear
  * Saves money
  * Reduces down-time
- **Dependability** – over 30 years of experience
  * Applications support saves time experimenting

The most prominent characteristic of GE products is our manufacturing reproducibility. The benefits to the customer are many:

When you need to change a nebulizer or spray chamber, there is no need to re-optimize any parameters. This saves you valuable time. With other brands, re-optimization is often required.

Due to optimized design and tight specifications, GE products last longer, saving the operator both time and money.

GE retains a staff of applications experts in the field of ICP spectrometry to help you achieve the highest accuracy and productivity with your instrument.

GE Value Proposition – Nebulizer example

- Reproducible production eliminates optimization time, saving one hour of labor or US$75.
- Consistent capillary bore reduces clogging by a factor of two compared to other brands.

Let's examine our concentric glass nebulizers to determine the comparative value. There are two benefits to the design and reproducibility of our nebulizers:

Because one nebulizer can be replaced by another of the same model with no re-optimization, one hour of labor is saved.

Our unique and patented VitriCone capillary ensures consistent bore size throughout the entire length of the capillary. This results in a GE nebulizer lasting as least twice as long as a non-GE brand.

GE Value Proposition – Nebulizer example

	GE Price	Brand X Price
Initial investment	Y	X
Time spent optimizing brand x nebulizer	Y	X+$75
Half the lifetime for brand x nebulizer	Y	2(X+$75)
Real nebulizer cost	Y	2(X+$75)
e.g. $500 GE vs $400 X	$500	$950

In this example, the real cost of a Glass Expansion nebulizer is what you pay for it. However, there are hidden costs of a non-GE nebulizer, making it significantly more expensive even if the initial investment is lower.

The bottom line, when you buy a high quality nebulizer such as one from Glass Expansion, you realize savings down the road, making it the best value.

Notes

Product focus

- Nebulizers
- Cyclonic Spray Chambers
- IsoMist XR Programmable Temperature Spray Chamber
- Peltier Cooled Cyclonic Spray Chambers for the Agilent ICP-MS Models
- D-Torches
- Elegra Argon Humidifier
- RF Coils
- ICP-MS interface cones
- ConeGuard Thread Protector
- WindTunnel Autosampler Enclosure and Mobile Cart
- Trident In-Line Additions Kit
- Contour Flared-end Tubing
- Niagara CM Rapid Rinse Accessory
- Niagara Plus CM
- Assist CM
- Assist Oils CM
- TruFlo sample uptake monitor
- Guardian In-Line Particle Filter
- Guardian In-Line Non-Return Gas Filter
- Application Kits
- Connectors
- Laser Ablation Adaptors

Let's now look at the innovations individually with an eye toward how each might benefit the operation of your ICP spectrometer.

Notes

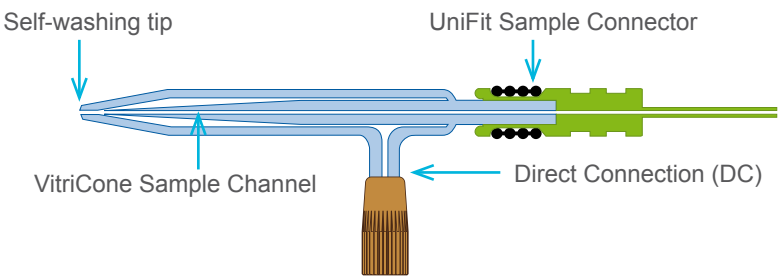
Nebulizer selection

- Conikal – basic glass concentric
- SeaSpray – high performance glass concentric
- MicroMist – low flow glass concentric
- Slurry – specialty glass concentric
- DuraMist – PEEK concentric
- OpalMist – PFA concentric
- Ceramic VeeSpray – ceramic non-concentric

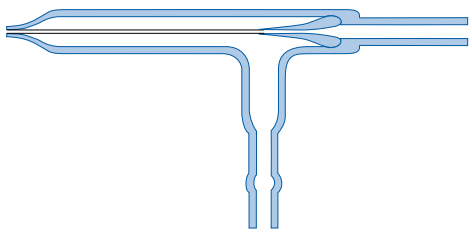
This is the range of nebulizers available. Each one has a variety of applications for which it is ideally suited. Only the VeeSpray model is not a concentric nebulizer design. It is instead a modified Babington type.

VitriCone capillary

Glass Expansion SeaSpray nebulizer



Other brands



All Glass Expansion concentric glass nebulizers incorporate the unique VitriCone capillary. Other manufacturers heat and draw a thin fragile capillary from glass tubing to create the internal capillary. This process is prone to a number of problems including inconsistent inner diameter, an increase in the porosity of the glass, and harmonic vibrations from the flow of argon, all of which degrade performance and lifetime. Glass Expansion is the only manufacturer that takes thick walled constant-bore tubing and machines the outside to a uniform aerodynamic shape. This guarantees a uniform sample channel, assuring tolerance to nasty samples and perfect reproducibility. Also, note the zero dead volume UniFit sample line fitting, also unique to GE.

Notes

DC Nebulizer

The DC (Direct Connection) nebulizer has a UniFit sample connector which slides easily over the sample arm and an argon connector configured to connect directly to your ICP.

DC Nebulizer Benefits:

- Inert metal-free argon connector.
- Instrument-specific Direct Connect flexible argon line.
- Reliable ratchet fitting ensures leak-free gas connection.

In addition to these unique benefits, the DC nebulizer shares the following benefits with the U-Series nebulizer:

- Resists blockage: The sample channel is uniform from the entry point to the tip, so there is nowhere for particulates to be trapped.
- Fast washout: Since there is nowhere for sample to be trapped, the fastest possible washout and highest sample throughput is achieved.
- Simple to use: Our proprietary UniFit connector slides easily over the sample arm and creates an excellent seal.
- Full length VitriCone construction

P/N A14-07-USS2, SeaSpray DC Nebulizer for Agilent 5100

P/N A23-1-UM04, MicroMist DC Nebulizer for NexION 1000/2000 ICP-MS

DC versions of the SeaSpray, MicroMist, Conikal, Slurry, DuraMist, OpalMist and VeeSpray nebulizers are available to suit the most common models of ICP-OES and ICP-MS.

The DC nebulizer part number has a prefix specific to each type of gas connector. For example, the prefix “A14-” denotes a connector for the Agilent 5100 ICP-OES, so part number A14-07-USS2 is a SeaSpray nebulizer configured for direct connection to the Agilent 5100.

Notes

SeaSpray Nebulizer High Performance and Tolerance

- Material: Borosilicate glass
- High physical reproducibility ~ 1%
- TDS tolerance, typically up to 20%
- Tolerance to particulates, typically up to 75µm
- Low RSD's due to highly accurate construction
- Standard available uptake: 2.0 and 0.4mL/min (1mL/min uptake available on request)

The SeaSpray nebulizer is the best choice when samples contain high concentrations of dissolved solids. Seawater, brines, and plating baths are just a few examples of SeaSpray applications. However, it is not recommended when samples contain large particulates or HF. The SeaSpray nebulizer produces the finest aerosol particles resulting in sensitivity gains.

MicroMist Nebulizer The Industry Standard for ICP-MS

- Material: Borosilicate glass
- High physical reproducibility ~ 1%
- TDS tolerance, typically up to 15%
- Low RSD's due to highly accurate construction
- Standard available uptake: 0.05, 0.1, 0.2, 0.4 & 0.6mL/min

When sample volume is limited, as may be the case for clinical or forensic samples, the MicroMist nebulizer is ideally suited. It is the nebulizer of choice for ICP-MS due to its smaller mean droplet size and efficient sample transport at low flow rates. However, for the ultimate in sample conservation plus matrix tolerance, we recommend the 0.4mL/min SeaSpray nebulizer.

Conikal Nebulizer The Industry Standard for ICP-OES

- Material: Borosilicate glass
- High physical reproducibility ~ 1%
- TDS tolerance, typically up to 5%
- Tolerance to particulates, typically up to 75µm
- Low RSD's due to highly accurate construction
- Standard available uptake: 1 & 2mL/min

The Conikal nebulizer is a general use nebulizer and is ideal for samples containing only moderate concentrations of dissolved salts, no particulates, and no hydrofluoric acid. A number of the instrument manufacturers employ this nebulizer as part of their standard instrument configuration.

Notes

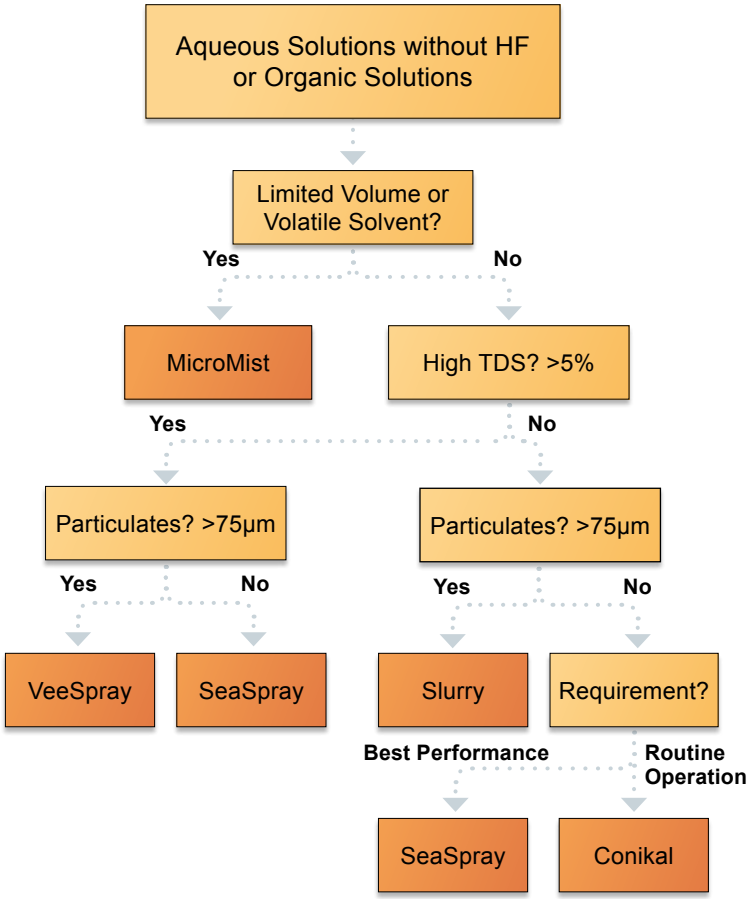
Slurry Nebulizer Ideal for Wear Metals in Engine Oils

- Material: Borosilicate glass
- High physical reproducibility ~ 1%
- TDS tolerance, typically ~ 1%
- High tolerance to particulates, typically up to 150µm
- Low RSD's due to highly accurate construction
- Slurry nebulizers have a natural liquid uptake of 4mL/min but operate best between 1.5 and 2.5mL/min

The Slurry nebulizer excels at exactly what it sounds like, the analysis of slurries. One common slurry application is the analysis of used engine oils for wear metals, and the Slurry nebulizer is the ideal choice. But any sample which consists of small particulates in a liquid matrix is a slurry and is suited to this nebulizer. It is important to note, however, that samples that contain high dissolved solids are not suitable for the Slurry nebulizer.

Nebulizer selection guide for non-HF samples

This guide summarizes the various nebulizer recommendations for samples that do not contain HF.



DuraMist Nebulizer Routine High Precision for HF Samples and High Salt Samples

- Material: HF Resistant PEEK
- High physical reproducibility ~ 2%
- Tolerance to particulates, up to 75µm depending on uptake
- TDS tolerance, typically up to 30%
- Low RSD's due to concentric geometry
- Uses only standard ICP argon supply pressures
- Standard 6mm size fits standard cyclonic spray chambers. Adaptors are available for Scott type spray chambers
- Standard available uptakes: 0.4 and 1.0 mL/min

The DuraMist concentric nebulizer is the most economical nebulizer for high precision analyses involving samples digested in HF. The DuraMist nebulizer is recommended for samples containing up to 5% HF.

OpalMist Nebulizer Ideal for ICP-MS work

- Material: PFA
- High physical reproducibility ~ 3%
- Strong and consistent self-aspiration
- Tolerance to particulates, up to 75µm depending on uptake
- TDS tolerance, typically up to 15%
- Low RSD's due to concentric geometry
- Standard 6mm size fits standard cyclonic spray chambers. Adaptors are available for Scott type spray chambers
- Standard available uptakes: 0.05, 0.1, 0.2, 0.4, 0.6 & 2mL/min

The OpalMist has two primary applications as follows:

For ICP-OES, it is the nebulizer of choice when samples contain both high dissolved solids and HF, but do not contain large particulates.

For ICP-MS, the high purity of PFA make it the preferred nebulizer for ultra trace analyses.

Ceramic VeeSpray Nebulizer Ideal for dirty samples

- Material: 99.8% Alumina Ceramic
- High physical reproducibility ~ 1%
- TDS tolerance, typically up to 30%
- High tolerance to particulates, typically up to 300µm
- Must be pumped – does not self aspirate
- Design uptake range: 0.6 – 3mL/min. Operates best between 1.5 and 2.5mL/min

The Ceramic VeeSpray is clearly the most rugged nebulizer. It can handle high dissolved solids and particulates without clogging and is suitable to all aqueous and organic solvents, even samples containing HF. It should be noted, however, that the VeeSpray is not a concentric nebulizer and therefore does not self-aspirate sample; it must be pumped. Because of this, pulsations from the peristaltic pump are more evident and this can degrade precision somewhat.

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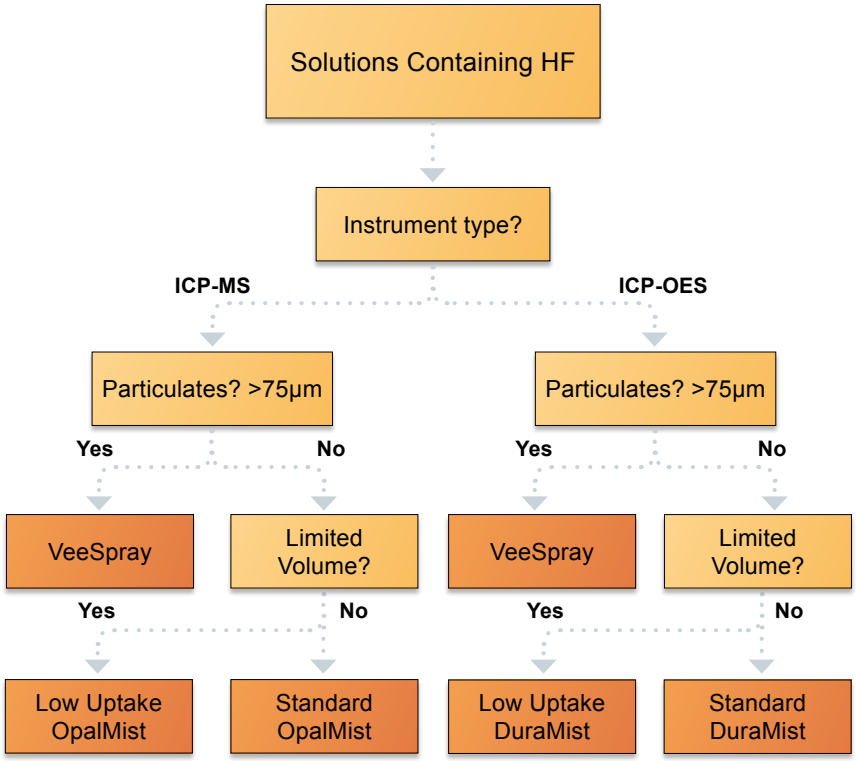
Nebulizer Selection for HF samples



This guide simplifies the nebulizer selection process for samples containing HF.

Notes

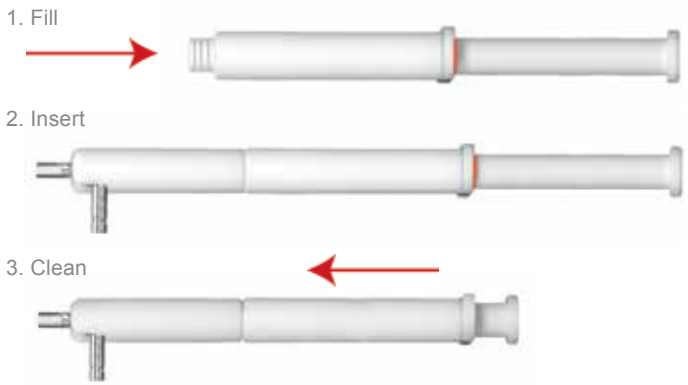
Nebulizer Maintenance Eluo™ Nebulizer Cleaner

- Rugged plastic construction
- Large volume barrel
- Nebulizer locking mechanism
- Maintain nebulizers with daily cleaning

We cannot always accurately characterize the samples we analyze and sometimes we run samples with particulates on a nebulizer not well suited for them. The Eluo is a convenient tool for unclogging nebulizers if it is needed. Also, it is a good idea to routinely back-flush the nebulizer with the Eluo to avoid buildup of any deposits at the orifice.

Eluo Operation Easy as 1, 2, 3.

1. Fill the barrel with methanol
2. Insert nebulizer tip first and lock arm
3. Depress plunger to clean nebulizer



It is a simple process to clean a Glass Expansion nebulizer.

- Unscrew the nebulizer holder from the Eluo barrel.
- Fill the barrel with an appropriate solvent (we recommend methanol as it does a good job of removing both inorganic salts and organic deposits and it dries easily after use).
- Screw the nebulizer holder back onto the Eluo barrel.
- Insert the nebulizer tip first into the nebulizer holder and rotate the nebulizer so that the gas arm locks into place.
- Depress the plunger so that all of the solvent passes through the nebulizer.
- Remove the nebulizer and dry if necessary.

Three Versions of Eluo

The Eluo is available for Glass Expansion concentric glass and HF-resistant nebulizers.

Part Number	Description
70-ELUO	Eluo Nebulizer Cleaning Tool (glass concentric nebulizers)
70-ELUO-OP	Eluo Nebulizer Cleaning Tool (old design OpalMist and PolyCon nebulizer)
70-ELUO-OPD	Eluo Nebulizer Cleaning Tool (new design OpalMist, PolyCon or DuraMist nebulizer)

There are three versions of Eluo. The standard configuration, P/N 70-ELUO, accommodates all Glass Expansion concentric glass nebulizers, while the Eluo-OP and Eluo-OPD is recommended for the OpalMist, PolyCon and DuraMist. Because of its larger nebulizer holder, the Eluo-OP and Eluo-OPD will also accommodate other brands of concentric glass nebulizer. However, other brands have less rugged inner capillaries and are more easily damaged by applying the hydraulic pressure delivered by the Eluo.

It should be noted that if you have all three types of nebulizer, a standard Eluo can be converted to an OP configuration by purchasing just the OP nebulizer holder, P/N 703-0074, or to an OPD configuration by purchasing just the OPD nebulizer holder P/N 70-803-0932.

Glass concentric nebulizer – requires 70-ELUO

Old design OpalMist and PolyCon – requires 70-ELUO-OP

New design OpalMist, PolyCon and DuraMist – requires 70-ELUO-OPD

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Notes

Spray Chamber Selection

- Glass Tracey – Cyclonic
- Glass Twister – Cyclonic with baffle
- Glass Cinnabar – Small volume cyclonic
- Glass Twinnabar – Small volume cyclonic with baffle
- PFA Tracey – HF resistant cyclonic for ICP-MS
- PTFE Tracey – HF resistant cyclonic for ICP-OES
- PTFE Twister - HF resistant cyclonic for ICP-OES
- IsoMist XR Programmable Temperature Spray Chamber (Extended range)
- Peltier Cooled Cyclonic(PCC) Spray Chambers for the Agilent ICP-MS Models

Glass Expansion offers a wide variety of spray chambers to accommodate all kinds of samples. The glass spray chambers are available in 4 different configurations while the inert chambers are made of either PFA or PTFE.
The IsoMist and PCC can be configured with a spray chamber made of glass, quartz or PFA.

Glass Spray Chambers

Tracey

Twister

Cinnabar

Twinnabar

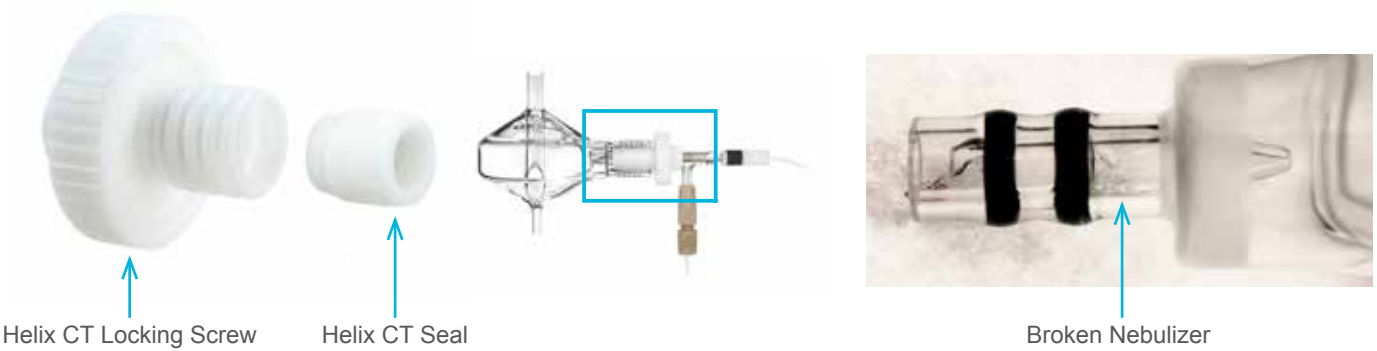
This shows the distinctions between the glass spray chambers. The Tracey and the Twister are both standard volume (50mL) spray chambers and are recommended for most samples where the sample uptake rate is at least 0.4mL/min. The Twister has a built-in baffle or “knock down” tube that serves as a droplet size cutoff filter and is recommended when stability and precision are key. The Tracey allows larger droplets to reach the plasma and will in general yield somewhat better sensitivity.

The Cinnabar and Twinnabar are analogous low volume (20mL) spray chambers and are recommended for fast washout when an uptake rate below 0.4mL/min is employed.

Notes

Exclusive Helix CT interface between nebulizer and spray chamber

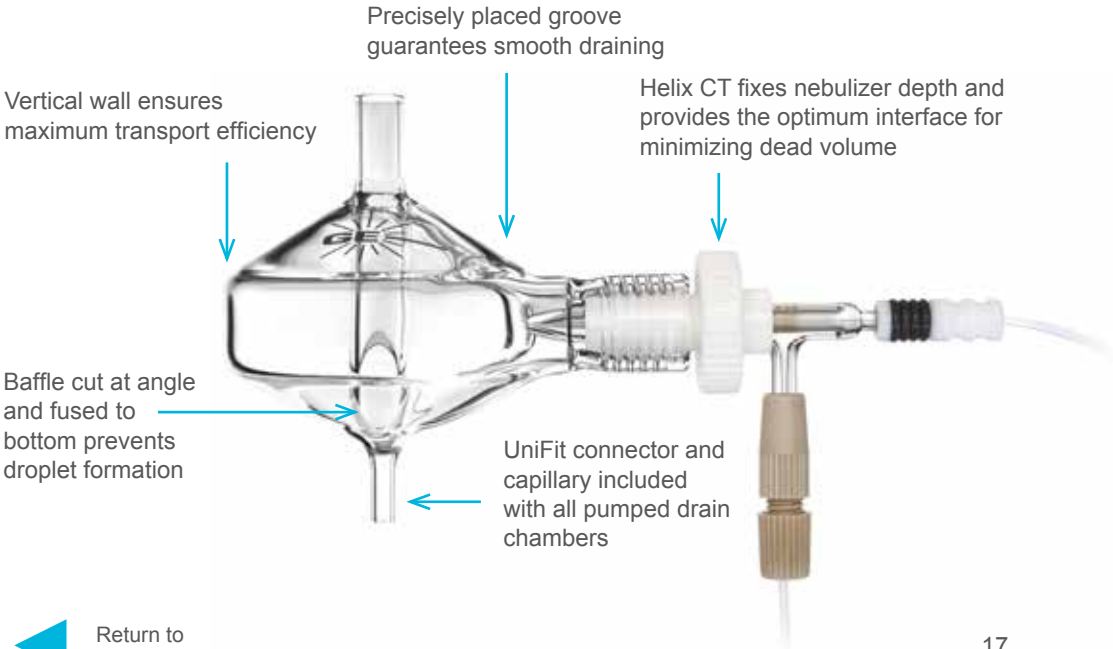
- New Helix CT locking screw with ConstanTorque technology
- PTFE ferrule seals spray chamber
- Solution contacts only PTFE and glass
- Standard for all spray chambers
- Prevents pooling at nebulizer port reducing carryover



The new Helix CT locking screw with built-in torque control mechanism allows for a consistent seal of the PTFE ferrule against the nebulizer- making it impossible to overtighten or undertighten while ensuring a gas-tight seal each and every time.
No need to worry about changing o-rings or nebulizers getting bonded to o-rings.

The photo directly left shows an old style spray chamber with o-rings. This spray chamber was sent to us by a customer who broke the nebulizer when trying to remove it after it bonded to the o-rings.

Glass Spray Chamber Detail



Both the design and manufacture of cyclonic spray chambers are critical to the performance of your ICP. The Helix CT fitting not only eliminates the problems presented by o-rings but also is carefully designed to fix the depth of penetration of a Glass Expansion nebulizer so that the aerosol produced is optimum.

An indented groove is built into the top of the spray chamber and serves as a barrier preventing solution from being swept into the torch. The position and depth of this groove are critical.

Note that the walls of the chamber have a vertical region. This is important for proper aerosol generation and affects transport efficiency to the torch.

The knock out tube or baffle is cut at an angle and carefully positioned to maximize transport of the aerosol but minimize transport of large droplets.

All pumped spray chambers include a UniFit connector & capillary for smooth and efficient draining.

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Inert Spray Chambers

ICP-OES

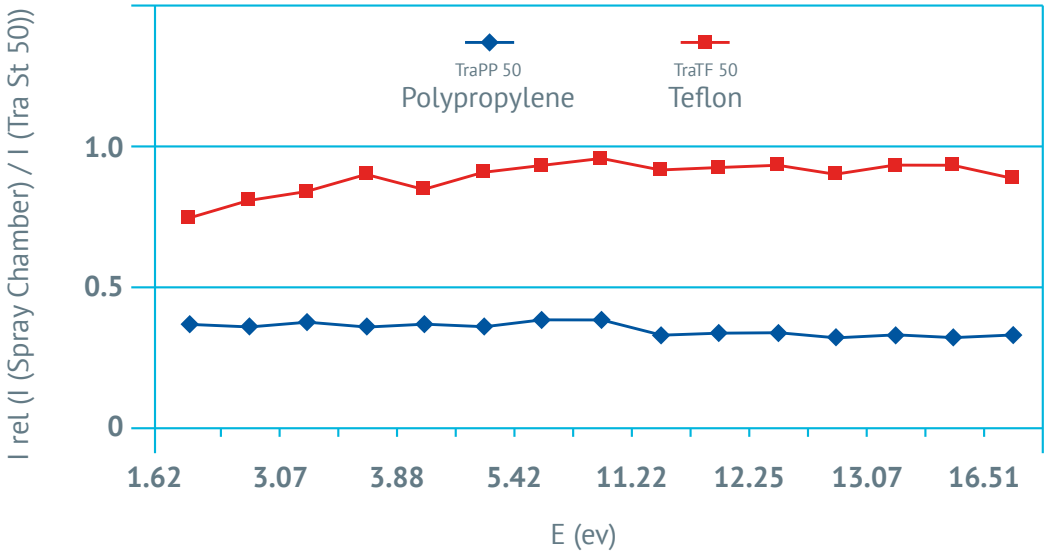
- PTFE Material
  - * Inert
  - * High purity
  - * Stediflow surface treatment
- 50mL internal volume
- Tracey and Twister models available

ICP-MS

- PFA Material
  - * Inert
  - * Ultra high purity
  - * Stediflow surface treatment
- 44mL internal volume

We offer inert spray chambers in two materials. PTFE is used for ICP-OES applications, while, due to its high purity, PFA is used for ICP-MS applications. In both cases, the interior of the chamber undergoes our Stediflow surface treatment which improves the wettability of the surface and ensures efficient drainage. Without the Stediflow treatment, droplets tend to form on the surface and degrade both sensitivity and precision.

Inert Spray Chambers – Sensitivity



A great deal of work went into the optimization of inert spray chambers over the past several years. Dr. Canals at the University of Alicante in Spain, in collaboration with Glass Expansion, undertook a detailed study of spray chamber material and design. The graph here shows just some of that data and particularly the comparison of the current design to the previous polypropylene design. Both spray chambers were compared to the best performing glass spray chamber. Note that the sensitivity has doubled with the current design and gives close to the same performance as the glass chamber. Although not shown here, precision also was improved with the Teflon material.

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Limitations of Room Temperature Spray Chambers

- Sensitivity drift with temperature
- Excessive plasma loading (volatile solvents)
- Excessive oxide formation (ICP-MS)
- Insufficient control of analyte transport

So far, we have discussed only those spray chambers that operate at room temperature. One consideration of these is that, as the room temperature changes, so does that of the spray chamber and that affects the transport efficiency and hence the sensitivity, resulting in analyte drift. Another concern is that specific sample matrices, particularly those which are very volatile, excessively load the plasma, resulting in instability and, in the worst case, extinguish the plasma.

For ICP-MS applications, excessive oxide formation can occur at room temperature, leading to isobaric interferences which must be dealt with. In summary, a room temperature spray chamber affords little control over analyte transport to the torch.

Limitations of Jacketed Spray Chambers

- Requires antifreeze solution
- Requires bulky floor model chiller
- Cumbersome coolant lines from chiller to chamber
- Freezing of condensate on lines
- Requires intricate jacketed chamber

In the past, when temperature control of the spray chamber was desired, an external chiller/heater was operated with a jacketed spray chamber. Due to inconveniences such as those shown, this approach was only used when absolutely necessary.

Notes

IsoMist XR Programmable Temperature Spray Chamber

- Programmable from -25 to 80°C in 1°C increments
- Maintains temperature to within 0.1°C
- Compact design
- 100% self-contained (no external lines)
- Incorporates Bluetooth® technology for clean wireless control (USB available)
- Compatible with all ICP-OES and ICP-MS models
- Time taken to pass below 0°C from 25°C < 15 minutes

The IsoMist XR is a Programmable Temperature Spray Chamber with the features shown. It incorporates a cyclonic spray chamber which is encapsulated in a conductive material to enhance heat transfer.

IsoMist XR Benefits

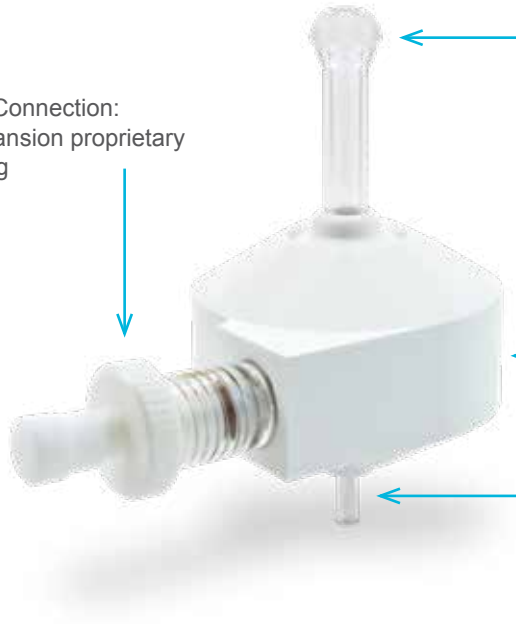
- Enables the analysis of volatile organics
- Enhances sensitivity for limited volume samples
- Reduces isobaric oxide interferences
- Increases the chance of passing QC checks
- Provides a record for regulatory compliance
- Eliminates drift (2°C change equals 10% shift in sensitivity)

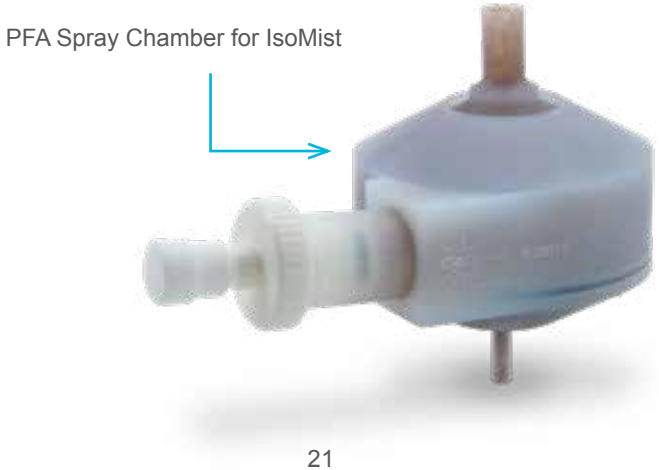
The benefits of the IsoMist XR are shown here and will be demonstrated subsequently.

Notes

IsoMist XR Configurations

- Standard glass cyclonic Twister spray chamber; e.g. KT-1013-XR
- Quartz cyclonic Twister spray chamber; e.g. KT-1013Q-XR
- High purity PFA cyclonic spray chamber; e.g. KT-1013P-XR
- Low volume Twinnabar spray chamber; e.g. KT-1013T-XR
- Glass, quartz and PFA spray chambers are interchangeable





Each IsoMist is customized for the particular make and model of ICP or ICP-MS with which it will be used. In some instances, the nebulizer will be on the left and others on the right side of the accessory. The standard configuration includes a glass Twister spray chamber, but the IsoMist can also be ordered with either a quartz or PFA spray chamber. And if you want to use more than one type of chamber, no problem; they are completely interchangeable. The IsoMist can also be supplied with a low volume Twinnabar spray chamber but this is not interchangeable with the other spray chambers.

Notes

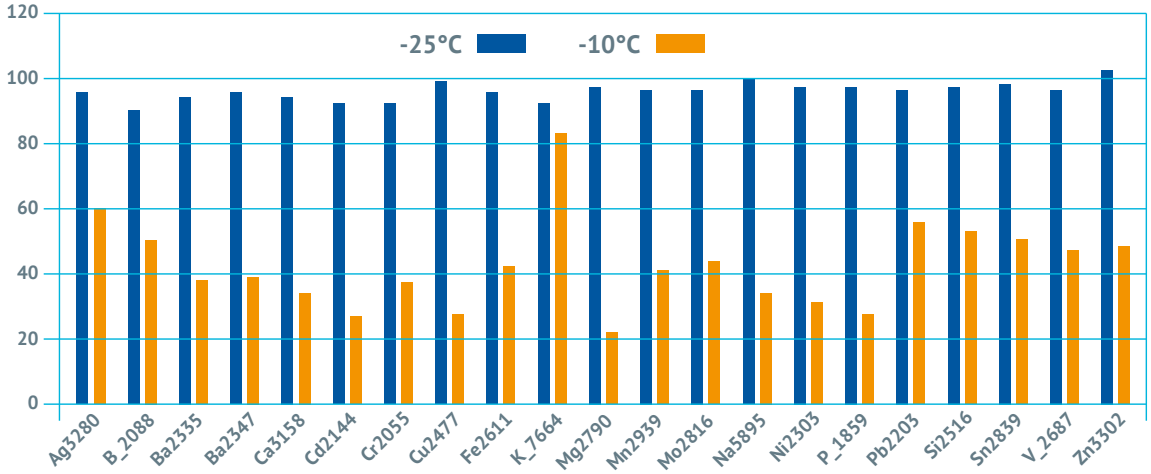
IsoMist XR with iCAP 6500 Duo ICP

The instrument parameters and configuration employed	
Torch	D-Torch with alumina inner tube and ceramic outer tube
Injector	Quartz tapered 1.0mm bore
Nebulizer	SeaSpray glass concentric with 0.4mL/min uptake
Pump tubing	Contour Flared-end Solva two tag, Orange/ Yellow 0.51mm ID
Plasma gas flow rate (L/min)	16
Auxiliary gas flow rate (L/min)	2
Forward Power (watts)	1350
Nebulizer gas flow rate (L/min)	0.28
Sample uptake rate (mL/min)	0.5
Spray chamber temperature (°C)	-10 and -25

Trace metal content in naphtha is important for a number of reasons. The presence of metals such as nickel during the cracking process can poison the expensive catalyst, while vanadium causes corrosion problems. During the refining process, release of toxic metals such as lead, mercury, and arsenic must be monitored and minimized. The presence of trace metals is also used to gain insight into the geological origin and migration of crude oil to aid in exploration.

The analysis of naphtha by ICP-OES is complicated by the high volatility of the sample, which can overload the plasma. It is therefore often diluted with a suitable solvent such as kerosene or xylene to facilitate the analysis. Unfortunately, due to the low levels of detection desired, dilution may not always be a viable course of action.

Effect of Spray Chamber Temperature on Intensity



With the IsoMist we can analyze naphtha directly without dilution.

With the IsoMist XR, temperatures as low as -25°C can be achieved and maintained.

When compared to -10°C, an approximate 100% increase in intensities on average for all lines was observed.

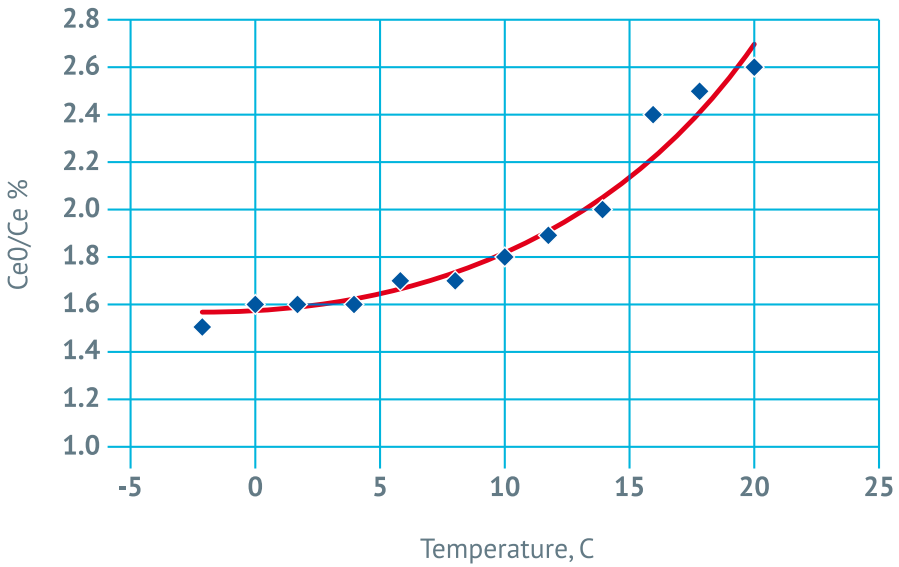
Notes

Oxide Reduction in ICP-MS Isobaric oxide interferences

Element/Isotope	Interference
^{56}Fe	$^{40}Ar^{16}O+$
$^{51}V+$	$^{35}Cl^{16}O+$
$^{44}Ca+$	$^{14}N^{14}N^{16}O+$
$^{48}Ti+$	$^{32}S^{16}O+$
$^{52}Cr+$	$^{34}S^{18}O+$
$^{64}Zn+$	$^{32}S^{16}O^{16}O+$
$^{64}Zn+$	$^{48}Ca^{16}O+$

For ICP-MS, there are a number of oxides that can interfere with specific masses as shown, resulting in the reporting of false positives.

Reducing Oxides for ICP-MS Effect of IsoMist XR Temperature



It is generally regarded that an oxide ratio of less than 2% is desirable to provide a more robust system. Even instruments which use collision/reaction cells to reduce oxide and other molecular isobaric interferences benefit from a reduced oxide ratio. In this experiment, it was found that using an IsoMist XR temperature of 2°C was optimum.

Notes

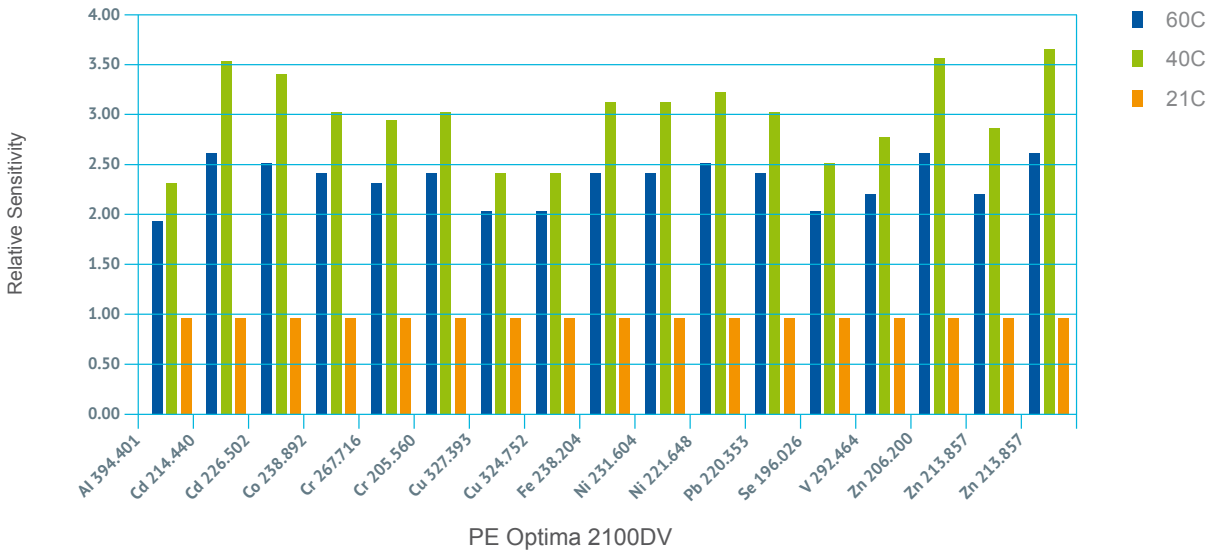
Analysis of Limited Sample Volumes

- Biological applications
- Intracellular fluids
- Neonatal samples
- Forensic applications
- Waste reduction applications
- Radioactive samples
- Toxic samples
- Requires micro-flow nebulization
- Sensitivity and DL's usually sacrificed

Another application of the IsoMist XR, this one involving heating rather than cooling of the spray chamber, relates to the analysis of small sample volumes such as is sometimes the case in the clinical analysis of intracellular fluids and neonatal blood and serum samples. Forensic labs are often challenged to harvest as much information as possible from a very small specimen. Also, where waste is very expensive to dispose of, as is the case with radioactive or very toxic samples, minimizing sample uptake minimizes waste. In each of these cases, the analyst is charged with the task of attaining valid analytical data often at very low concentrations making dilution an untenable alternative.

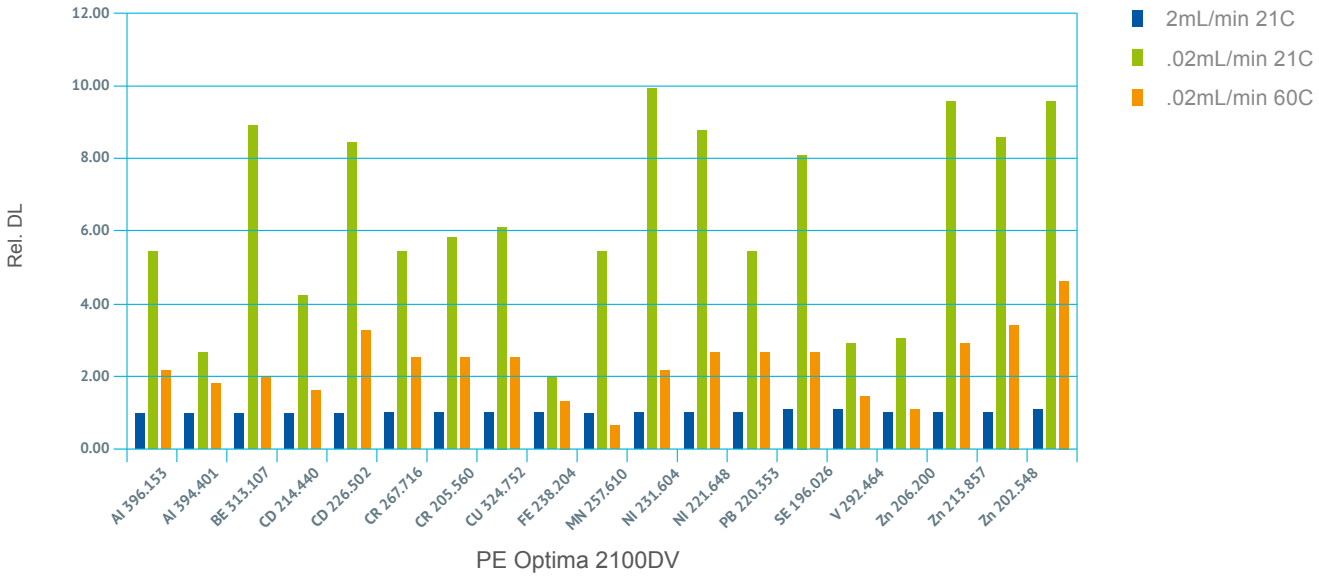
Notes

Effect of Temperature on Normalized Sensitivity (20µL/min uptake)



In this experiment, a 20µL/min sample uptake rate was used to conserve sample. Using the IsoMist XR, sensitivity for aqueous standards was determined at 3 different temperatures, 21 (room temperature), 40, and 60°C. Data was normalized to the 21°C results. Note that at 40°C, sensitivity was double that at 21°C and that at 60°C, triple. This is significant in that by heating the spray chamber to 60°C, we can achieve 3 times more sensitivity without consuming more sample; more and better information without the cost of more sample.

Effect of Temperature on DL



We also determined detection limits for these analytes under the same conditions. In this case, data was normalized to that attained at 21°C but with the standard uptake rate of 2mL/min (blue). The red bars show the degradation in detection limits resulting from changing to 20µL/min also at 21°C, about a factor of 4 to 10. The yellow bars give the degradation in detection limits achieved when 20µL/min was run at 60°C. Note that now, only a factor of 2 to 3 is sacrificed and in some cases, there is no degradation at all.

Notes

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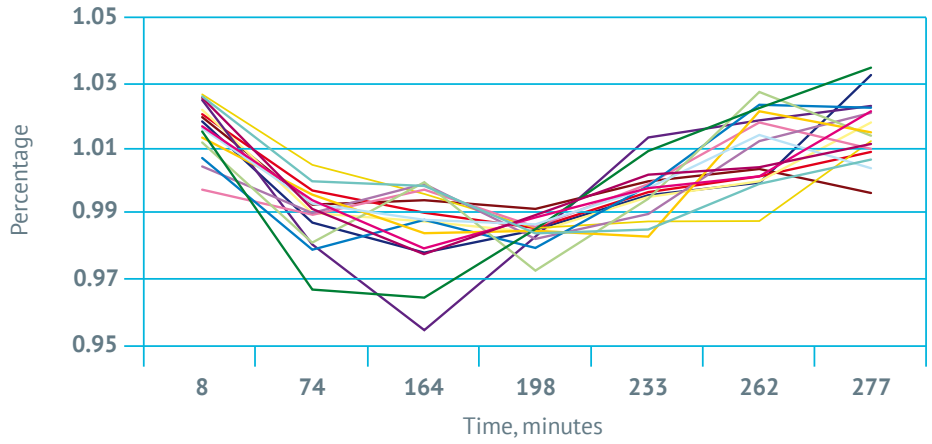
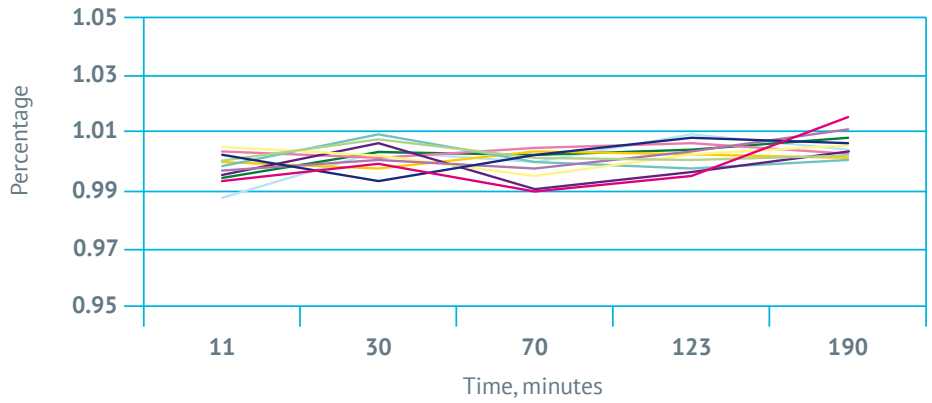
Constant temperature benefits (1mL/min sample uptake)

- Higher accuracy
- Higher productivity
- Greater reproducibility
- Better experiments

Without IsoMist XR



With IsoMist XR



Another benefit of the IsoMist XR results from the maintenance of a constant temperature, neither cooling nor heating. The data shown here was taken on an ICP-OES at 1mL/min sample uptake rate. Without temperature control, the intensity drifts as much as 3% high and 5% low during four hours of running (a range of 8%). With the IsoMist controlling and maintaining temperature at 21°C, intensities are held to within plus or minus 1%. This kind of stability is necessary to achieve maximum accuracy and reproducibility. Also, if drift is more severe, it will result in out of spec controls, necessitating re-running of standards and samples. Indeed, any ICP experiment reported in the literature should state the temperature of the spray chamber so that it is capable of being reproduced.

The benefits of this added layer of stability are significant. Oftentimes, operators wait up to an hour or more for the instrument to reach equilibrium before starting the run; this is no longer necessary. Even after an uncontrolled instrument reaches equilibrium, the heating/cooling system of the laboratory causes a sinusoidal temperature pattern which would be mirrored in the analytical results. The bottom line for environmental service labs and others is passing QC checks in order to avoid rerunning samples. If the prospect of rerunning is diminished, the laboratory will be more profitable.

Stability Summary

- No need to wait 60 minutes for stabilization after start-up
- Eliminates the need for expensive lab temperature regulation
- Increases the likelihood of passing QC checks
- Eliminates rerunning of samples

Notes

IsoMist XR Target Markets

- Oil refineries – light naphthas
- Solvent manufacturers – ketones & alcohols
- Environmental labs – eliminate calibrations
- Wear metals in used engine oils – reduce viscosity
- Precious metal refiners – greater accuracy
- Elan/NexION ICP-MS users – oxide reduction
- Regional hospital laboratories – small volumes
- Any “hot” determinations – reduced waste

Some of the industries for whom a temperature controlled spray chamber would have the most value are listed here. Any laboratory that needs to analyze volatile solvents would benefit from the cooling capability of the IsoMist. One interesting application is heating the spray chamber to reduce the viscosity of samples such as used engine oils and edible oils. In the precious metal business, the highest accuracy is desired. By eliminating or minimizing drift between calibrations, higher accuracy (and hence higher profitability) can be achieved.

Notes

Peltier Cooled Cyclonic Spray Chamber for Agilent ICP-MS

Part Number	Description
KT-1116	PCC Spray Chamber for Agilent 7700/7800/7900/8800/8900

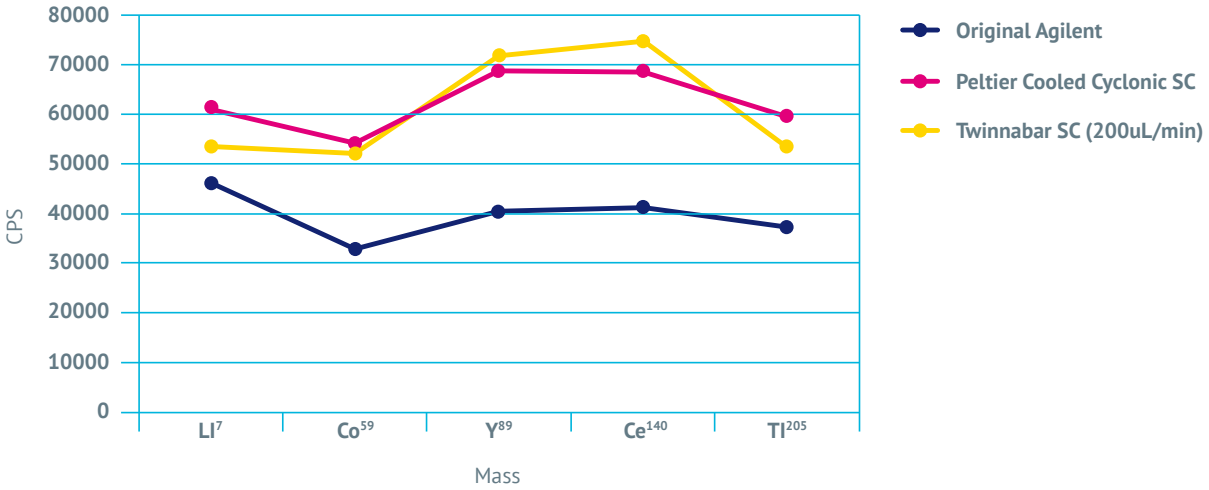
- Interchangeable glass, quartz and PFA cyclonic spray chambers
- Faster washout than standard Scott style spray chamber
- Higher sample throughput than standard Scott style spray chamber
- Temperature controlled from ICP-MS software and electronics
- Uses standard water cooling from ICP-MS unit
- Peltier cooling system
- Supplied with convenient mounting bracket

When the best temperature flexibility or temperature stability is required, we recommend the IsoMist Programmable Temperature Spray Chamber.

However, for many ICP-MS applications, a fixed temperature of around 2°C is used and no flexibility is needed. For these applications, we recommend the Peltier Cooled Cyclonic Spray Chambers for the Agilent 7700/7800/7900/8800/8900 ICP-MS models. These accessories are based on the spray chamber and Peltier system of the IsoMist but are coupled to the electronics and water cooling systems of the ICP-MS.

Agilent 7700/7800/7900/8800/8900 users can therefore get the benefit of a cyclonic spray chamber at an economical price. Compared to the Scott style spray chamber, the cyclonic spray chamber provides faster washout and increased sample throughput.

Intensity Comparison Effect of spray chamber design on signal intensities



The intensity experiment showed large improvements when using either the Twister or Twinnabar. The Twinnabar experiment utilized half the sample uptake rate but also yielded a higher transport efficiency due to the smaller sample uptake rate.

Rather than use identical parameters for all three chamber configurations, we felt it was a better test to have the automated optimization protocol of the instrument determine the best conditions for each chamber. For this reason, there are slightly different conditions for each.

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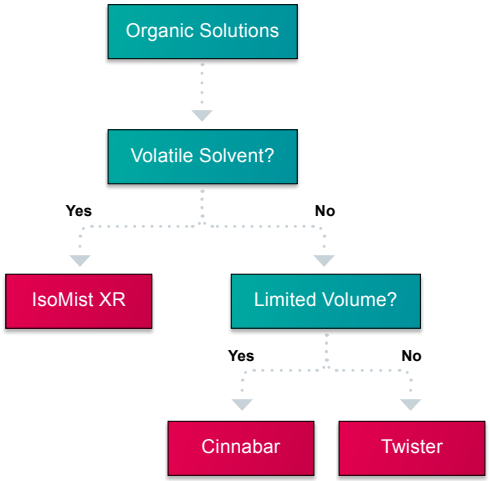
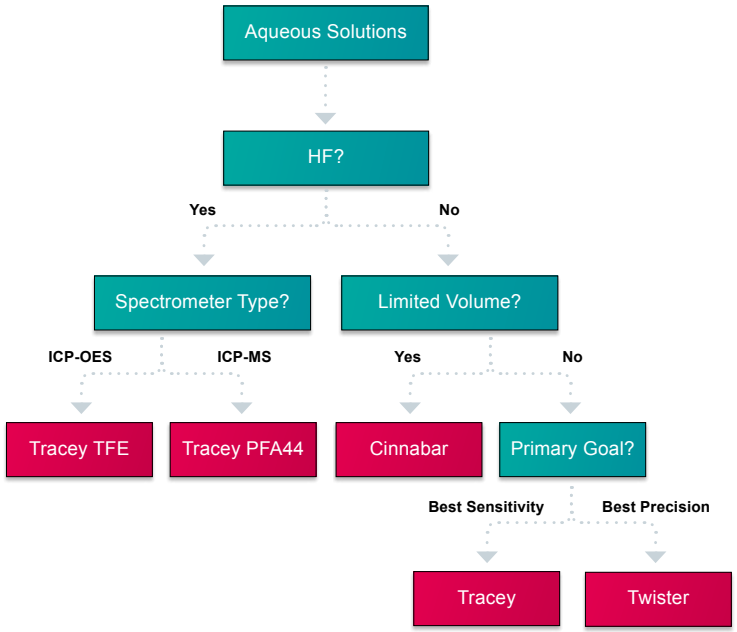
Spray Chamber Selection (Organics)



This guide summarizes the proper selection of a spray chamber based on the type of organic solvent analyzed.

Spray Chamber Selection (Aqueous)



Similarly, this guide walks the analyst through a series of questions leading to the proper spray chamber for a variety of aqueous sample types.

The Cinnabar Spray chamber also provides a faster washout.

Notes

Torch Designs

Single-piece quartz torch

- No removable parts

Semi-demountable (SDT) torch

- Removable injector

D-Torch

- Removable injector
- Removable outer tube

Fully Demountable torch (FDT)

- Removable injector
- Removable inner tube
- Removable outer tube

Glass Expansion offers a choice of torch design with varying degrees of demountability.

Notes

Torch Availability

Element/Isotope	Single piece	SDT	FDT	D-Torch
Agilent ICP-MS	✓	✓		✓
Agilent (Varian) ICPOES	✓	✓	✓	✓
Analytik Jena ICPOES	✓		✓	
JY				✓
Leeman	✓	✓		
Nu/Micromass	✓			✓
PE Elan		✓		✓
PE NexION		✓		✓
PE Optima		✓		✓
PE Avio				✓
Shimadzu	✓	✓		
Hitachi	✓	✓		
Spectro	✓	✓		✓
Thermo iCAP		✓		✓
Thermo ICP-MS	✓	✓		

This table illustrates which torch types are available for the individual instrument makes.

Notes

D-Torch

- Replace just outer tube (fastest to degrade)
- Easy to switch injector from HF to aqueous to organics
- Optional ceramic outer tube
- Economical price

For Spectro EOP

For Thermo iCap 6000/7000 Duo

For Perkin Elmer AVIO

For Agilent 5100/5110

A relatively new line of torches called the D-Torch provides demountable outer tubes and injectors. This design is much less expensive than the ABC torches but still provides the major benefit of a demountable outer tube. For these torches, a ceramic inner tube is used for long life.

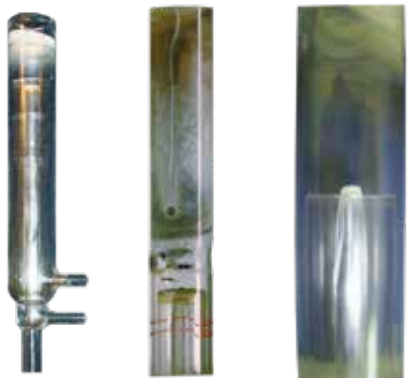
The outer tube takes the brunt of the punishment from both the sample and the plasma and is therefore the first part to deteriorate. A process called devitrification occurs from the exposure of quartz to salts at high temperature. The D-Torch is a cost-effective alternative for any laboratory with a moderate workload. They will only need to replace the outer tube when it wears, instead of replacing the entire torch. Customers will realise a saving after only a few replacements of the outer tube.

The demountable injector makes it easy to modify the torch to suit the analysis of HF-containing samples or organic solvents which typically require an injector with a smaller orifice.

The ceramic outer tube provides greatly extended lifetime for demanding samples such as oils, fusions, or high-salt solutions.

Notes

Effect of Salt on Torches



Quartz torch (a) and ceramic torch (b) exposed to 10% NaCl for 6 hours.

The Benefits of a Ceramic Torch

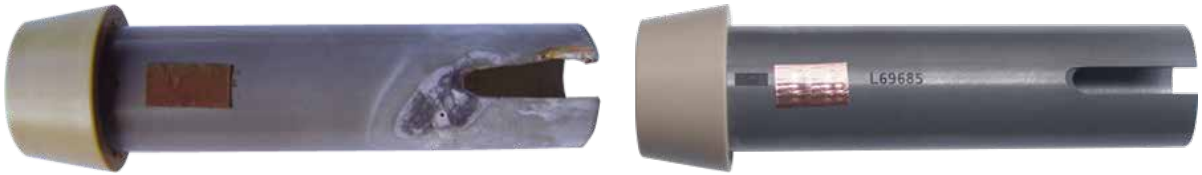
In general the ceramic outer tube has a much longer lifetime, greatly reducing interruptions and downtime due to torch failure. The ceramic outer tube is of particular benefit for:

- the analysis of wear metals in engine oils, where quartz outer tubes often suffer from short lifetime.
- Si determinations, where quartz outer tubes often produce high background signals.
- fusion samples or samples with high levels of dissolved solids which cause quartz tubes to devitrefy.

Lithium borate fusion samples

The D-Torch ceramic outer tube in the photo below has been running lithium borate fusion samples for three years at 5-7 days per week and 20-22 hours per day.

This ceramic tube is showing clear signs of wear and tear but it has been running very demanding samples for approximately 20,000 hours. And at the time this photo was taken it was still operational. As a comparison, before the ceramic D-Torch was installed, a standard quartz torch was lasting only about 100 hours. So the ceramic torch has outlasted 200 standard quartz torches, **SAVING THE USER AT LEAST $40,000**.



Ceramic tube after 3 years of use compared with new ceramic tube

These are the effects of devitrification. The torch in the middle has worn right through the quartz outer tube. The torch on the right shows the salting out that can occur on the injector.

The D-Torch reduces the cost of torch replacement since only the outer tube is replaced.

The Elegra Argon Humidifier reduces salt deposits.

The ceramic outer tube of the D-Torch is made from sialon, which is a ceramic material derived from silicon nitride. Sialon is one of the most durable and robust ceramic materials known and maintains its properties at high temperatures. A combination of high temperature and salt deposit causes a quartz torch to devitrify. Higher concentrations of salt in the samples lead to more rapid devitrification. By contrast, the ceramic outer tube of the D-Torch does not devitrify and is not affected by salt deposits. The quartz torch in Figure (a), was run for only 6 hours with samples containing 10% NaCl and is already badly degraded. The ceramic D-Torch in Figure (b) was run for the same period and with the same samples as the quartz torch, but shows no degradation at all. In general, the ceramic outer tube has a much longer lifetime, greatly reducing interruptions and downtime due to torch failure. Sialon is also beneficial for low level Si determinations, where quartz outer tubes can produce high background signals.

Notes

D-Torch DL Comparison

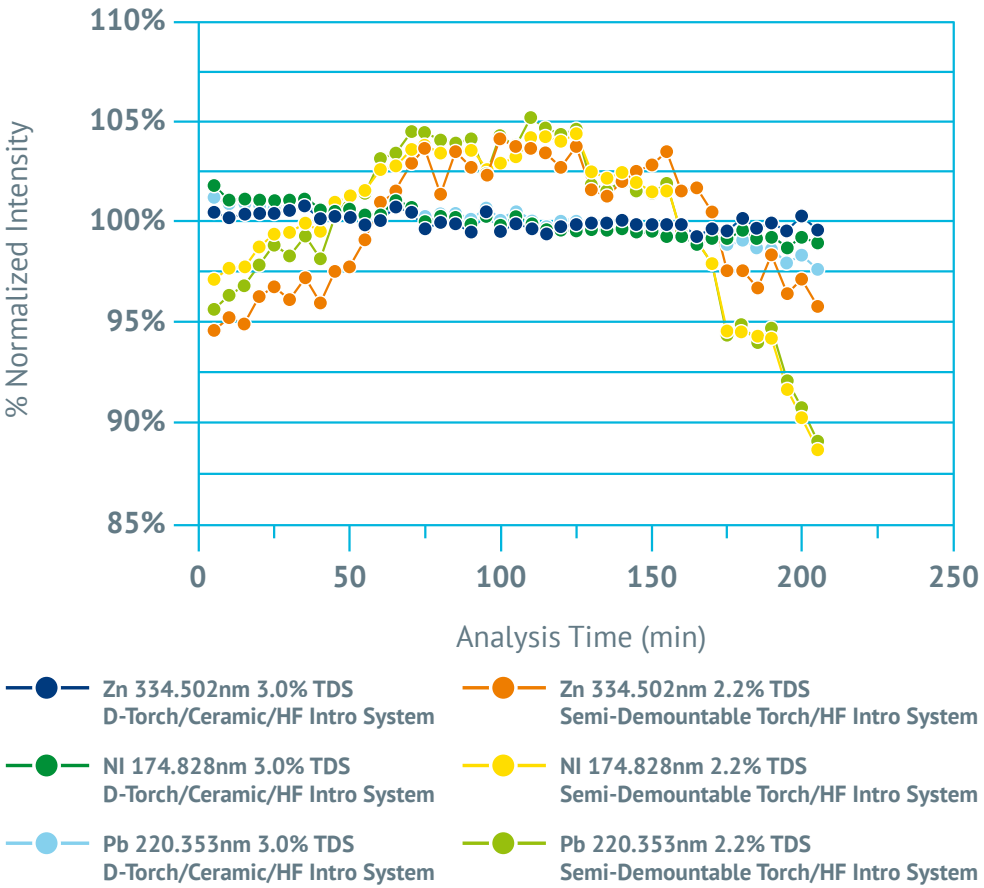
	Detection Limit (µg/L)	
Element (λ)	Radial Quartz Torch	Radial Ceramic D-Torch
Al 167	1.6	1.1
Ba 455	0.07	0.12
Cu 324	0.88	0.62
K 766	25.5	11.7
Mg 279	0.05	0.05
Mn 257	0.36	0.25
Ni 221	1.6	1.3
P 177	5.1	5.0
Zn 213	0.23	0.28

D-Torch for iCAP Radial

A comparison of detection limits between the radial EMT torch and the radial ceramic D-Torch using default parameters for the plasma and sample introduction settings with 10 second integration times.

Notes

Fully Ceramic D-Torch – Less Maintenance & Improved Stability with High TDS



D-Torch for Spectro Arcos EOP

The D-Torch incorporates a ceramic intermediate tube for greater robustness and provides the analyst with an outer tube (quartz or ceramic) which can be replaced when it fails rather than replacing the entire torch. A ceramic outer tube is of particular benefit for the analysis of difficult sample matrices such as high TDS and HF. The D-Torch also features an interchangeable injector, allowing the analyst to have a specific injector for each application whether aqueous, organics, high TDS or HF. Having a demountable torch also allows for easy maintenance and cleaning.

The ceramic outer tube runs hotter than quartz which slows the build-up of material on the outer tube and results in a more robust plasma, a result which is especially important in the presence of high TDS samples.

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Maximizing Up-Time – Elegra Argon Humidifier

- Compact, cost-effective design.
- No heating or electric power required.
- Non-pressurized water reservoir.
- An easy-to-use bypass switch allows you to take the Elegra off-line without disconnecting argon lines. (Not available with Elegra Dual)
- Highly efficient membrane humidification technology.
- Improved signal stability for samples with high TDS.
- Simple to use and maintain.
- Facilitates long, uninterrupted run times.
- Inert metal-free construction eliminates possibility of contamination.
- Rugged and durable polymer casing.
- Maximum and minimum fill marks ensure that you are always operating under optimum conditions.
- Compatible with all ICP-OES and ICP-MS models. Direct connection to argon outlet provided for most models.
- Two-channel configuration available for ICP-MS instruments using auxiliary argon.

The Elegra argon humidifier is a good way to reduce the salting out we saw earlier at the injector tip.

The Elegra is available in two models.

The standard Elegra Argon Humidifier comes with a bypass switch. Once the reservoir is filled and gas lines connected, the humidifier is in-line and can simply be switched ON or OFF by rotating the switch to start or stop humidification.

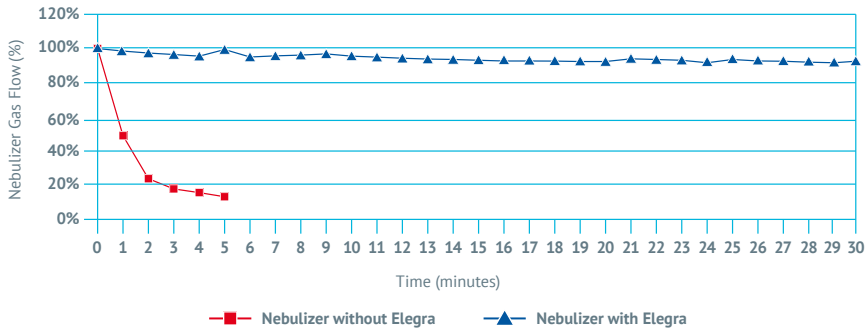
The Dual Elegra Argon Humidifier is for ICPMS instruments using Auxiliary argon. In this system the second channel is used to humidify auxiliary/ make-up gas to sample introduction system.

Two Versions of Elegra

Elegra Humidifier

Elegra Dual Humidifier

Elegra Nebulizer High TDS Stress Test (25% NaCl)



The graph at left is the result of an extreme test, aspirating a 25% salt solution continuously without rinsing. Without the Elegra, the nebulizer begins to clog after only a few minutes as designated by the steep decrease in nebulizer flow. However, with the Elegra installed, the nebulizer is stable for well over 30 minutes.

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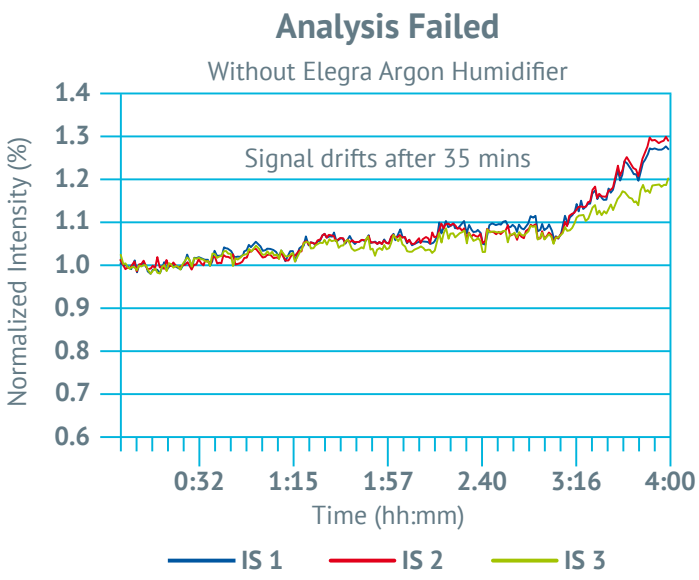
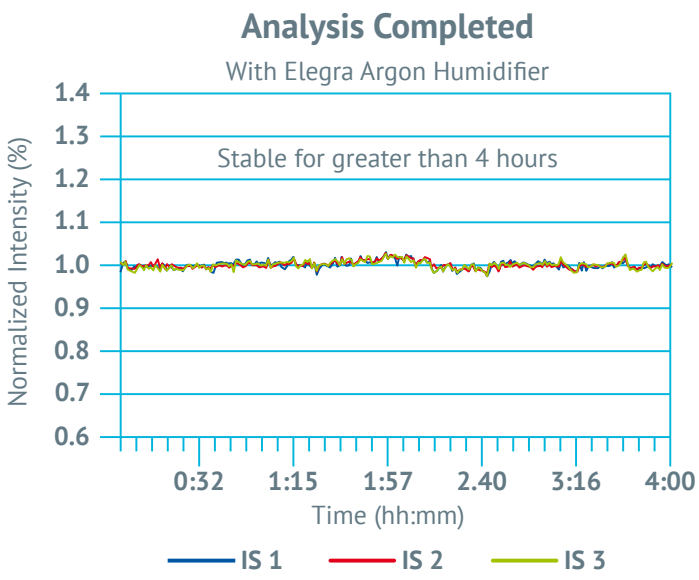
Notes

Stability in 0.5% Lithium Metaborate

Internal Standard Signal for Three Lines





The graphs on the left demonstrate the benefit of using the Elegra with the real-world application of analyzing fusion samples with 0.5% lithium metaborate by ICP-OES. All three internal standard lines monitored began to drift quickly when no Elegra was used, while their responses were very stable with the Elegra installed.

Notes

RF Coils

- Plated after coiling
- Available in gold and silver
- Coil-former guarantees concentricity
- Coil-former maintains coil spacing
- Installation tool guarantees proper alignment
- Installation tool & USB eliminate need for a service call

A high quality RF coil is crucial to the smooth operation of an ICP spectrometer. Glass Expansion has developed a precise process for manufacturing coils for a wide variety of instrument models. Unlike other operators who take plated copper tubing and coil it, Glass Expansion coils the copper tubing first and then performs a consistent plating process of either gold or silver. A plastic former is inserted into the coil to guarantee and maintain the proper concentricity and spacing between turns. The former is also used in conjunction with the installation tool during the alignment process. The alignment tool kit includes a USB to walk you through the installation and alignment process. There is no reason to pay a service engineer to make a billable call (coils are considered consumables and are not covered under the instrument warranty).

Which Coil to Recommend?

- Copper: labs on a tight budget
- Silver: most labs concerned with both long life and high performance
- Gold: highly corrosive environments
- Teflon-coated silver: longest lasting and best performance

Teflon-coated Silver RF Coil

Bare copper is the least expensive coil but is subject to corrosion faster than a plated coil. Silver-plated coils will last longer and silver provides the most efficient conductive surface for RF energy. Gold plating provides more corrosion resistance than silver, although in some cases Teflon-coated silver is available, providing both long life and efficient energy transfer.

Why Replace RF Coils?

- Regular replacement of corroded coils reduces the load on the RF generating system
- Changing corroded coils increases energy transfer, resulting in a more robust plasma and generally higher analytical line intensities
- Reduce chance of arcing

Notes

Available RF Coils

Make	Model	Copper	Silver	Gold	Teflon Coated
Agilent	7500		✓	✓	
	7700/8800	✓	✓	✓	
	7800/7900	✓	✓	✓	
Agilent (Varian)	Liberty Radial		✓	✓	
	Vista Radial		✓	✓	✓
	Vista/Liberty Axial		✓	✓	✓
	700-ES		✓	✓	✓
JY	ALL		✓	✓	
PE NexION	300/350	✓	✓		
PE Elan	5000	✓	✓		
	6000/9000/DRC	✓	✓		
PE Optima	3000	✓	✓	✓	
	2000/4000/5000/7000		✓	✓	
Thermo	IRIS		✓	✓	✓
	iCAP 6000		✓	✓	✓
	iCAP 6000/7000 MKII		✓	✓	

These are the coils currently available for the various instrument models. Please inquire if you do not see your specific ICP model listed.

When to Replace RF Coils

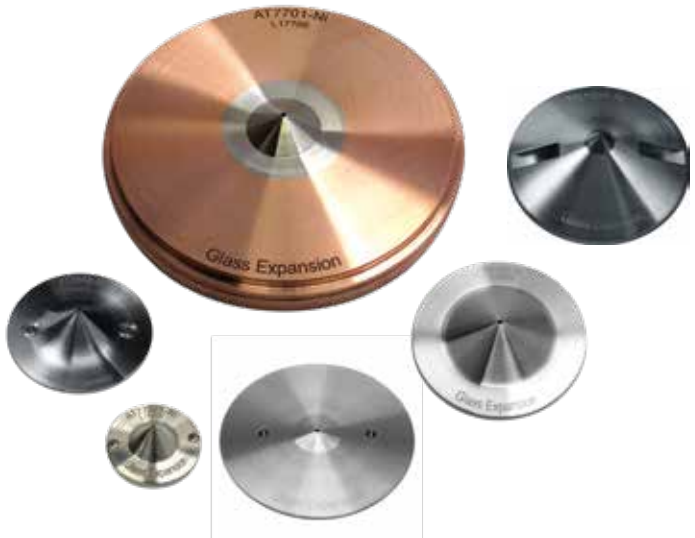
- Coil surface appears corroded or pitted
- Torch outer tubes fail predominantly on one side
- Noticeable crackling noise during liquid aspiration
- More than two years old for ICP-OES
- More than 6 months old for ICP-MS

Here are some guidelines to let you know when it is time to replace the RF coil. Failure to replace a worn RF coil in a timely fashion can lead to torch and power tube deterioration which can be much more costly than coil replacement.

Notes

Interface cones for ICP-MS

- Meet or exceed OEM specifications
- Available for all common ICP-MS models
- Satisfaction guaranteed



Glass Expansion manufactures interface cones in its Melbourne facility. Our manufacturing plant includes four CNC machines and an electron beam welder and is the best equipped and best qualified cone machining plant in the world.

Cone Availability

ICP-MS	Ni	Al	Pt	Pt - Boron Free	Cu
Agilent	✓	✓	✓	✓	
GV/Micromass	✓	✓			
Nu	✓		✓		
PE	✓	✓	✓	✓	
Thermo Finnigan	✓	✓	✓	✓	
Thermo VG	✓	✓	✓		
Shimadzu	✓		✓		✓

This table shows the various materials available for cone pairs (sampler and skimmer) for the different ICP-MS models.

Extend Life of Platinum Cones

- Free refurbishment of platinum cones
- Rebate for value of platinum if cone cannot be refurbished

Glass Expansion will refurbish your platinum cones for free, even if they were not purchased from us. When the cone reaches the end of its life and cannot be refurbished, we will give you a rebate equal to the value of the platinum in the cone.

Notes

ConeGuard™ Thread Protector

- Extend the life of your ICP-MS cones
- Seals the thread and protects it from corrosion during the cleaning process
- Keeps the thread in good condition to prevent the possibility of cross-threading and potential damage to the instrument housing

Simple to use

The ConeGuard simply screws onto the threaded part of the cone and o-ring seals prevent any solution from coming in contact with the thread.

ConeGuard with sampler cone for Agilent 7500

When cleaning cones which have a screw thread, it is important that the thread is not contacted by any corrosive solution. If the thread gets corroded, the cone may not seal correctly or it may bond to the base and be difficult to remove.

With Pt cones, the thread is likely to wear out before the Pt insert.

Notes

WindTunnel Autosampler Enclosure

- Protects samples against airborne contaminants
- Protects the operator against fumes and odours
- Suitable for the Cetac 130, 260, 280, 520, 520HS and 560 plus PerkinElmer AS93+ and S10, and Agilent SPS-3 autosamplers
- Shatter-proof polycarbonate construction
- Easy access through front and rear roll-up doors
- Optional fan maintains positive pressure
- Optional HEPA filter
- Optional exhaust port flange
- Optional solid polyethylene base
- Multiple ports for tubing and power cords
- Larger model suitable for Cetac XLR8 and XLR-860 autosampler

The WindTunnel is designed to fit over an autosampler sitting on a solid flat surface.

The optional accessories allow you to configure the WindTunnel to best suit your requirements.

When fitted with the optional fan and HEPA filter, the WindTunnel provides a positive pressure enclosure.

The addition of the optional flange, allows the fumes to be removed through a laboratory exhaust system (not supplied).

The WindTunnel can be used without the fan and filter to function as a convenient dust cover.

The Base is designed with a deep cut in the top surface around the inside perimeter of the enclosure to catch any acid spill. A hole in the side of the base allows a tube to be inserted to catch the spill drain off.

Notes

WindTunnel Mobile Cart

- Chemical-resistant polymer construction
- Inbuilt shelving for reagent and waste containers
- Fully mobile for easy positioning
- Locating pins to lock WindTunnel Enclosure in place
- Drain fitting to remove any accidental spills
- Lightweight and fully collapsible for easy shipping

The WindTunnel Mobile Cart frees up bench space and allows the autosampler to be placed in the most convenient position for your analysis.

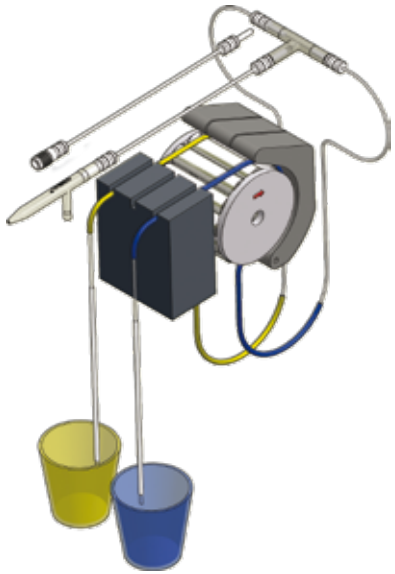
Notes

Trident In-line Reagent Addition Kit

Part Number	Description
60-808-1185	For standard applications
60-808-1150	For HF applications

- Ideal for all ICP-OES and ICP-MS systems
- Mixing tee guarantees intimate mixing with minimal washout time
- Totally modular
- Separate kit for HF resistant applications
- Easy installation of Contour flared-end tubing

EzyFit glass mixing T-piece

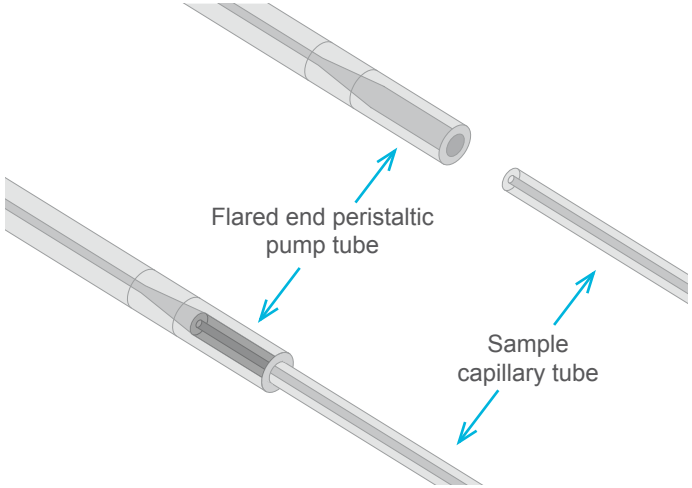


Manual sample dilution, when desired, or the addition of internal standard element(s) can be a tedious and error-fraught process. The Trident kit allows you to automatically carry out these processes accurately and without extra labor. Two kits are available, one comprising a glass tee and another which includes an HF-resistant tee. An extra channel on the instrument peristaltic pump is required. The dilution factor is determined by the choice of pump tubing ID for the sample and diluent (internal standard).

The Trident kit can be used with all ICP-OES and ICP-MS instruments. The tee has a built-in mixing chamber that guarantees mixing of the sample and diluent yet requires minimal washout time between samples. The kit is totally modular so that each component can be replaced individually when needed. To facilitate the installation of small ID pump tubing to either minimize or maximize the dilution factor, we supply a complete line of Contour Flared-end Tubing.

Contour™ Flared-end Tubing

- Flared at both ends
- Available in all materials and sizes
- Easy to minimize sample dilution when using internal standard



The Contour line of flared-end tubing is available in standard PVC, Solva, Viton, and Tygon MH materials and from 0.13mm to 3.17mm ID. It makes it easy to minimize sample dilution when adding internal standard without worrying about the difficulty of installing small ID tubing.

Notes

Pump tubing for all applications

- PVC – for most routine applications using dilute acid solutions
- Solva – for hydrocarbons and petroleum products (eg. gasoline, kerosene)
- Viton – for concentrated acids and corrosive solvents
- Tygon MH – for organic solvents such as MIBK

If you are not sure what the best tubing is for a particular application, our technical support staff can provide a recommendation.

Optimizing Tubing ID's

- Typical sample tube ID: 0.76 or 0.89mm ID
- Typical IS tube ID: 0.19 to 0.38mm ID
- Volume varies as $(\text{Radius})^2$
- Thermo: 0.89 and 0.38mm ID (20% dilution)
- PE: 0.76 and 0.25mm ID (10% dilution)
- Minimum dilution: 0.89 and 0.13mm ID

  * Dilution of 2%

Some common examples of the setup for adding internal standard are listed here. These have all been selected to maintain proper pump speed and total liquid delivery to the nebulizer.

Notes

Trident Dilution Calculator www.geicp.com

Trident Dilution Factor Calculator

Do you need to know how much your sample and internal standard are diluted?
Simply select your peristaltic pump tubing and our Dilution Factor Calculator will show you.

Sample pump tubing: black/black, 0.76mm ID

Internal standard pump tubing: orange/red, 0.19mm ID

Sample is diluted by **5.9%**
ie Final conc. of sample is **0.941** times initial concentration

Internal standard is diluted by **94.1%**
ie Final conc. of internal standard is **0.059** times initial concentration
or Internal standard is diluted by a factor of **16.9**

This calculation should be used as a guide only. Variations between pump tubes and roller pressures mean that the accuracy of the calculation cannot be guaranteed.

A Trident dilution calculator is available at our web site. Simply enter the selections for both the sample and internal standard tubing and the calculator tells you the dilution effect on both the sample and internal standard in terms of % and dilution factor.

Notes

Pump Speed and Sample Uptake Calculator

- Choose the right pump tubing to give you the required sample uptake
- Select the pump speed to give you the required sample uptake
- Find out what the sample uptake is with the pump tubing and pump speed you are currently using

Some ICP software systems provide information on the pump speed required for a particular sample uptake but many do not. In this situation, the user often has no idea what the sample uptake is. The Calculator on our website enables the user to find out what pump speed is needed to give a specific uptake or, alternatively, what the uptake is for the pump speed being used.

Notes

Niagara CM Rapid Rinse Accessory

- Shortens sample turnaround time
- Increases sample throughput
- Reduces cost per sample
- Lengthens life of consumables (cones, torches)
- Requires serial communication
- Low cost enhanced productivity accessory
- Easily installed
- Dual rinse option
- Robust, inert sample path
- Post wash feature with the option to add a series of bubbles which improves washout

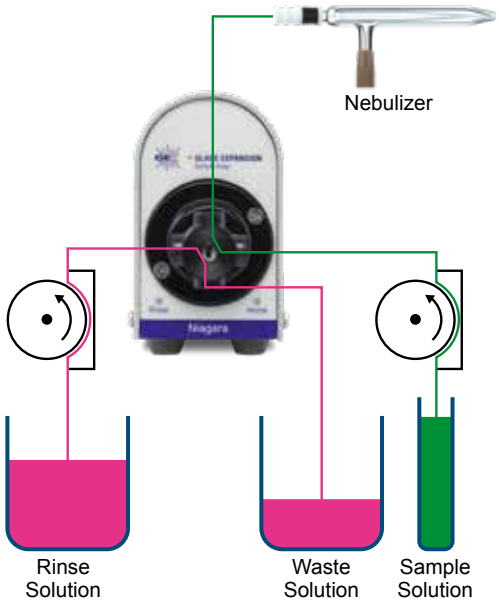
Let's now talk about some accessories that can benefit the analyst in a number of ways. First is the new redesigned Niagara CM.

The Niagara CM comes with everything you need, including cables, connections, and a software application on USB Key. It aids the analyst by speeding up the sample cycle. Also, since sample comes into contact with the sample introduction components less, consumables have a longer lifetime. It is also an excellent way to reduce carryover issues especially those from "sticky" elements.

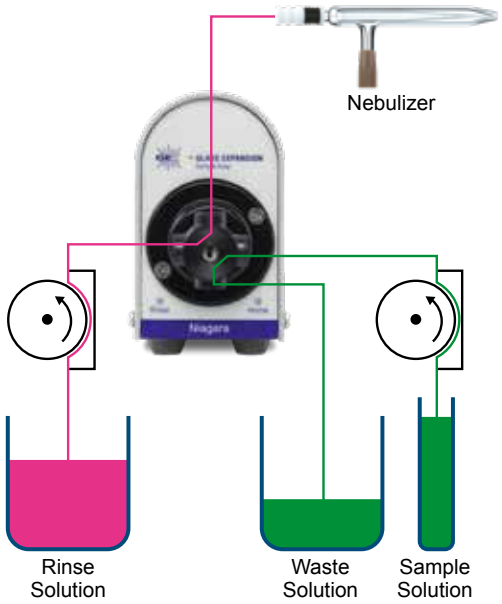
The inert 4-port valve is constructed entirely of PEEK and Teflon for maximum chemical resistance.

Flow Diagram of Niagara CM

Sample to Nebulizer, Rinse to Waste.



Rinse to Nebulizer, Sample to Waste.



The Niagara CM has two valve positions. As shown on the left, when in the sample position, sample is being directed to the nebulizer while rinse is carried to waste. As soon as the analyte measurement is complete, the valve is triggered by the autosampler command to lift the probe. At that instant, as shown on the right, the sample is diverted to waste and the nebulizer and spray chamber are rinsed.

The Control Module (CM) combines versatility with ease of installation and operation with the new NRRV2 Softwave.

Notes

Return to Contents Page

Niagara Time Saving

Method timing with and without the Niagara Rapid Rinse		
	Without Niagara	With Niagara
Total Time (sec)	200	129
Improvement	N/A	35%
Samples per hour	18	28

Method settings with and without the Niagara Rapid Rinse		
	Without Niagara	With Niagara
Autosampler Probe ID	0.5mm	0.5mm
Sample peristaltic pump tubing	Orange/Green, 0.38mm ID	Orange/Yellow, 0.51mm ID
Rinse peristaltic pump tubing	N/A	Orange/Blue, 0.25mm ID
Waste peristaltic pump tubing	White/White, 1.02mm ID	White/White, 1.02mm ID
Uptake Delay (sec)	50	23
Flush Pump Speed	45 rpm	70 rpm
Stabilization (sec)	30	15
Stabilization Pump Speed	45 rpm	20 rpm
Analysis Pump Speed	45 rpm	20 rpm
Read (sec)	90	90
Rinse (sec)	30	1

Carryover Comparison

Washout Experiments after analyzing 1000 ppm Tl				
Sample ID	Standard setup 30 sec Rinse	Standard setup 1 sec Rinse	Niagara 10 sec Rinse	Niagara with Bubbles 1 sec Rinse
Blank-1 (2%HNO3)	0.07 ppm Tl	0.48 ppm Tl	0.05 ppm Tl	0.04 ppm Tl
Blank-2 (2%HNO3)	0.02 ppm Tl	0.06 ppm Tl	0.01 ppm Tl	0.01 ppm Tl
Blank-3 (2%HNO3)	0.02 ppm Tl	0.04 ppm Tl	0.01 ppm Tl	0.00 ppm Tl
Sample to Sample Time	71 (sec)	41 (sec)	49 (sec)	38 (sec)

By eliminating the need for a lengthy rinse step the sample cycle can be reduced by as much as 30%, allowing the operater to run more sample per hour.

Thallium (Tl) is known to be a very “sticky” element that can result in the need for very long wash times. Thus a 1000ppm Tl solution was chosen for this test. These experiments were carried out using an Agilent MP-AES 4100. Results in the Carryover Comparison table contain values in ppm Tl for three consecutive 2% HNO3 Blank solutions that were run after a 1000ppm Tl solution. The washout experiments were run three ways; without the Niagara, with a standard Niagara setup (no bubbles), and with the Niagara utilizing the new wash command adding a series of bubbles. With the new wash command, a dual rinse can be used in addition to adding a series of air bubbles. The dual rinse option provides the ICP analyst an option to use a more aggressive solution to rinse the uptake lines, but be directed to waste and not introduced to the ICP.
With only a 10 sec rinse, the standard Niagara system achieved a better washout compared to a 30 sec rinse without the Niagara saving a considerable amount of time (31%). However, adding the bubbles and the possibility to have dual rinse stations with bubbles reduced the carryover even further, giving better than 4 orders of magnitude washout with a 46% savings in sample time compared to the standard instrument setup.

Notes

Niagara Plus CM

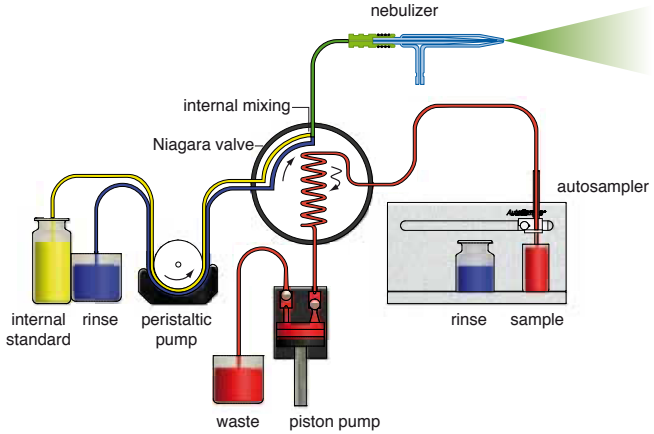
- Selectable sample loop
- Programmable speed postive displacement pump
- Purpose built 6/7-port valve
- Constant flow of solution to plasma maintains stability and reduces stabilisation times.
- Inert sample path reduces carryover - Sample does not contact any peristatic pump tubing
- New control box simplifying installation
- Compatible with a range of autosamplers

Even higher productivity can be achieved with the Niagara Plus CM. This accessory uses a completely customized inert valve which has a longer lifetime, less dead volume and is customer serviceable. Sample is loaded into a selectable volume sample loop by a fast draw positive displacement pump and injected by the peristaltic pump on the ICP. Internal standard is accommodated by the valve as well.

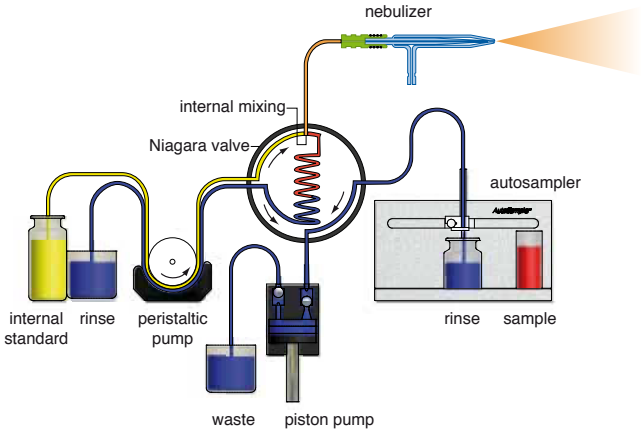
The robust, long-life, positive displacement pump is inert and tolerant to organic solvents and samples containing high TDS unlike vacuum pumps. The programmable speed positive displacement uptake pump allows for optimization of uptake speeds for different sample matrices and viscosities. The diaphragm based vacuum pumps are fixed speed regardless of sample viscosity and compromise sample throughput.

Flow diagram for Niagara Plus CM

Fill sample loop, rinse nebulizer and spray chamber.



Aspirate sample, rinse autosampler probe.



In the left graphic, the autosampler sits in the sample vial and the positive displacement pump fills the sample loop while rinse and internal standard are being delivered to the nebulizer by the ICP peristaltic pump. In the right graphic, the sample is being pushed to the nebulizer by the peristaltic pump while being mixed with the internal standard. Note that the sample never comes in contact with the peristaltic pump tubing, eliminating any concerns about contamination.

Notes

Typical Time Saving for Niagara Plus CM with ICP-OES

	Standard operation		Niagara Plus	
	Cycle time	Rinse time	Cycle time	Rinse time
Probe to sample	5	0	5	5
Uptake delay	15	0	5	5
Stabilization	10	0	10	0
Read	15	0	15	0
Probe to rinse	5	0	0	0
Rinse	30	30	0	0
TOTAL (seconds)	80	30	35	10

Thus the Niagara Plus CM saves more than 50% of the sample cycle with no sacrifice in performance.

Niagara Applications

- ICP-MS
  - * Slower methods
  - * Higher cost/sample
  - * Saves on cones, torches and other consumables
- ICP-OES
  - * Mineral labs
  - * Environmental labs
  - * Wear metal labs
  - * Saves on all consumables

Both the Niagara CM and the Niagara Plus CM bring benefits to laboratories with ICP-MS or ICP-OES instruments. For ICP-MS instruments which are sequential, sample times can be quite lengthy and the Niagara can help speed this up. Environmental and Wear metal labs using ICP-OES base their prices on the number of samples per day analyzed. So the Niagara products have a large impact on both cost and competitiveness, not to mention sample turnaround time.

Notes

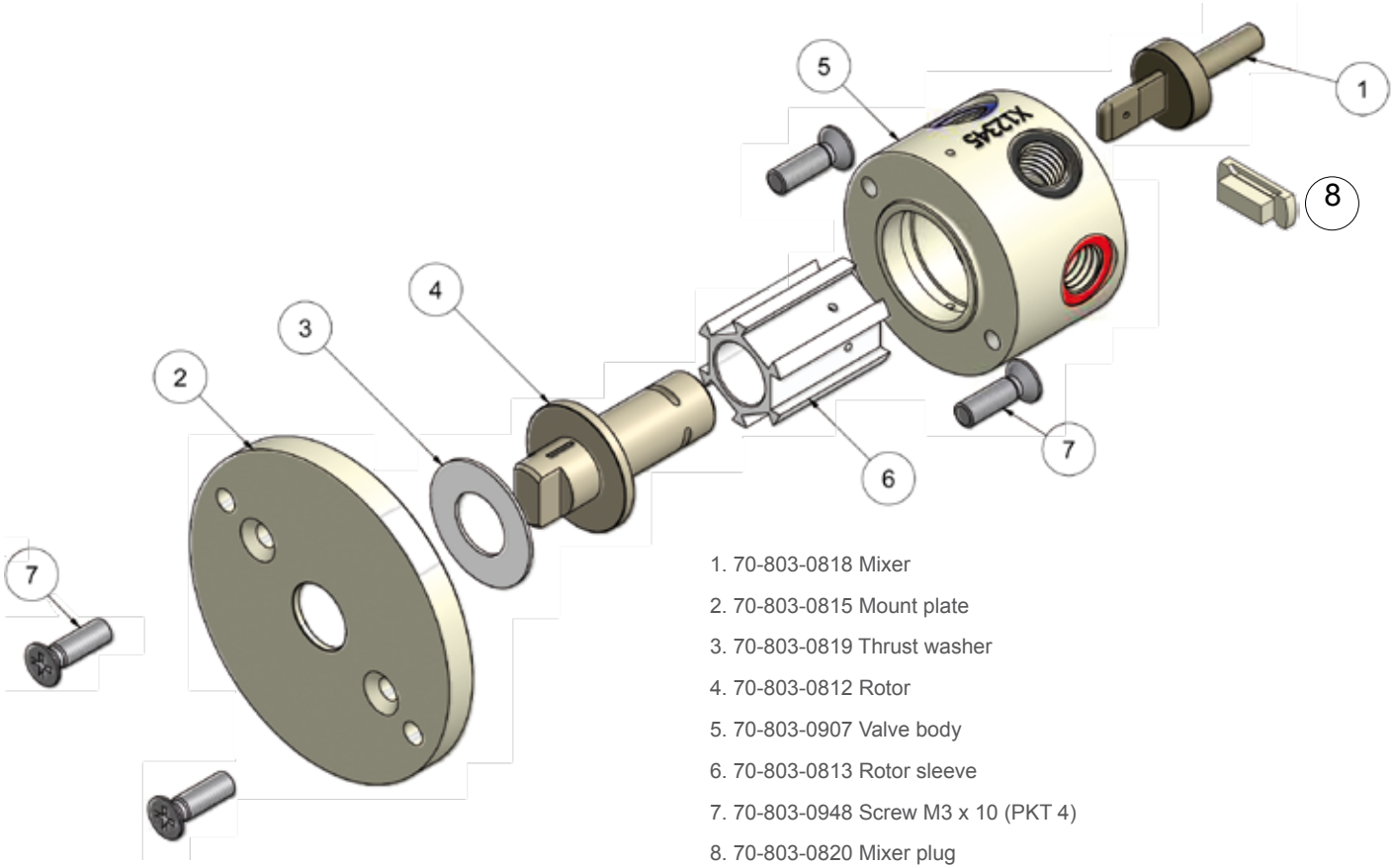
Purpose-built Niagara Plus CM 6/7-port Valve

Fastest throughput due to:

- Minimum swept volume
- Minimum distance from valve to nebulizer
- Removable T-piece for internal standard (or dilution)
- Constant path ID

Economical operation due to:

- Longer lifetime than a general-purpose valve
- Easy to configure and clean
- Can replace components rather than complete valve
- Designed specifically for ICP



1. 70-803-0818 Mixer
2. 70-803-0815 Mount plate
3. 70-803-0819 Thrust washer
4. 70-803-0812 Rotor
5. 70-803-0907 Valve body
6. 70-803-0813 Rotor sleeve
7. 70-803-0948 Screw M3 x 10 (PKT 4)
8. 70-803-0820 Mixer plug

The Niagara valve has been designed and manufactured by Glass Expansion specifically for ICP applications. The Niagara Plus CM has several competitors but all of them use commercially available general-purpose valves. These valves often suffer from a short lifetime in the demanding ICP environment. The materials used in the Niagara valve were selected for use with ICP samples. And when the Niagara valve does wear, individual components can be replaced economically. With all other valve systems the entire expensive valve must be replaced when any component wears.

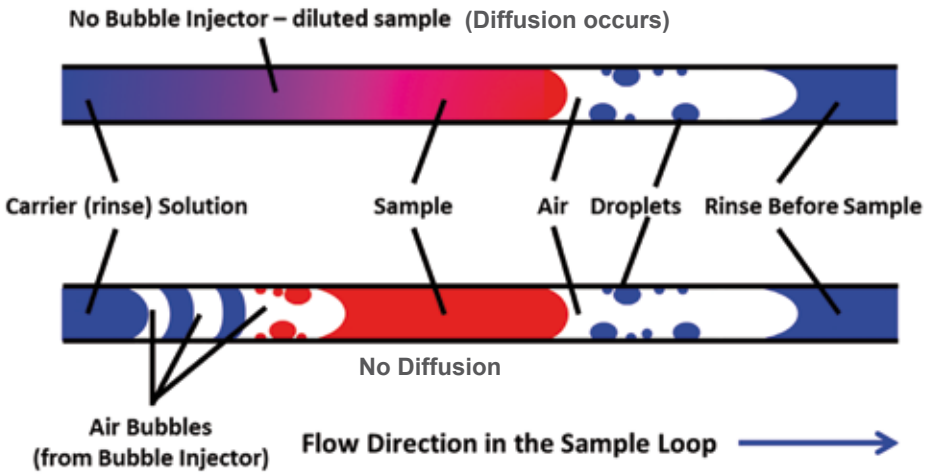
Constant internal diameter flow path guarantees a laminar flow, which prevents mixing between the sample and rinse, reducing washout time for faster analysis.

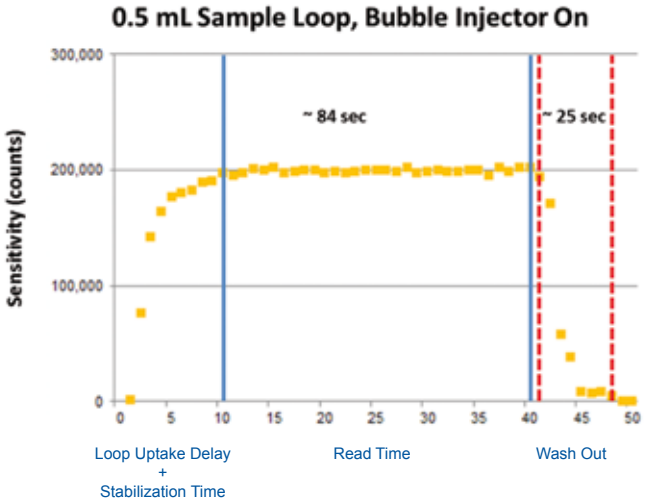
What makes the Niagara Plus CM Unique?

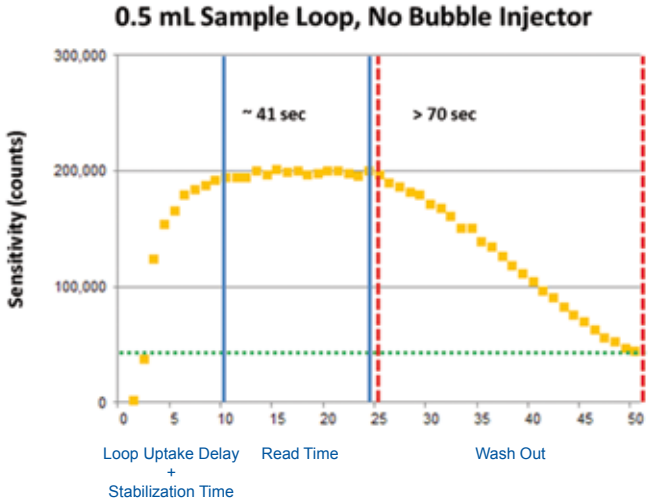
- Bubble injector:
  * Air bubbles prevent boundary diffusion allowing for a smaller volume of sample to fill the loop.
- Time In Sample (TIS) feature:
  * Programs the time the autosampler probe sits in the sample tube, conserving sample.
- Built-in internal standard tee (removable):
  * Low volume mixing tee allows the operator to tee in diluent or IS without significantly lengthening stabilization time or washout time.
- Programmable Uptake Pump:
  * The wizard calculates the optimum pump speed for the length of the uptake tubing including probe and sample loop size.
- Can be easily upgraded to the Assist.

Notes

Advantages of a Bubble Injector







Replicates (2.78 seconds per rep)

- Less sample required
- Air bubbles improve sample loop washout resulting in enhanced analytical precision and detection limit.

Notes

Niagara Plus CM with Peltier Cooled Cyclonic Spray Chamber

The Niagara Plus CM integrates with the Peltier Cooled Cyclonic Spray chamber to improve both performance and sample throughput.

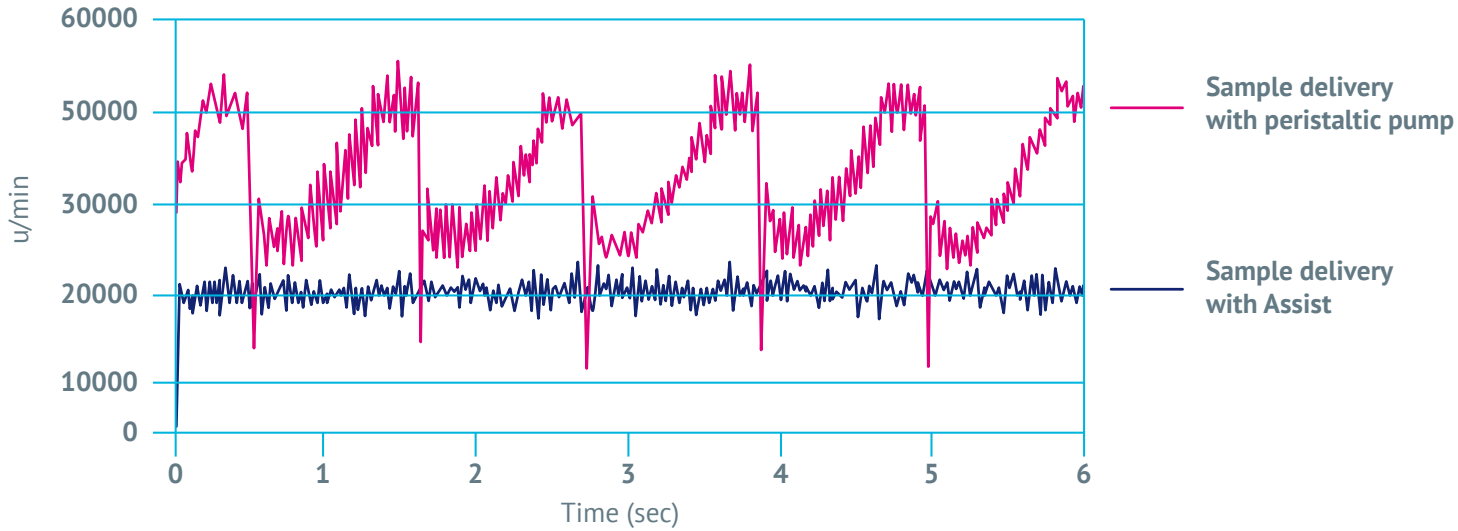
Niagara Plus CM and Peltier Cooled Cyclonic Spray chamber on Agillent 7700.

The Niagara Plus CM interfaces easily with the Peltier Cooled Cyclonic Spray Chamber. This system gives the user the performance gain of the Peltier Cooled Cyclonic Spray Chamber combined with the improved sample throughput of the Niagara Plus CM.

Notes

Assist CM

- Assists you with faster throughput
- Assists you improved accuracy
- Assists you with better precision
- Syringe drives provide accurate flow rates and ratios of sample and internal standard.
- Syringe drives eliminate the pulsations of the peristaltic pump, delivering enhanced precision and detection limits.



- Increased sample throughput, ~ 90% of sample cycle devoted to measurement.
- Reduced carry over, minimum sample volume usage.
- Syringe drives provide accurate flow rates of the Sample and Internal standard, minimize fluctuation.
- Syringe drives provide accurate ratio of Sample to Internal standard.
- Online dilution of samples at a fixed and accurate ratio.
- Dilution of up to 100 to 1 with syringe drives.

Notes

Assist Oils CM

- In-line dilution
- Stainless steel dilution probe
- Rapid syringe delivery
- Rapid rinse

- Optimizing sample intro reduces consumable cost while improving accuracy and throughput.
- Assist Oils package eliminates manual sample prep, while improving throughput and washout.
- Works with your existing autosampler
- Uptake syringe takes undiluted oil and mixes it with a solvent via the diluent syringe
- Each sample diluted at the tip of the custom designed probe and loaded onto the sample loop.
- Sample syringe precisely pushes the diluted oil sample out of the loop to the nebulizer

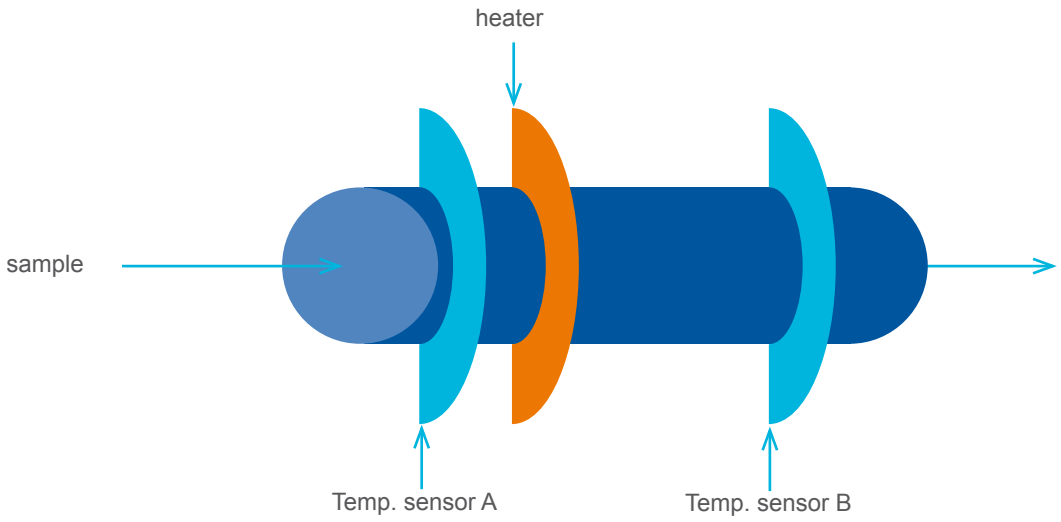
Notes

TruFlo Sample Uptake Monitor

- Worn pump tubing?
- Worn pump rollers?
- Improperly adjusted pump tension?
- Clogged nebulizer?
- Kinked sample capillary?

Our new TruFlo sample uptake monitor addresses an issue that has been ignored until now. The sample uptake rate is a critical parameter, one that affects both the magnitude and precision of the analytical signal. The TruFlo allows you to monitor this parameter in real time, enabling you to diagnose problems like the ones shown here before the validity of your results is jeopardized.

How it works Thermal Flow Measurement



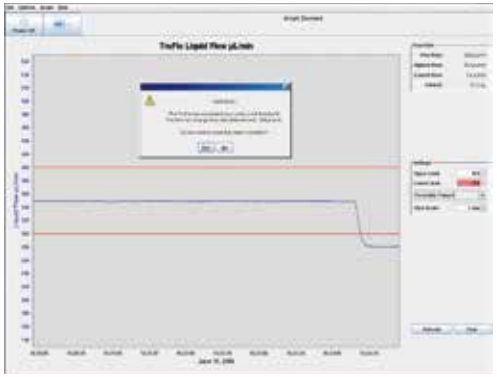
Flow Rate is related to (TempA – TempB)

It uses thermoelectric sensing to measure liquid flow. A few calories of heat are added upstream and the temperature change between two sensors is measured. The temperature change is related to liquid flow rate.

Notes

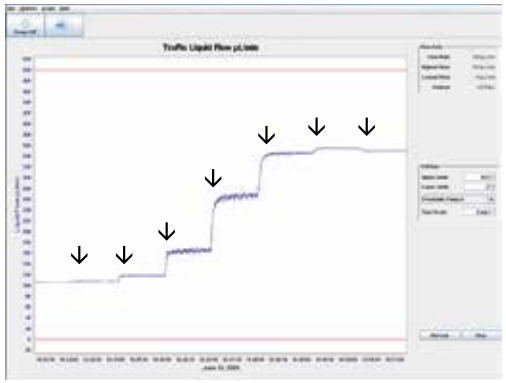
Features of TruFlo

- Adjustable damping
- Settable alarm limits
- Digital display
- Recordable graph
- Range: 0 to 4mL/min
- HF resistant models available
- Can be calibrated for non-aqueous solutions

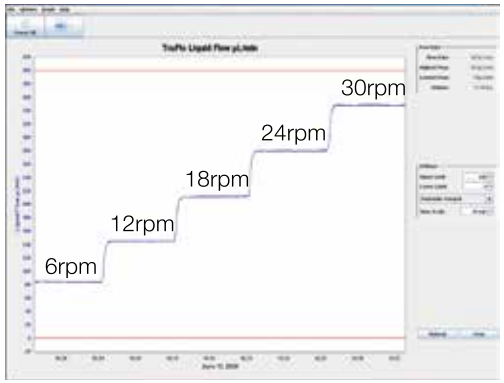


The graph shown here demonstrates the application of alarm limits. Once the flow rate falls outside the preset acceptable range, an audible and visible alarm occurs alerting the operator to a problem immediately.

Graphic Benefits



Adjusting pump tension



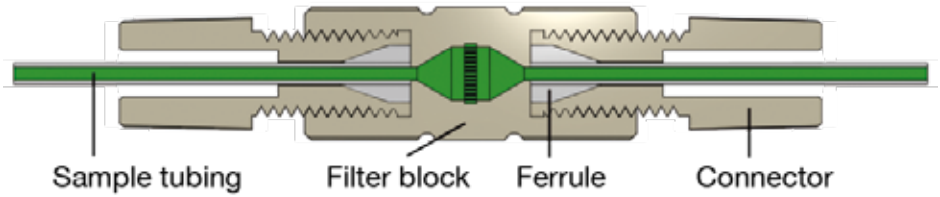
Uptake rate vs. pump speed

The graphic display facilitates tasks which are otherwise difficult. The graph on the left shows the effect of tightening the tension on the pump tubing half a turn at a time. Too little tension results in erratic flow and hence erratic results where too much tension unnecessarily wears the tubing and decreases tubing life. With the graphic display, the analyst is always certain that just the right pressure is applied.

The graph on the right shows the effect of increasing pump speed on flow rate. There is no need to calculate flow rate based on arcane formulas of tubing volume and pump speed or to use a graduated cylinder and a stop watch. Just read the flow rate right off the display.

Notes

Guardian In-Line Particle Filter



- Reduces the chance of a blocked nebulizer
- Protects high throughput valves from damage from particulate matter.
- Enhances the day-to-day reproducibility of your results
- Purpose-built clog-resistant design
- Incorporates a 120 micron filter
- Available in 1/16 inch (1.6mm) and 1.3mm OD sample tubing
- Filter and Housing Material: HF Resistant PEEK
- Particle build-up is easily removed by back-flushing and ultrasonic cleaning

If there are particulates in your samples, there is a risk that they may get trapped in the fine channels of your sample line or within the nebulizer. The Gaurdian In-Line Particle Filter provides a simple and effective way to eliminate this risk. This particle filter is easily inserted in the sample tubing between the autosampler probe and the nebulizer. It increases the life span of high throughput valves and reduces their maintenance required.

Back-flushing

Can be conveniently done using an adaptor connected to the Eluo Nebulizer Cleaning Tool.

Close plunger →

To flush Inline Particle Filter →

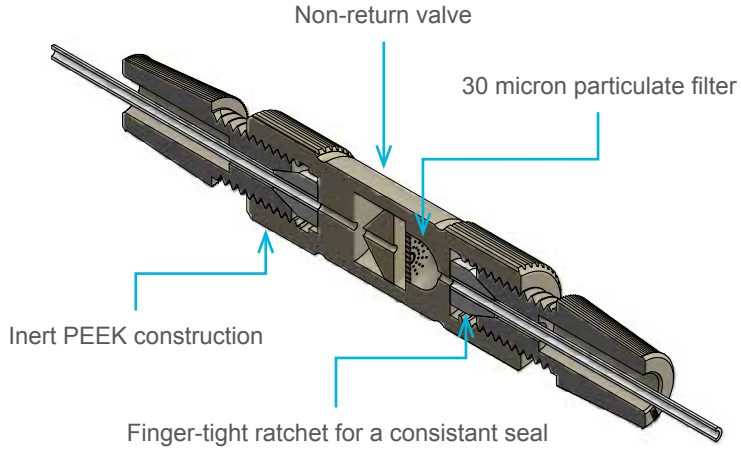
Do you want to be alerted when the filter needs to be back-flushed? The answer to this is quite simple, add our TruFlo Sample Monitor. With the digital display of the TruFlo Sample Monitor, you always know the actual rate of sample uptake (through the filter) to your nebulizer. You can set the upper and lower limits of your acceptable sample flow range and receive a warning on the screen and an audible alarm if the sample flow moves outside the acceptable range.
Then you know it is time to back-flush the inline particle filter.

Notes

Guardian In-Line Non-Return Gas Filter

The new Guardian In-line Non-Return Gas Filter provides protection for your ICP system in two ways:

1. A non-return valve prevents acidified sample or rinse solution syphoning into the instrument gas box.
2. A unique 30-micron PolyComb filter protects the nebulizer from particulates in the instrument gas supply.



The Guardian In-line Non-Return Gas Filter is positioned between the Ar inlet on the Direct Connection nebulizer and the gas supply fitting on the instrument. The In-line Non-Return Gas Filter has a one-way valve that allows argon to flow from the instrument into the nebulizer, but prevents liquid syphoning into the instrument. A unique PolyComb 30-micron filter design protects the nebulizer from particulates from the gas supply or from worn or damaged fittings in the gas lines. Unlike Sintered or Frit style filters, the linear honeycomb structure makes PolyComb most resistant to particulate and dissolved solid clogging.

Syphoning of the sample or rinse solution into the nebulizer argon control module on your ICP can occur at the end of an analytical run when the nebulizer gas pressure is turned off and there is liquid in the sample flow path. It is made worse if the autosampler probe stays in the rinse position at the end of a run.

A real problem using an autosampler for unattended overnight runs, it is a silent, invisible killer of your ICP. Acidified solution in the instrument Ar control module can cause corrosion to electronic sensors in mass flow controllers and damage regulators that can result in expensive repairs to your ICP and un-planned down time.

Notes

QA Kit

- Enhances day-to-day reproducibility
- Greatly reduces the chance of a blocked nebulizer

The QA Kit is a convenient package combining the TruFlo Sample Monitor, Guardian In-Line Particle Filter, Eluo Nebulizer Cleaning Tool and Eluo Adaptor for Inline Filter

Notes

Sample introduction kits for specific applications

- Standard
- Organics
- Volatile organics
- High solids
- HF resistant

HF Resistant Kit for PerkinElmer AVIO

Standard Kit for PerkinElmer NexION

High Solids Kit for Thermo Fisher iCAP 7000 Duo

The components of each applications kit have been specially selected to provide optimum performance for the specified application. Even if the complete kit is not needed, the customer can easily identify the best nebulizer, spray chamber and torch for the required application. If we do not already have a kit for the customer's application, the Glass Expansion customer support team can recommend the most appropriate system.

Notes

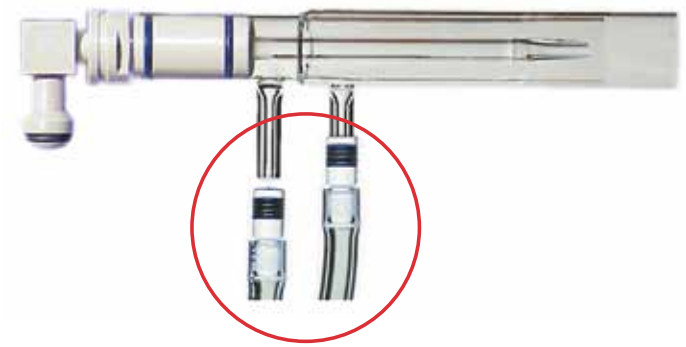
Making Analysis Easy – Spray Chambers

- UniFit drain connector
  - * Quick-connect
  - * Integrated capillary
  - * 1.3mm, 1.6mm and 2.0mm OD sizes

For spray chambers, we provide a UniFit connector for the drain line as part of every spray chamber kit which has a pumped drain. No need for an improvised connection that may be prone to leak.

Making Analysis Easy – Torches

- GazFit connectors
  - * High-purity Teflon
  - * Simple press-fit
  - * Gas-tight
  - * No bonding



GazFit connectors are available in a variety of sizes, (4, 5, 6, and 8mm) to connect to the coolant and auxiliary gas lines on torches. This prevents the Tygon tubing from being “welded” to the quartz arms.

Fluka RBS-25 Cleaning Solution

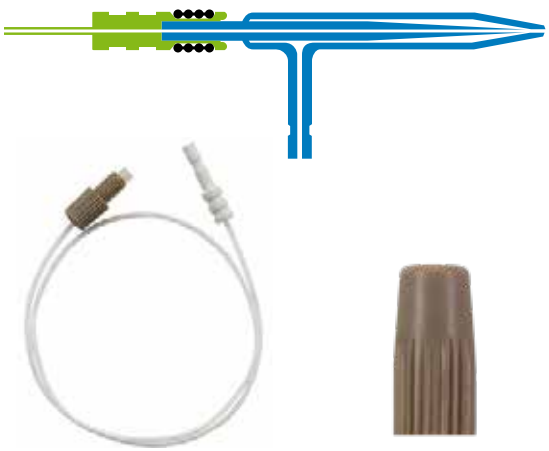
- Most effective cleaning solution for nebulizers, spray chambers and torches.
- Better than other detergents or acids

Many years of experience have shown us that Fluka RBS-25 is the most effective cleaning solution. Some customers have reported difficulty in obtaining it so we are now supplying it.

Notes

Making Analysis Easy – Direct Connection (DC) Nebulizers

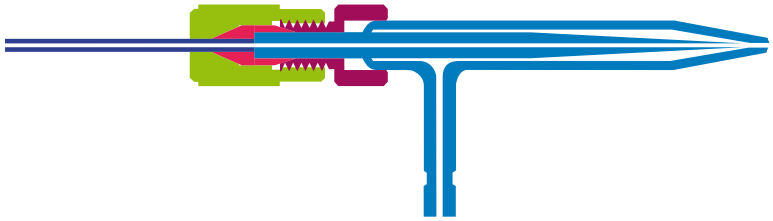
- U-Series connector
  - * Eliminates dead volume
  - * Available with different size capillaries
- Nebulizer gas connector
  - * Inert metal free
  - * Facilitates removal and installation of nebulizer
  - * Reliable PEEK ratchet fitting ensures leak free gas connection
  - * Instrument specific Direct Connect flexible argon line



Sometimes it is the little things that make a big difference as in the case of easy to use and leak-proof connectors. The graphic shows our U-Series nebulizer sample connection. The Teflon connector fits the outside of the sample inlet port on the nebulizer making an easy installation with zero dead volume. For the nebulizer gas connection, we recommend an argon connector configured to connect directly to the ICP

HPLC Interface Kit

- Resists blockage
- Fast washout
- Minimal dead volume
- Minimizes peak broadening
- Simple to use



All U-Series nebulizers are compatible with our HPLC interface kit. This easy to install kit provides a quick high integrity connection to the output capillary of an HPLC. When used with either an ICP-OES or ICP-MS, the HPLC interface facilitates speciation of elemental compounds so that more information about the sample can be garnered.

Notes

Laser Ablation Adaptors

Various adaptor sizes to match each ICP-MS torch

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Notes

Reagent Tube with PTFE Sinker

- Keeps the tube in your solution

Another product to make life easier for the analyst is the reagent tube with PTFE sinker. This prevents the end of the sample tube from curling up inside the reagent vessel so that solution is no longer delivered.

Tubing Connector

- Connects 1.3mm or 1.6mm to 1/16 inch tubing

For 1.3mm tubing order p/N: FT-16-1.3 and for 1.6mm tubing order P/N: FT-16-1.6

Carbon Fibre Autosampler probes

- Encapsulated carbon fibre tube
- Continuous PFA tubing
- Available for most common Autosampler models

Notes

Customer comments

(In reference to the Elegra) Talking with my operators that are here today neither of them has changed a nebulizer since we put it on.....We had been replacing nebulizers after about a week and half.....I will be ordering 2 more.
Contract laboratory - USA

For our particular application this PCC kit was a great improvement. On specific cases that required four (or more) blank runs to bring the boron level to baseline now we can do it two or one blank run. This allowed us to increase sample throughput by about 50%.
Specialty Chemicals Manufacturer - USA

We like the TruFlo monitor. It has helped us on a number of occasions to track down some minor issues and we use it constantly while running our ICP.
Oil company – USA

With Niagara Plus we have found a marked improvement in carry over, productivity, gas and internal standard usage without the loss of sensitivity ... Argon saving would be around 40-50% as sample time has been halved.
University environmental laboratory – Australia

The D-Torch is performing very well. The ceramic outer has been in almost constant service 22 hours a day, 6 days a week since we purchased it and we have had no issues ... We are due to purchase a replacement ICP and will certainly be purchasing another D-Torch to go along with it.
Lubricating oils laboratory – Australia

The equipment works extraordinarily well. Keeping temperature at 5degC the noise drops to half as much as without the IsoMist. There is no problem at all with temperature stability and the signal is twice as much as the one obtained without the IsoMist.
University laboratory – Spain

I would like to thank you for an excellent service! The goods were delivered in three(!) working days from the other side of the world. I'm still in a state of disbelief.
Environmental laboratory – Finland

The Ceramic torch is quite excellent, mostly from a maintenance standpoint, it forms much less deposits on it and that which forms is usually very easy to clean ... I do think we'll continue buying ceramic torches mostly because they last much longer and are so much easier to keep clean.
Environmental laboratory – Sweden

We were very pleased with the Eluo – great idea and a lot easier than how we used to clean the nebulisers. Keep up with the great ideas.
Contract laboratory – New Zealand

We welcome feedback from our customers and we are happy to publish comments in the Customer Comments section of our website. A few examples are shown here

Glass Expansion Products Always the Highest Value

- Tightest tolerances
- Most innovative designs
- Most reproducible
- Guaranteed superior performance
- Backed up with technical support
- Designed to facilitate lab work

To summarize, Glass Expansion has gone to great lengths to consider all aspects of the ICP spectrometer laboratory and to offer the quality products and support that help you to achieve high quality analytical results.

Notes

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