GLASS EXPANSION
Quality By Design

Tips and Tricks to Improve Signal Stability in ICP-OES and ICP-MS

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ICP ALLEY

Introduction: About Glass Expansion

Glass Expansion has been designing and manufacturing ICP sample introduction components **for over 40 years.** We are globally recognized for its **quality** and **reliability.**

- Autosampler Probes
- Pump Tubing
- Nebulizers
- Cyclonic Spray Chambers
- Torches & Injectors
- RF Coils
- Cones
- Tools & Accessories

Introduction: About Glass Expansion

- Fully equipped R&D laboratory
- Expert technical staff
- Application notes
- Newsletters
- Catalogs
- Product flyers
- Product care guides
- Operating instructions
- Videos
- Webinars & installation guides

Flyers

Newsletters

Instructions

Application Notes

Catalogs

Signal drift in ICP-OES and ICP-MS is detrimental to every laboratory

It can be the result of several different factors, such as:

- Insufficient maintenance procedures
- Improper selection of sample introduction system components
- Inadequate matrix matching
- Incorrect method operating parameters

General Tips

Optimization Before Each Analysis

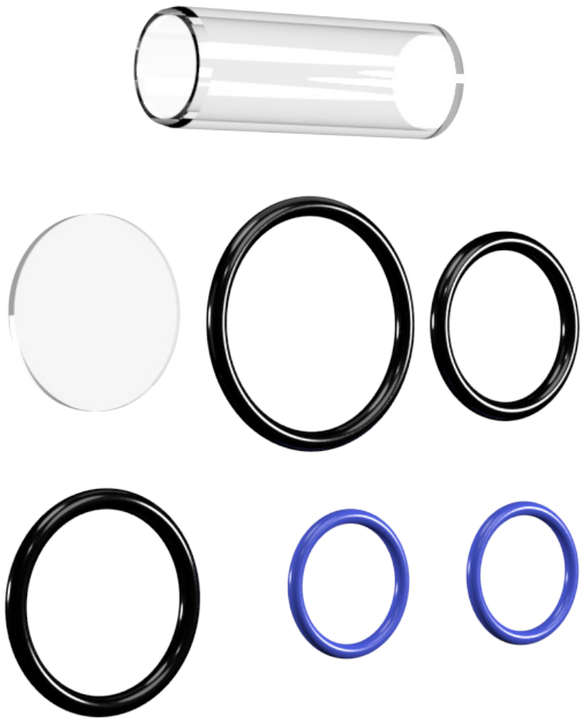
- Inspect peristaltic pump tubing; replace if worn
- Verify blank readings

Rinse Protocols

- Rinse between samples and at the end of each run
- Ensure the rinse solution matches your sample matrix
- Start and end analysis by nebulizing mildly acidic blank followed by UPW

Regular Maintenance

- Clean nebulizer, spray chamber, and torch regularly
- Clean cones as necessary, monitor counts and oxide ratios
- Check the condition of windows and seals, and replace as needed
- Follow manufacturer cleaning and replacement intervals



General Tips: Nebulizer

Verify the nebulizer back-pressure after instrument warm-up:

1. **Low nebulizer back-pressure** and a loss in sensitivity can indicate a leak on the supply line:
   - Check Ar nebulizer gas connection at the instrument and at the nebulizer gas arm.
   - Inspect for any visible cracks.

2. **High nebulizer back-pressure** can indicate a partially blocked or clogged nebulizer:
   - Clean nebulizer or replace if necessary.

3. **Record your normal sample uptake rate**
   - A change in uptake rate can indicate a blockage, worn pump tubing or incorrect tension on the pump.

Magnifier Inspection Tool
P/N 70-803-1923

Conikal™
SeaSpray™
MicroMist™
Slurry™

P/N 70-ELUO

DuraMist™

OpalMist™

P/N 70-ELUO-OPD

TruFlo Sample Monitor

General Tips: Spray Chamber

Suggestions:

- **Do not:** use HF, sonicate, nor use metal or ceramic brushes.
- **Daily cleaning:** Start and end analysis by nebulizing mildly acidic blank followed by DI water.
- **Initial cleaning:** Nebulize 2.5% Fluka RBS-25 for 15 mins followed by DI water.
- **Thorough cleaning:** Overnight soak in 25% Fluka followed by DI water rinse.
- Check Helix CT seal and UniFit drain line, replace as needed.

Important note: Our glassware nebulizers, spray chambers, and torches are supplied clean and ready to use.

Soak in 25% Fluka RBS-25

Replace Helix CT seal,
e.g. **P/N** 70-803-1456

Replace UniFit drain line,
e.g. **P/N** UFT-16-75

General Tips: Torch

Organics: Carbon deposits from organic samples can be burnt off the outer tube using a portable hand-held propane torch or baked off in a furnace.

Salts: Salt deposits are best removed by soaking the torch in a 25% solution (4x dilution) of Fluka RBS-25 or in dilute acid.

Metals: Metallic films are best removed by soaking the tube in acid. The best acid to use is usually the one that was used to prepare the samples.

- Wear safety gloves at all times when cleaning torches and be careful to avoid touching hot surfaces.
- For the D-Torch, to minimize damage to any polymer torch components, we recommend soaking the outer tube only to the level of the deposit. This is done by standing the tube upright in a controlled level of the solution.
- The D-Torch components also cannot be placed in a furnace.

General Tips: ICP-MS Cones

Suggestions:

- Always check gaskets or O-rings before installing cones

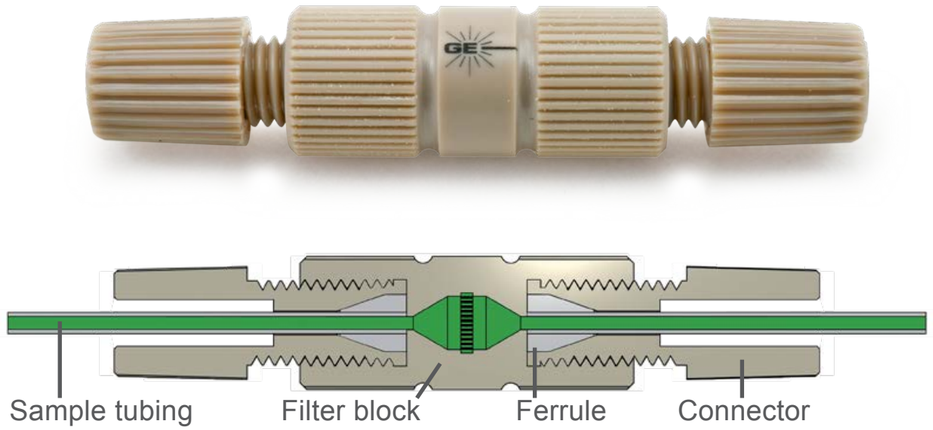
Cone Conditioning:

- To ensure the lowest background levels of Cu and Ni, conditioning before use is recommended for **uniform coating that leads to improved long-term stability.**
- To condition your cones, prepare the following conditioning solutions:
  - 1% nitric acid blank
  - 50ppm calcium in 1% nitric acid
- Install the new cones or cleaned cones into the instruments. Turn on the plasma.
  - **Aspirate the 50ppm calcium solution for 10 minutes**
  - **Change to 1% Nitric acid blank solution and aspirate for a further 10 minutes**

Types of Blockages: Particulates & Salting

Tools to Minimize Particulate Blockages

Guardian In-Line Particle Filter P/N 70-803-1108:

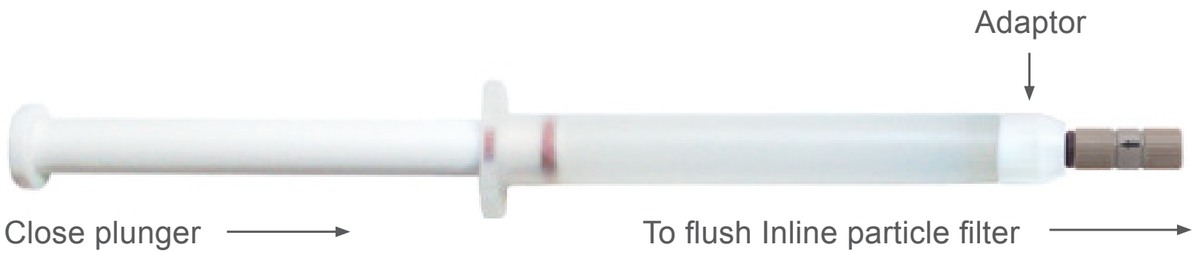


Benefits

- Prevent large particles from clogging your nebulizer
- Insert between probe and nebulizer
- Re-usable PEEK filter (120 µm)
- Easily backflush to remove build up

In-Line particle filter: *"So far it has worked great, we have noticed significantly less clogged lines."* ***Fertilizer manufacturer - USA***

Eluo Nebulizer Cleaning Tool P/N 70-ELUO:



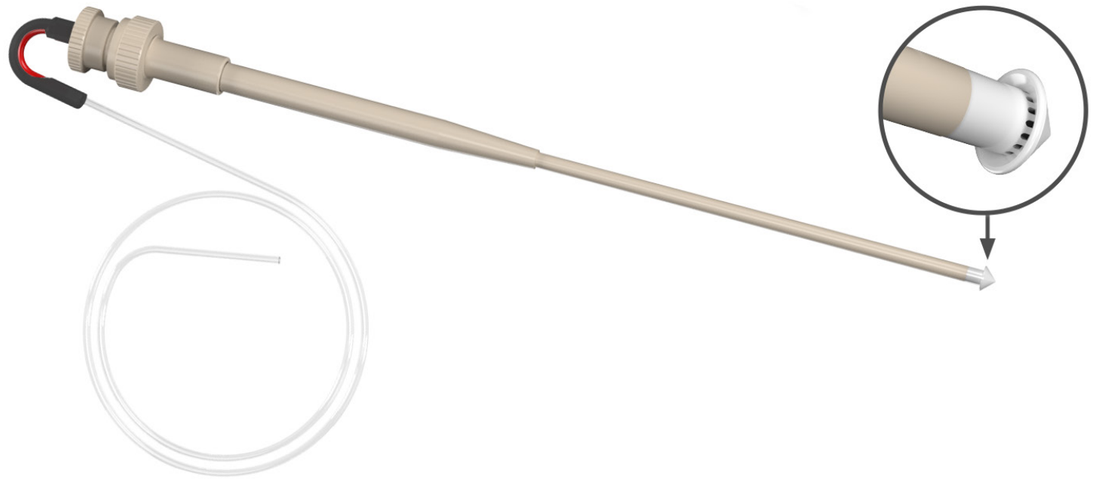
If you have the Eluo

- Add adaptor P/N 70-803-1160

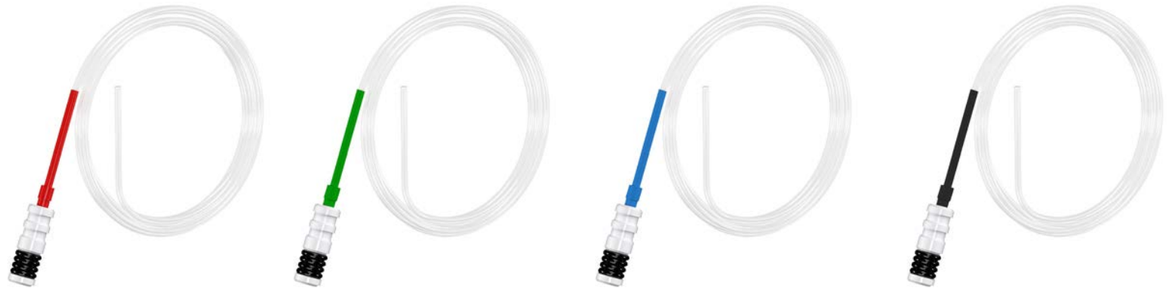
Tools to Minimize Particulate Blockages

Guardian Autosampler Probe:

- **Robust tip design** eliminates crushed and damaged tips due to misalignment
- **Drip-resistant** to minimize cross-contamination, especially with oils
- **Built-in particle filter** prevents blockages in nebulizer and tubing
- **Chemically inert construction** made from **Ceramic, PEEK, and PTFE** for strong acid/solvent resistance
- **PEEK** sheath designed to ensure precise alignment within the middle of the vial every time
- **Interchangeable UniFit™ sample lines** available in various IDs (e.g. 0.3, 0.50, 0.75 & 1.0mm)
- Available for Cetac, Agilent, PerkinElmer, Shimadzu, Aim Lab, and Thermo Scientific™ Autosamplers



Guardian™ Autosampler Probe
Suited for Aim Lab and Agilent SPS4 Series Autosamplers



Tools to Minimize Salting

Elegra Argon Humidifier:

Features:

- No heating or electric power required
- Membrane humidification technology
- Improved signal stability for samples with high TDS
- Inert metal free construction
- Dual-Channel version (ICP-MS)

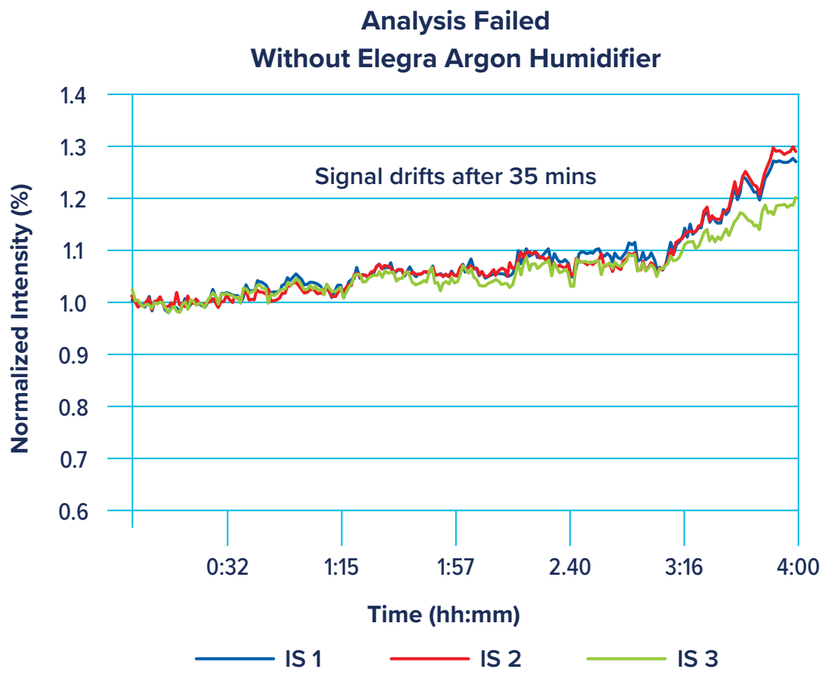
Other tips for high TDS:

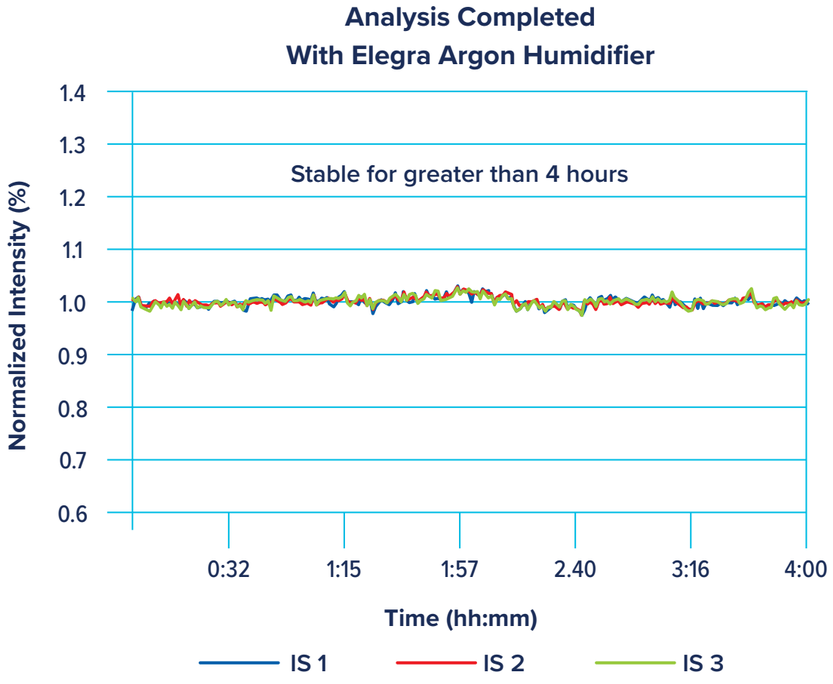
- Increasing the auxiliary argon flow will lift the plasma higher off the injector, slowing salt buildup at the injector tip.
- Extended rinses in between each sample.

Elegra Dual Humidifier

Tools to Minimize Salting

Internal Standard for Three Lines - Stability in 0.5% Lithium Metaborate:





Without Elegra:

With Elegra:

Tools for Internal Standard Addition

Internal standardization (IS) is commonly used in ICP spectrometry to compensate for:

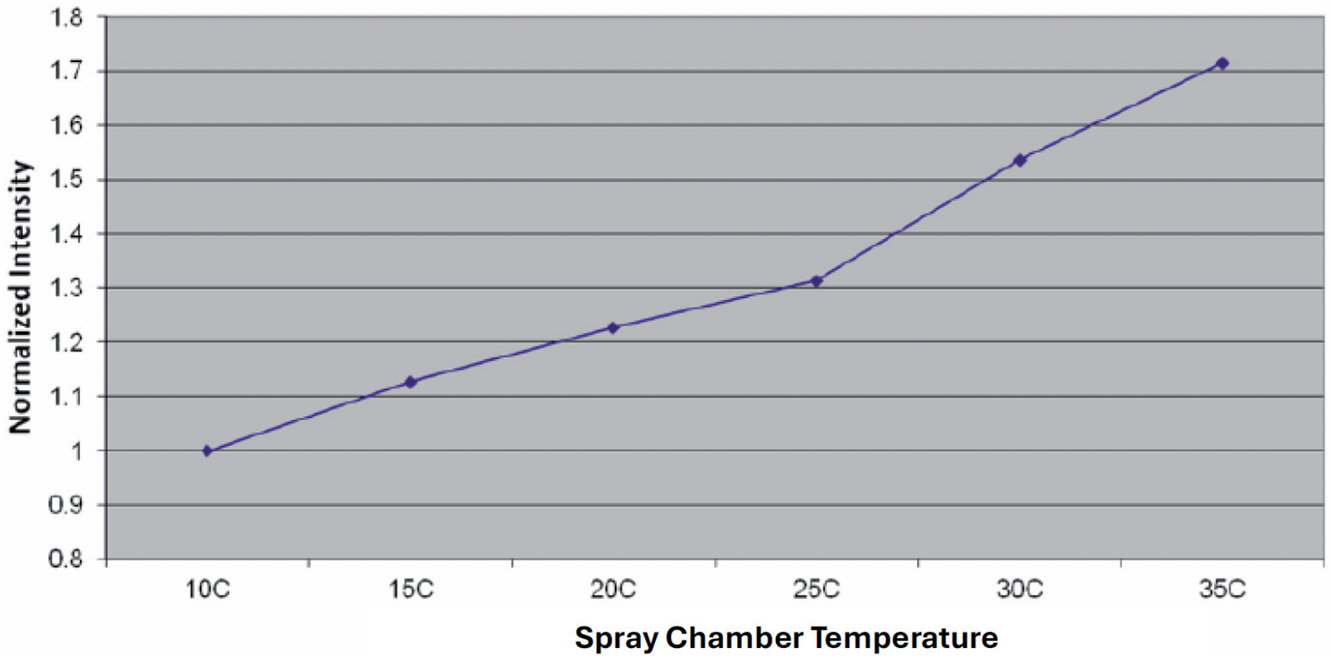
- Variations in sample uptake rates from differences in viscosity or total dissolved solids of your samples.
- Mass-space charge interferences in ICP-MS.
- Internal standardization enhances long-term stability and can improve analytical accuracy.

Trident CT™ Internal Standard Addition Kit

- Compact, efficient mixing chamber ensures complete mixing of the sample and reagent.
- **ConstantTorque™ (CT) ratchet fittings** for a durable, leak-free seal in all connections.
- Consistency in torque application helps maintain the reliability and performance of the mixing chamber.

Durable, Repeatable, Leak-free ConstantTorque™ Connections

Drift due to Laboratory Temperature



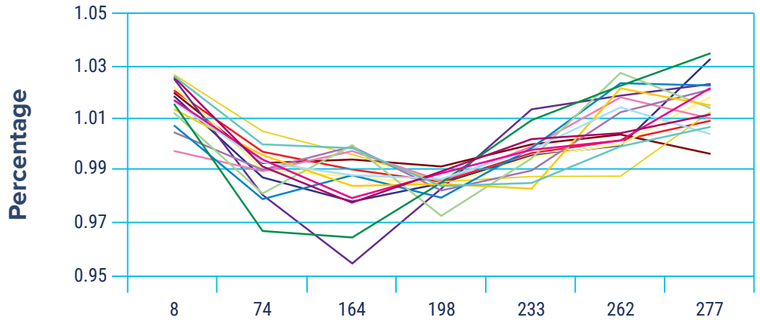
- 31% increase from 25 to 35 °C or 3% per °C
- When temperature change is severe, the result is out-of-spec control samples, necessitating re-running standards and samples.

IsoMist XR Programmable Temperature Spray Chamber

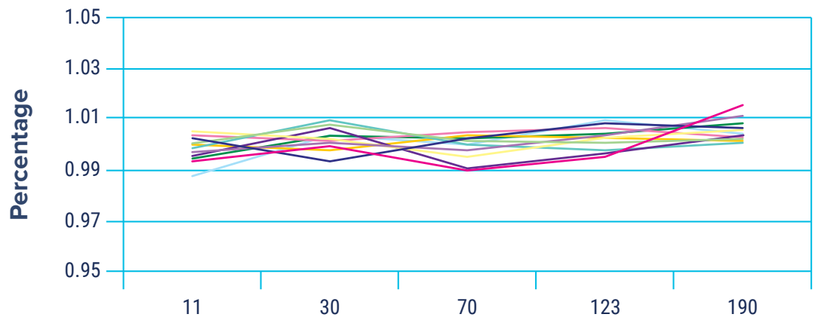
Features

- 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

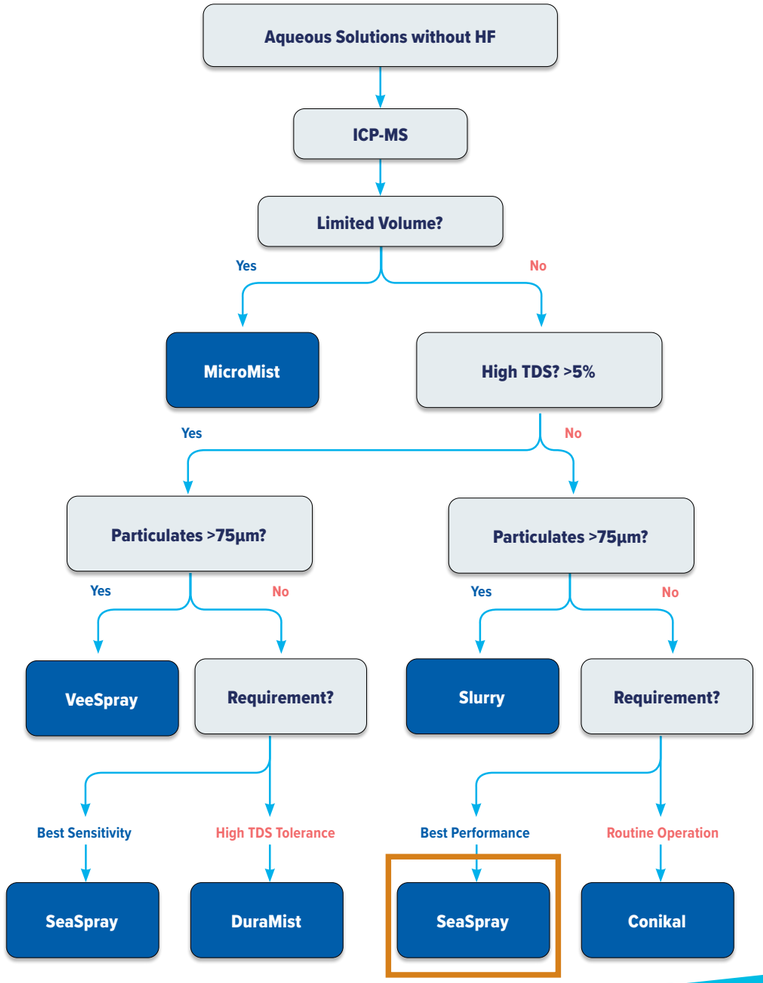
Without IsoMist XR



With IsoMist XR



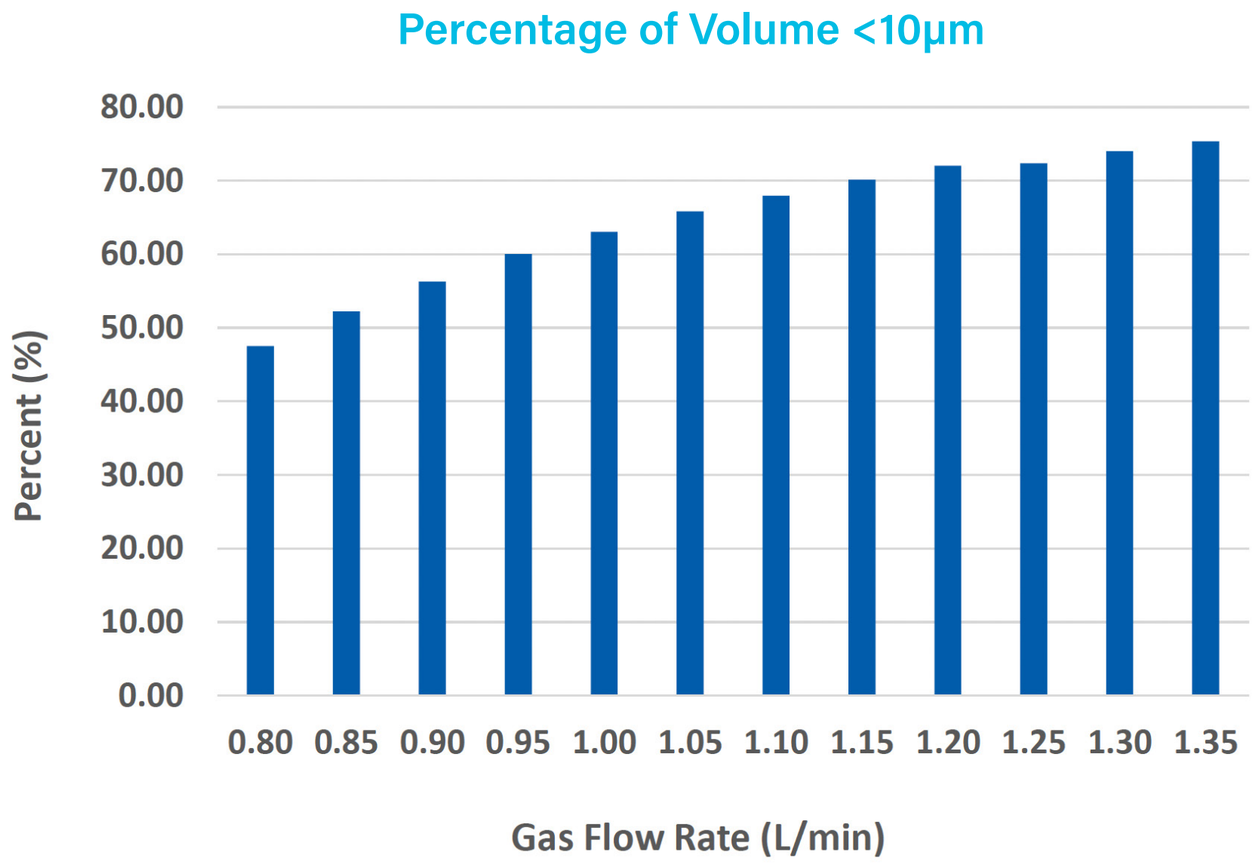
Nebulizer Selection



Nebulizer		TDS (%)	Particulates (µm)	HF	Precision	Purity	Material
SeaSpray™		20	75	No	High	Good	Glass
MicroMist™		15	40*	No	High	Good	Glass
Conikal™		5	75	No	High	Good	Glass
Slurry™		1	150	No	High	Good	Glass
OpalMist™		15	75*	Yes	High	Excellent	PFA
DuraMist™		30	75*	Yes	High	Good	PEEK
VeeSpray™		30	300	Yes	Moderate	Good	Ceramic

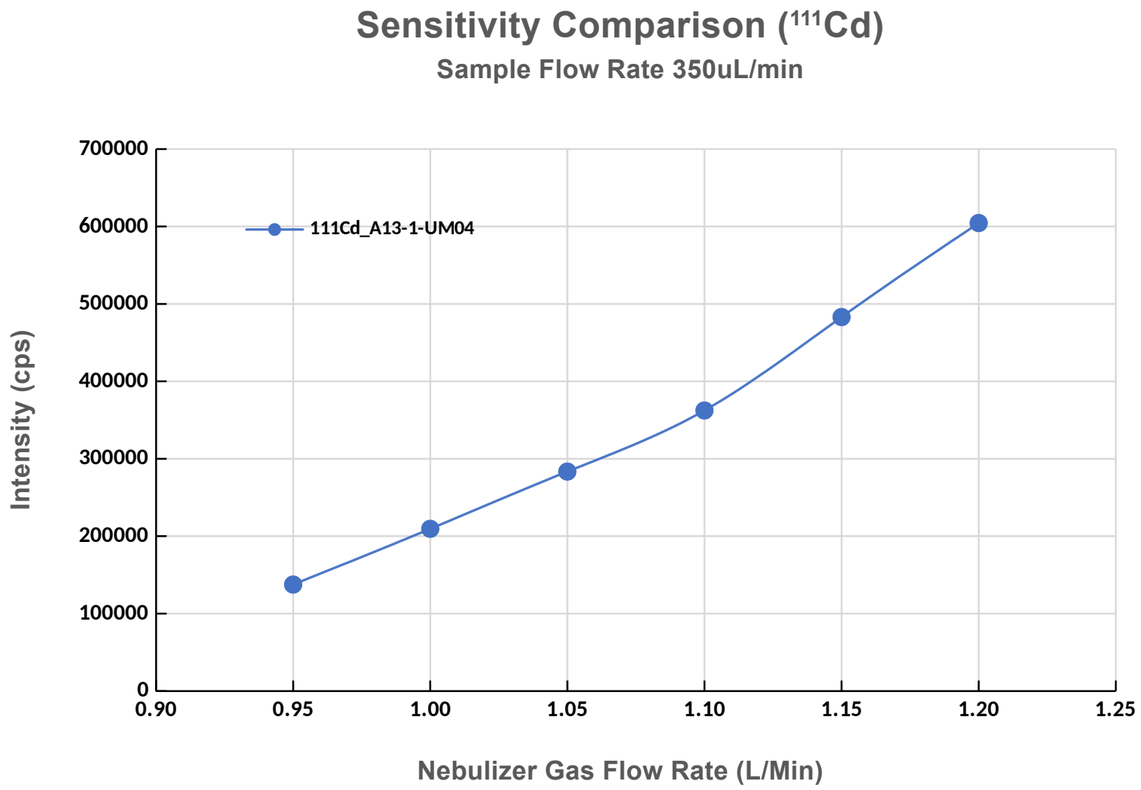
* Varies with nebulizer uptake

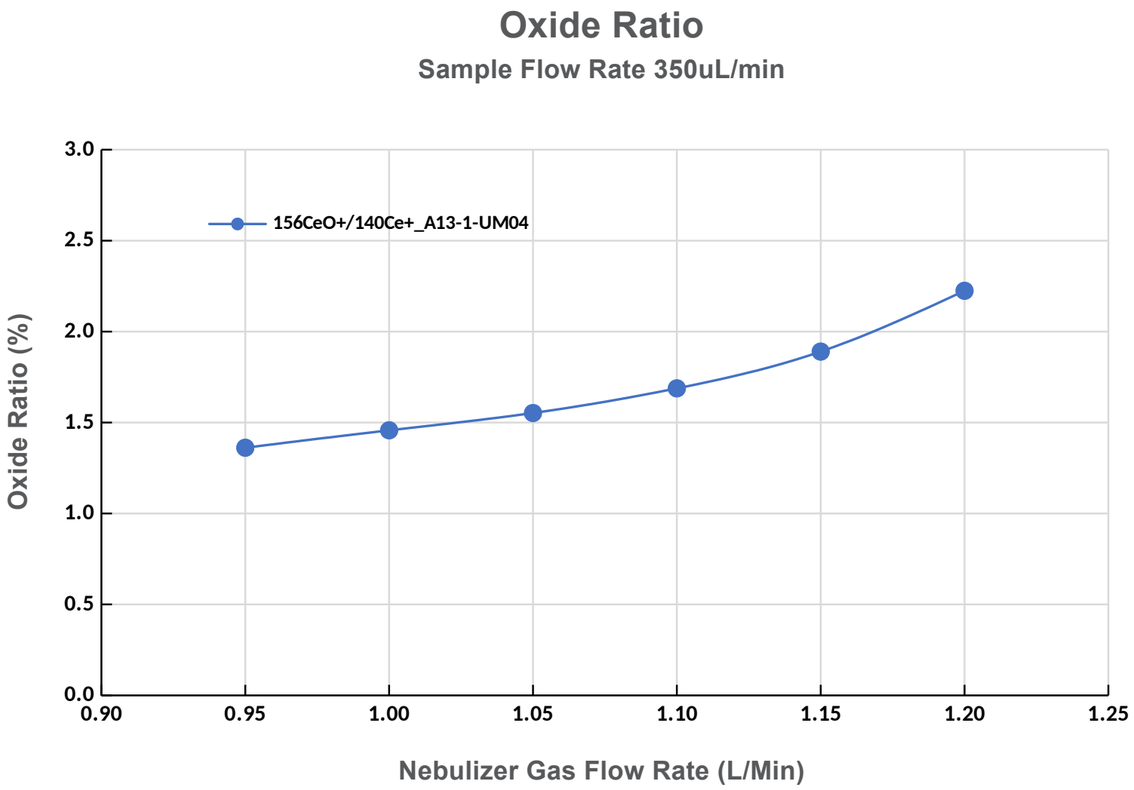
Nebulizer Operating Conditions



- Effect of nebulizer gas flow rate –high efficiency concentric (ICP-MS)
- A13-04-USS04
- Nebulizer sample flow constant at 0.4 mL/min
- The percent of droplet sizes less than 10µm increases as the nebulizer gas flow rate is increased.

Nebulizer Operating Conditions

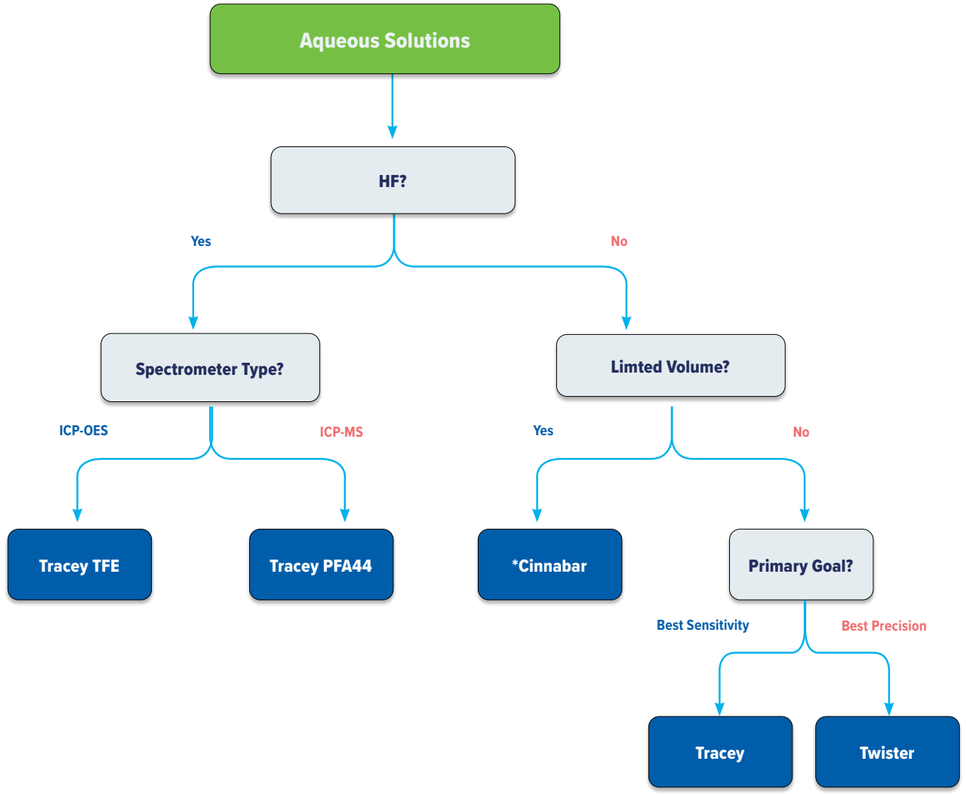




Spray Chamber Selection

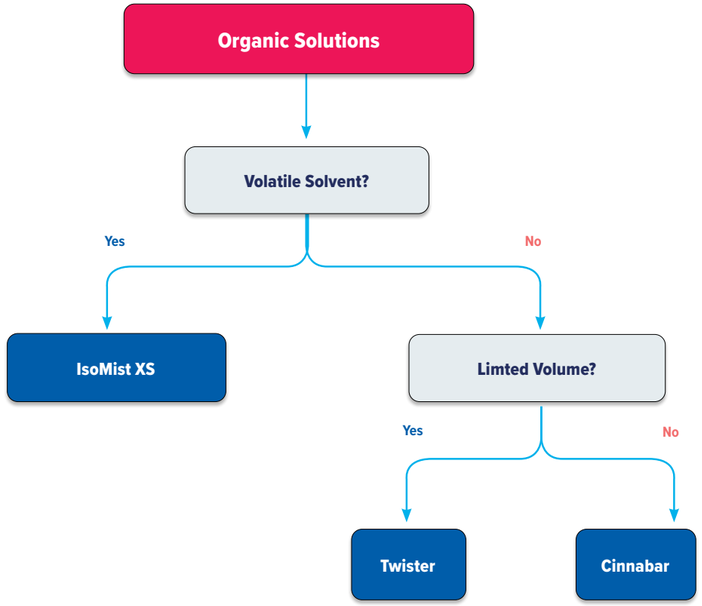
Aqueous

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.



Organics

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



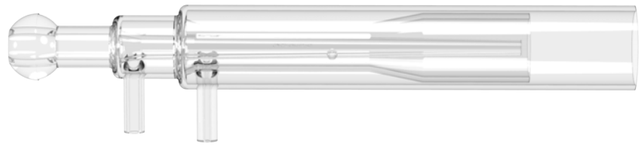
Spray Chamber Selection: Plasma Robustness

- Tracey™ provides approximately 15% increase in counts (on average)
- Twister™ provides improved signal to noise ratio (SNR)
- Negligible difference in signal-to-root background ratio (SRBR)
- Baffle of Twister provides narrower droplet distribution and smaller particle size
- Twister more suitable for high matrix samples and improved short-term precision

Twister™

Tracey™

Torch Selection



ICP Torch Designs:

1. **Single piece quartz torch:**

   General use torch: Lower initial cost structure with no removable parts

2. **Semi-demountable torch:**

   Enables injector interchangeability without torch replacement

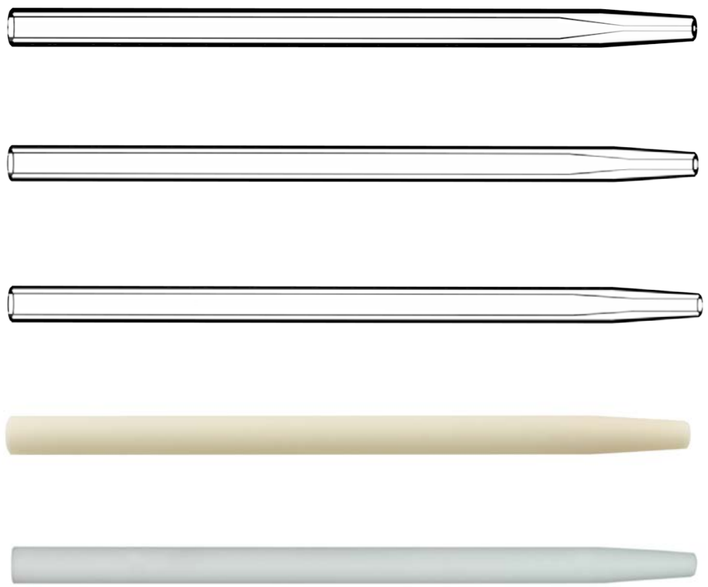
3. **D-Torch:**

   Removable: injector, outer tube

4. **Fully demountable torch (FDT):**

   Removable: injector, intermediate tube, outer tube

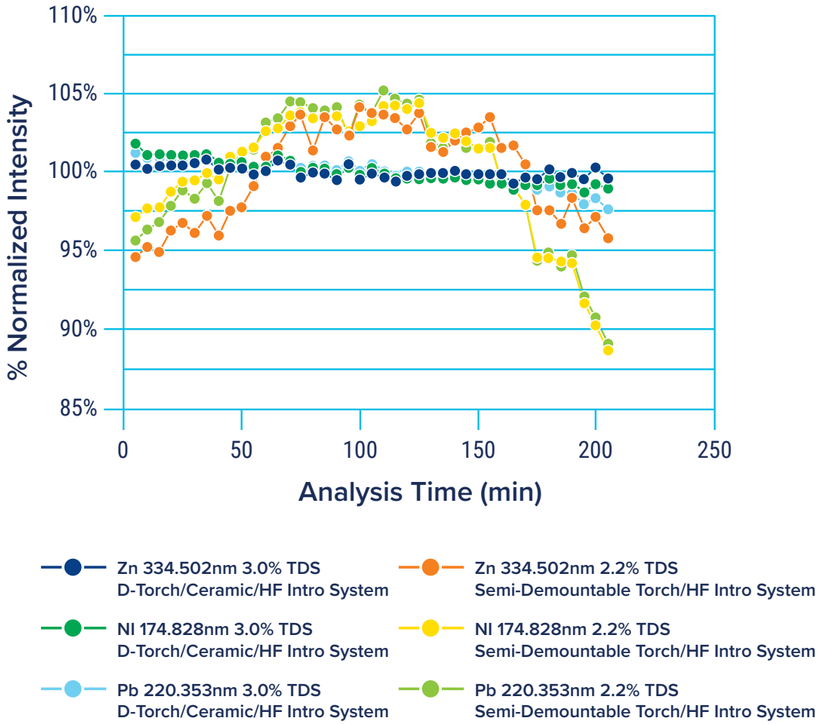
Demountable Torch = Application Flexibility



- Narrow bore quartz, **1.0mm** or less for volatile organics
- **1.5 to 2.0mm** quartz for standard aqueous matrices
- Large bore quartz, 2.0mm or greater for high TDS
- High grade **alumina for HF** containing samples
- Sapphire for ultra high purity and HF
- *Pt tipped and Sialon injectors are also available for some D-Torch models and by request.*

D-Torch with Ceramic Outer Tube

- **High Li conc. can degrade the torch's outer tube over time.**
- The demountable option allows for replacing only the outer tube, avoiding the need to replace the entire torch.
- **Injector: Alumina (~1.8 mm)**
- Ceramic outer tubes outlast quartz, reducing maintenance, cleaning, and downtime, especially for high-TDS samples
- **Provides a higher average signal intensity**



Six hours of running 10 % NaCl

Standard quartz torch body

Ceramic outer tube

General Guidelines on Cone Material

Copper:

- Often the **lowest-cost option**
- Most-susceptible to matrix effects, corrosion, and sample deposition
- Most-efficient heat transfer – this means it **“runs colder”**
- Often need more **frequent cleaning**

Nickel:

- Often the **“standard”** option
- Good thermal and chemical resistance –more than Cu but less than Pt
- Moderate heat transfer: runs ”hotter” than Cu but “colder” than Pt.

Platinum:

- Typically the most durable and longest-lasting option
- Excellent chemical resistance: **Suitable for aggressive acids or high-matrix samples**
- Least-efficient heat transfer– this means it “runs hotter” than both Cu and Ni
- **Can be refurbished**

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Thank You

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