



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



Dr. Ryan Brennan

President, Glass Expansion, Inc.
Contact: rbrennan@geicp.com

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

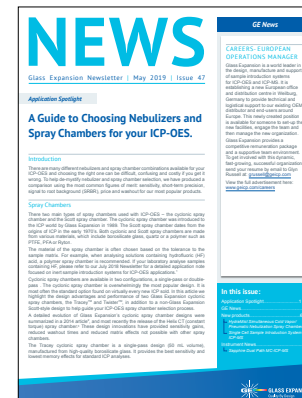


Introduction: About Glass Expansion

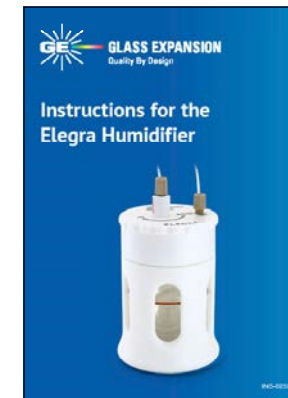
- Fully equipped R&D laboratory
- Expert technical staff
- Application notes
- Newsletters
- Catalogs
- Product flyers
- Product care guides
- Operating instructions
- Videos
- Webinars & installation guides



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

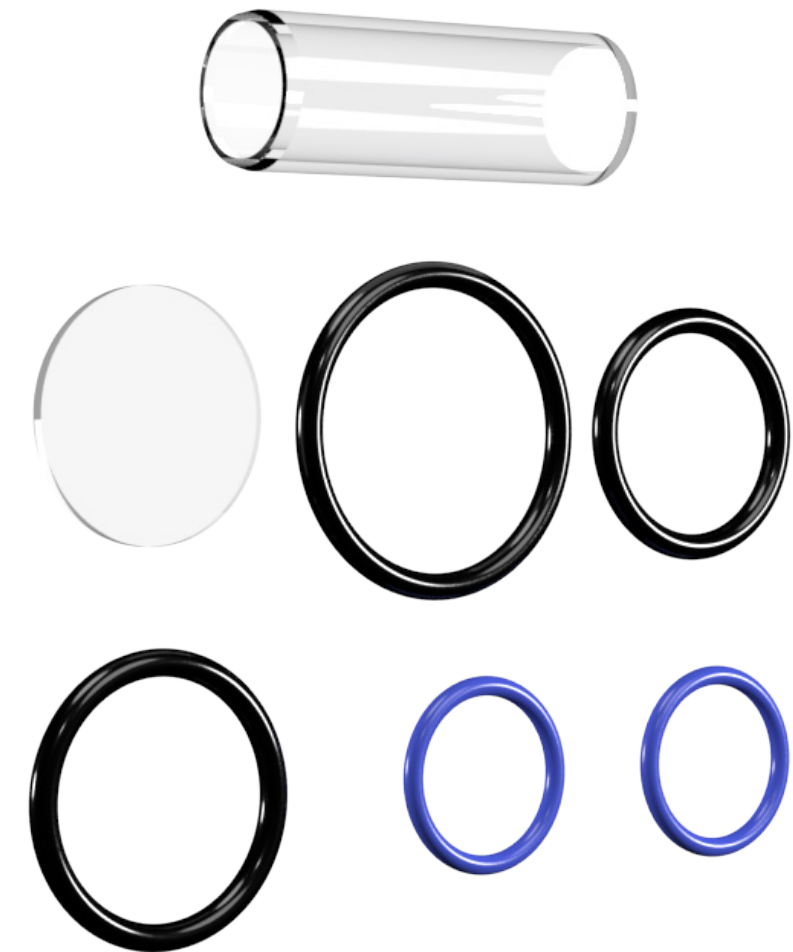
- Inspect peristaltic pump tubing; replace if worn
- Verify blank readings

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**

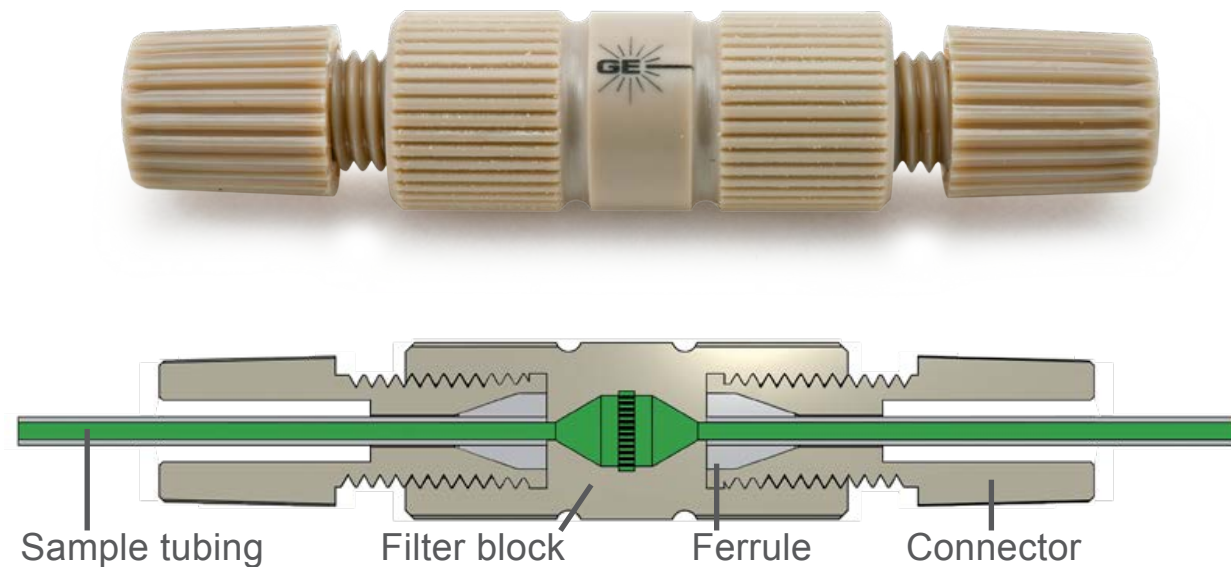


Types of Blockages: Particulates & Salting



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 μ m)
- 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:



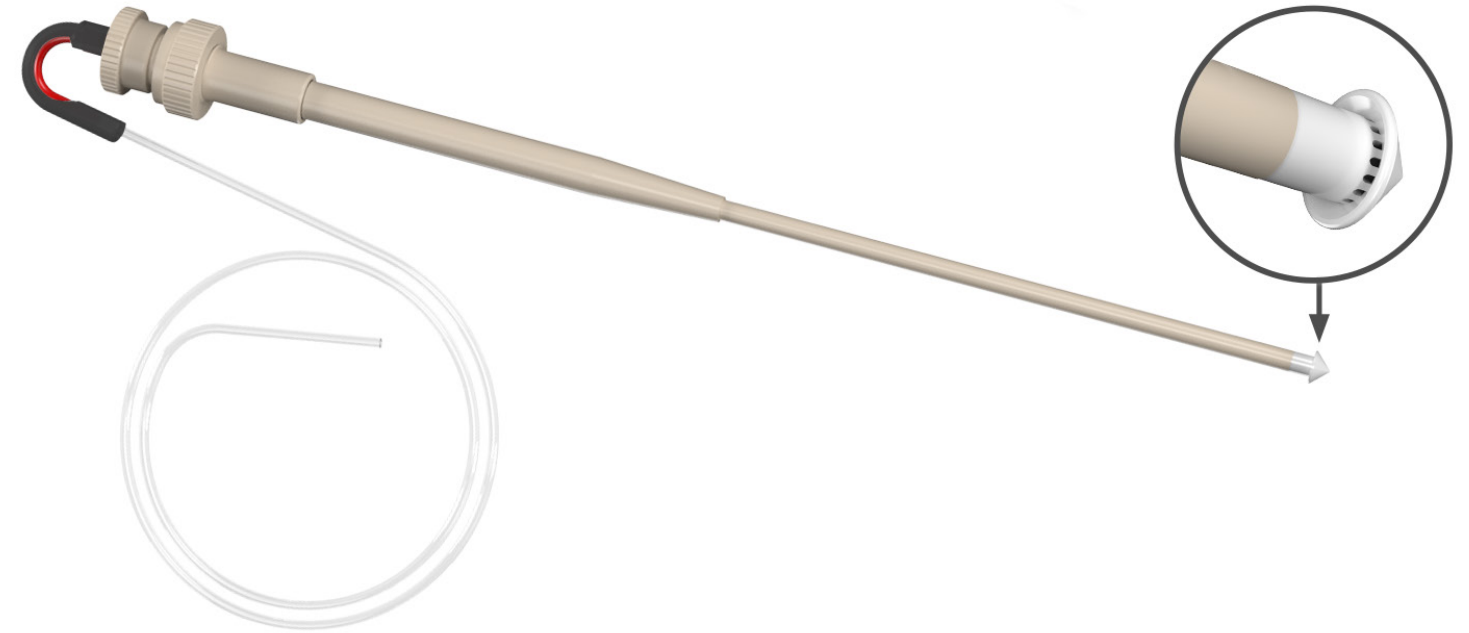
If you have the Eluo

- Add adaptor P/N 70-803-1160

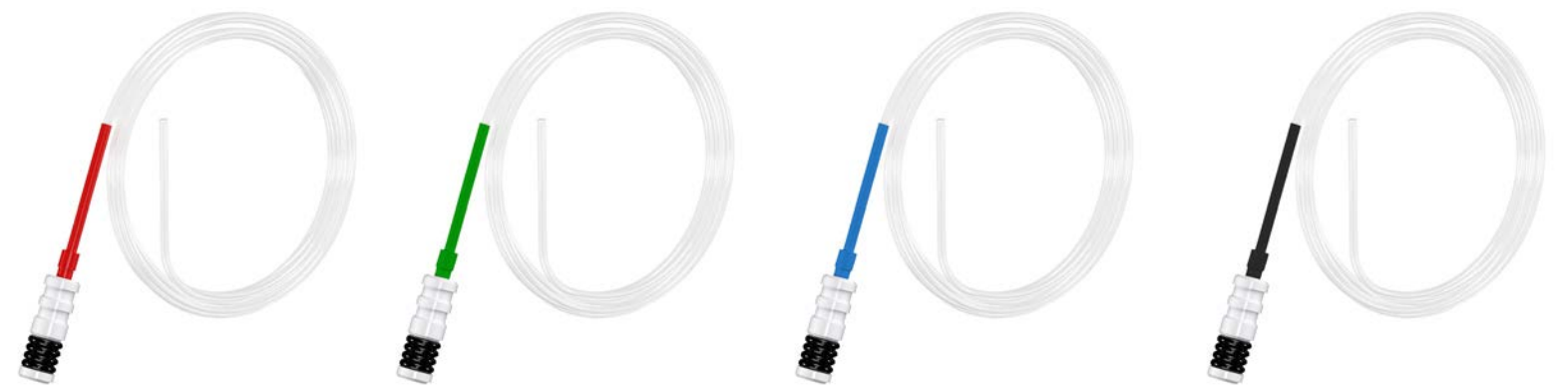
Tools to Minimize Particulate Blockages

Guardian Autosampler Probe:

- **Robust tip design** prevents crushed and damaged tips due to misalignment.
- **Drip-resistance** prevents cross contamination of samples, especially with oils.
- **Built-in particle filtering** holds back particulates from blocking the line.
- **Completely inert design**, Ceramic, PEEK and PTFE construction.
- **Interchangeable UniFit™** sample lines available in various IDs (e.g. 0.3, 0.50, 0.75 & 1.0mm)
- Designed to suit Teledyne Cetac®, Agilent®, PerkinElmer®, Shimadzu®, Aim Lab and Thermo Fisher 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:

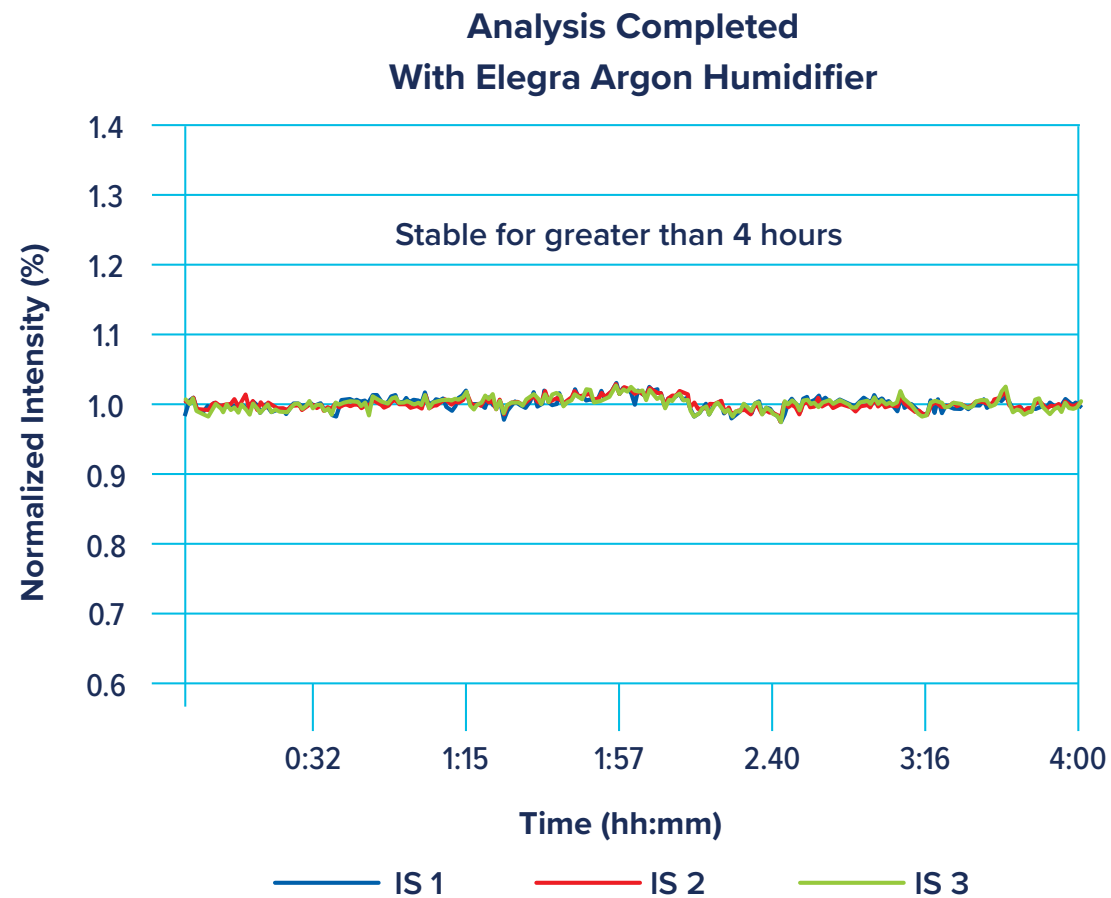
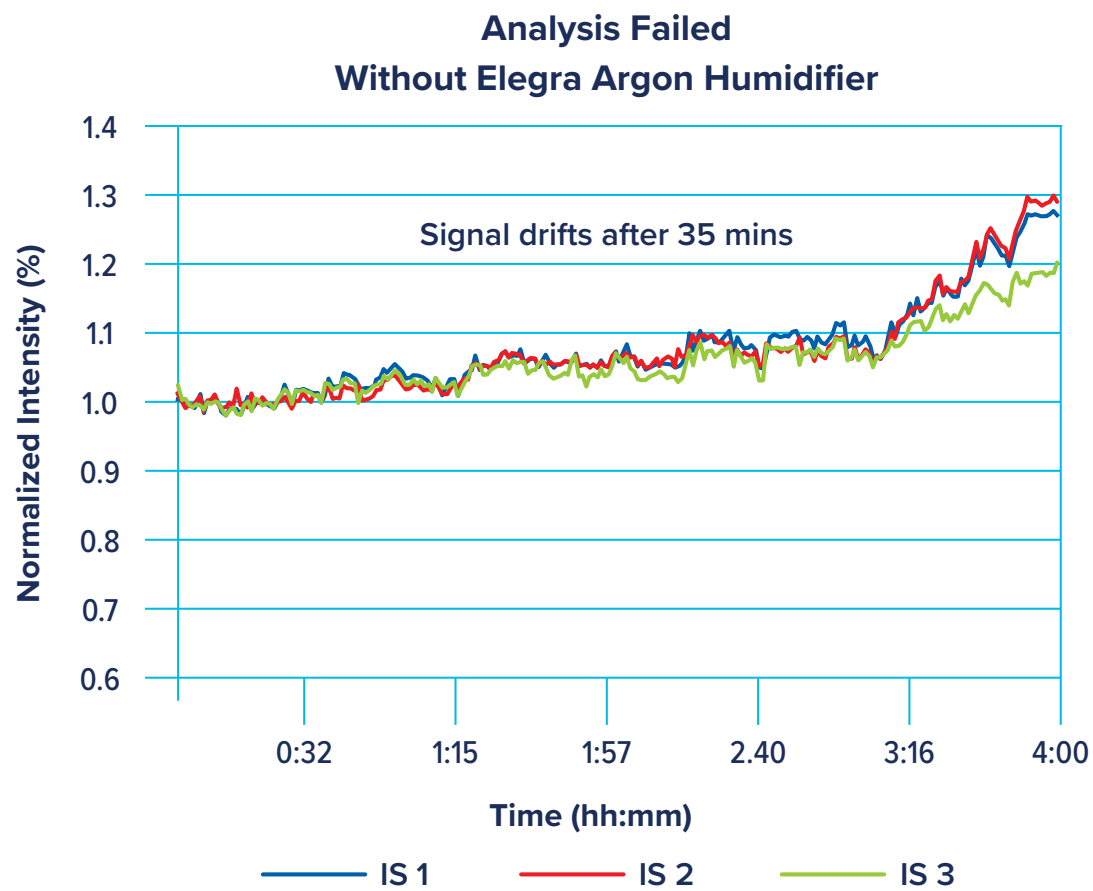
- Increasing the auxiliary argon flow will lift the plasma higher off the injector, slowing salt buildup at the injector tip.
- Extended rinses in between each sample.



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:

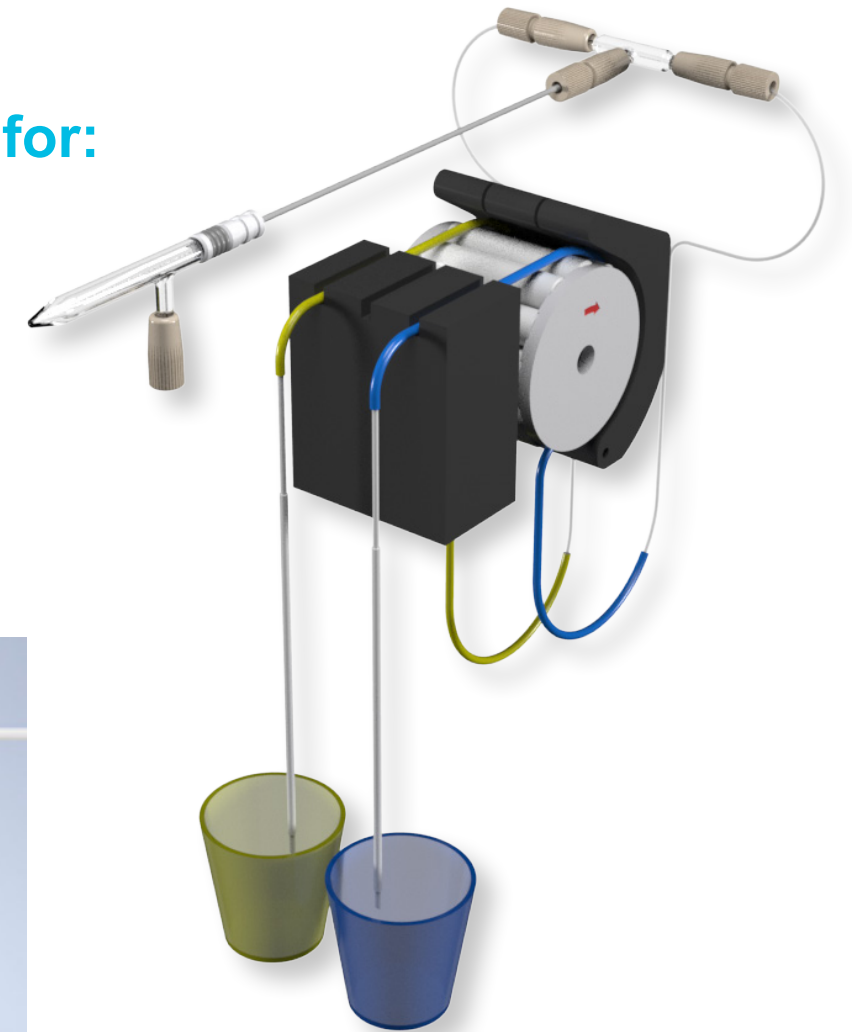
- Variations in sample uptake rates from differences in viscosity or total dissolved solids of your samples.
- Mass-space charge interferences in ICP-MS.
- Internal standardization enhances long-term stability and can improve analytical accuracy.

Trident CT™ Internal Standard Addition Kit

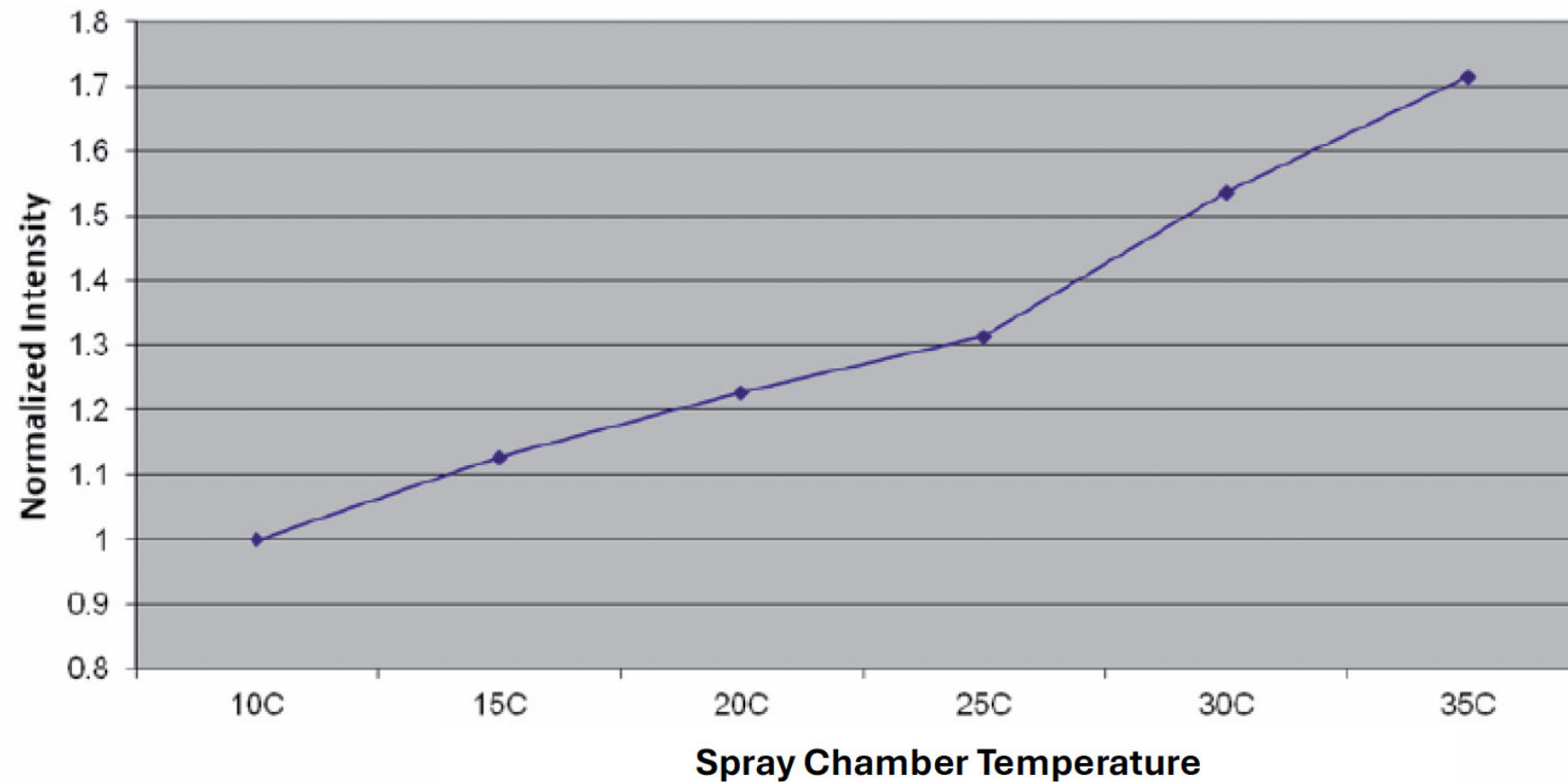
- Compact, efficient mixing chamber ensures complete mixing of the sample and reagent.
- **ConstantTorque™ (CT) ratchet fittings** for a durable, leak-free seal in all connections.
- Consistency in torque application helps maintain the reliability and performance of the mixing chamber.



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.

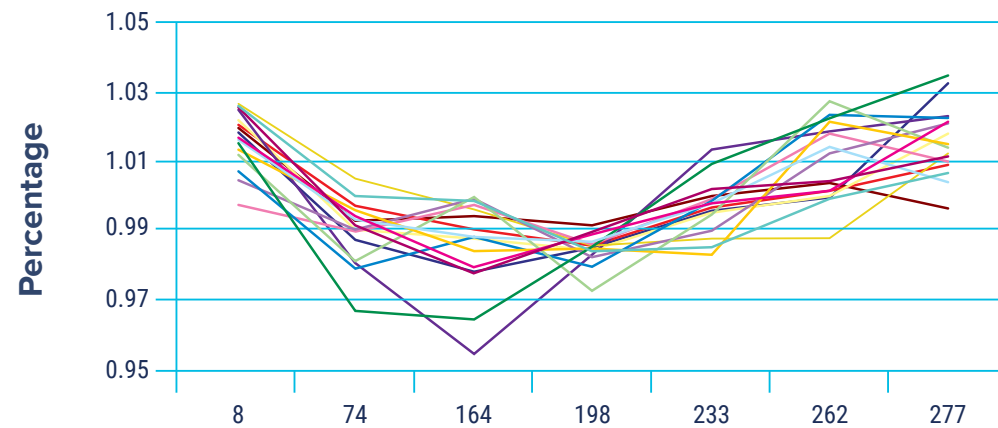
IsoMist XR Programmable Temperature Spray Chamber

Features

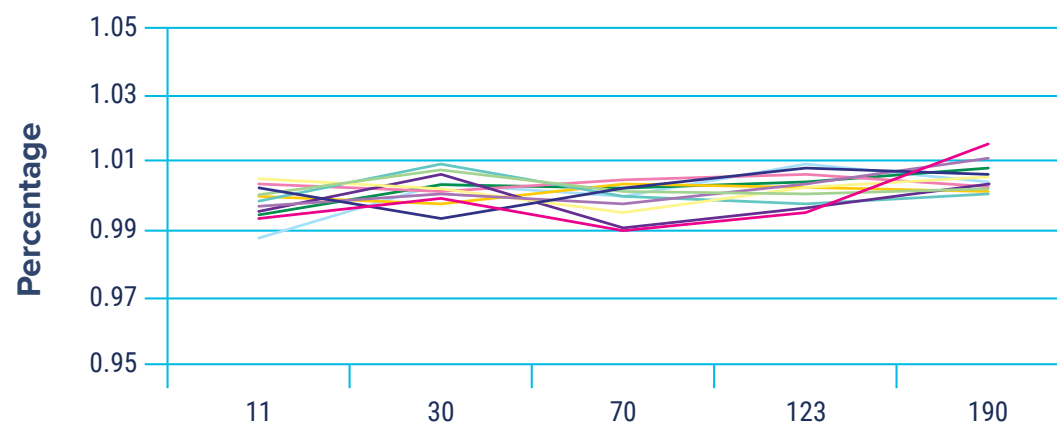
- Programmable from -25 to 80°C in 1°C increments
- Maintains temperature to within 0.1°C
- Compact design
- 100% self-contained (no external lines)
- Incorporates Bluetooth® technology for clean wireless control (USB available)
- Compatible with all ICP-OES and ICP-MS models
- Time taken to pass below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



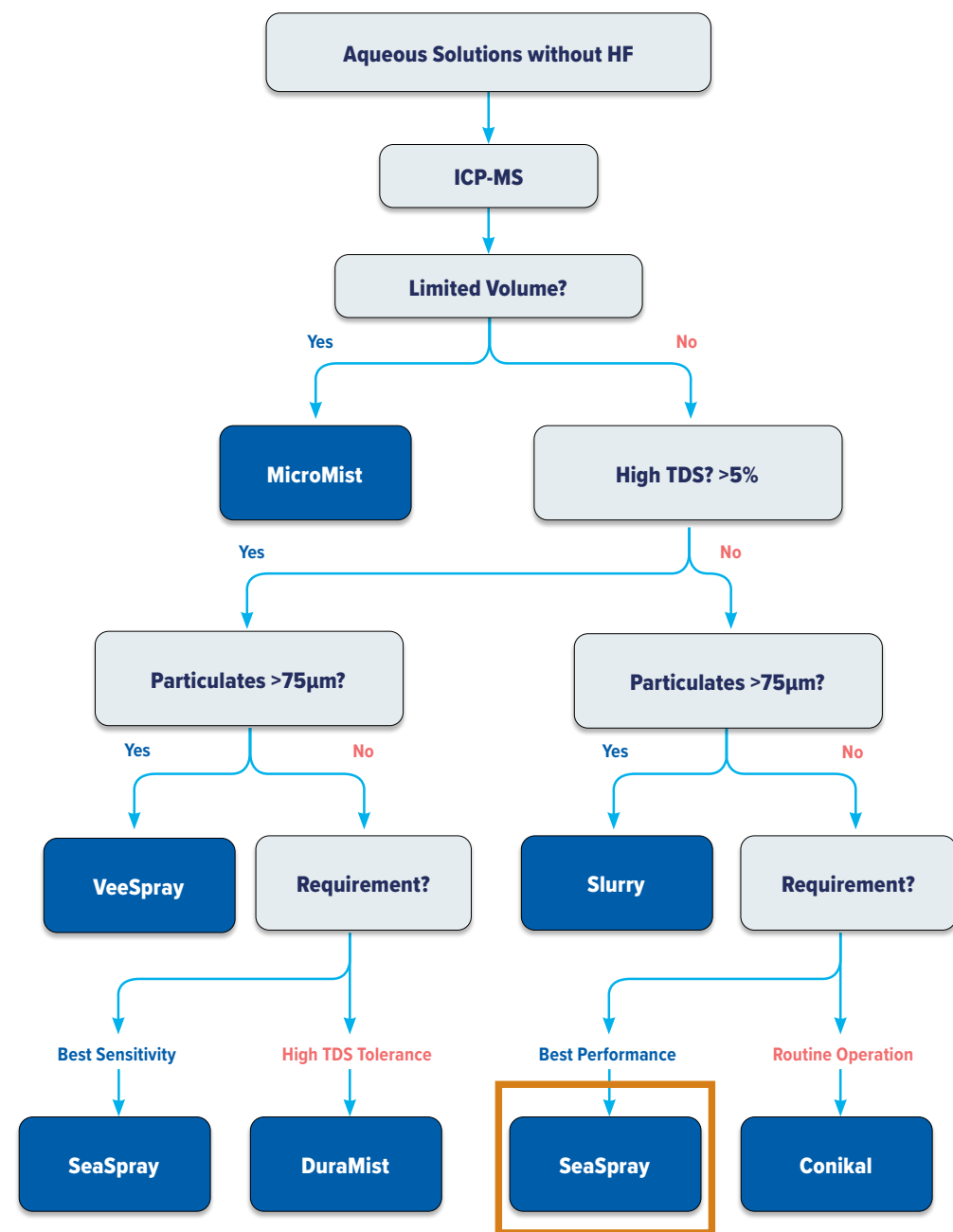
Without IsoMist XR



With IsoMist XR



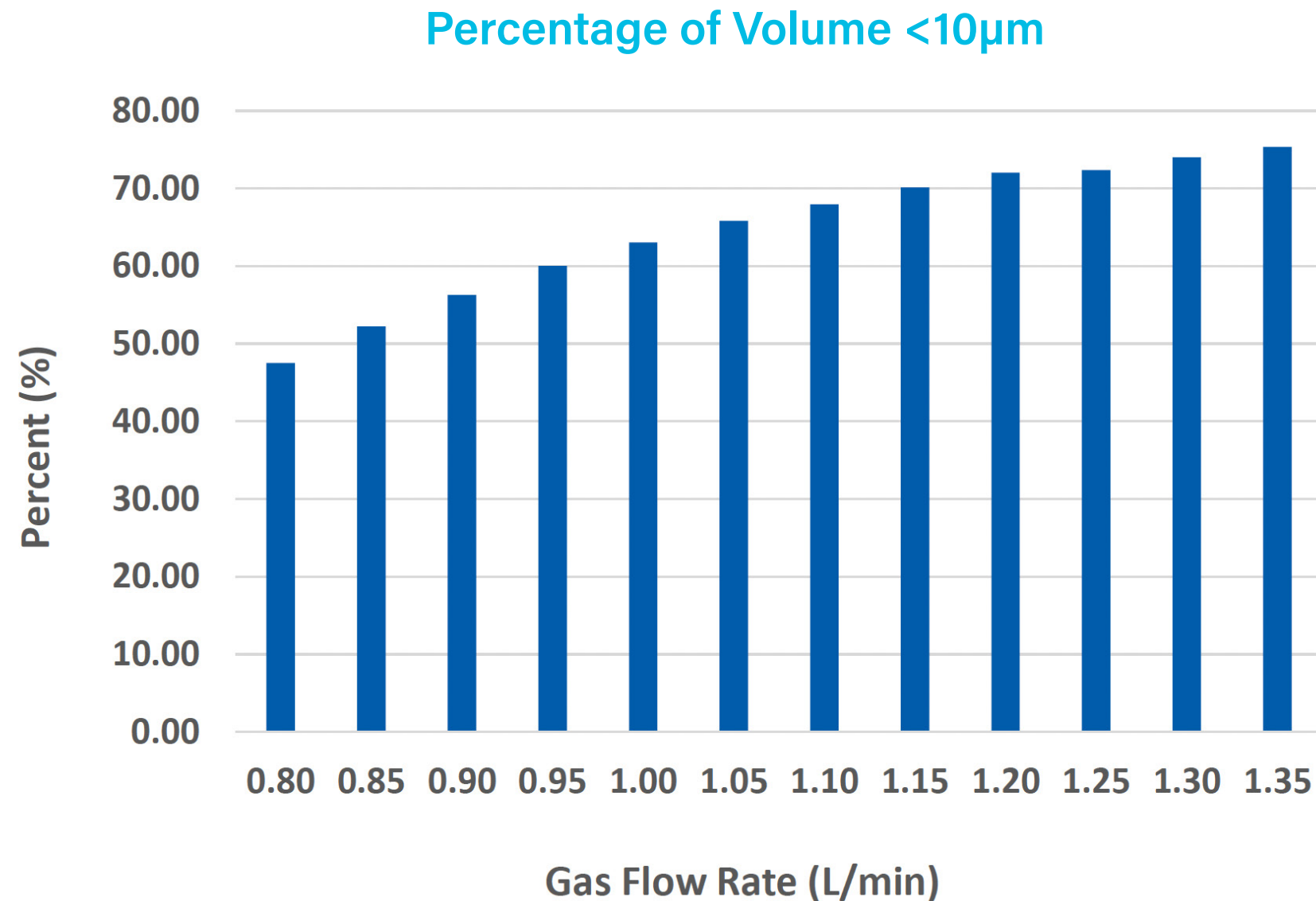
Nebulizer Selection



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

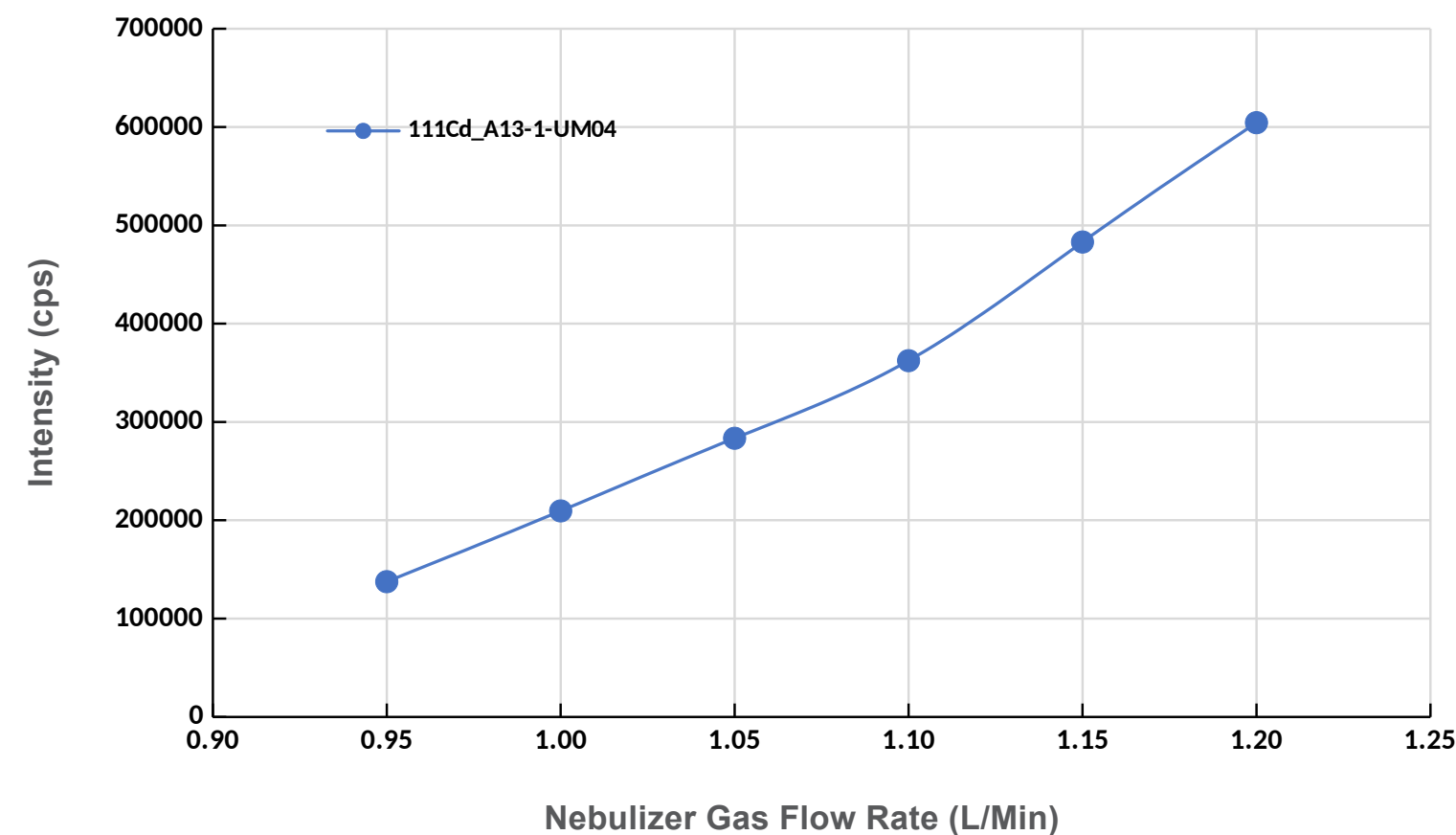
Nebulizer Operating Conditions



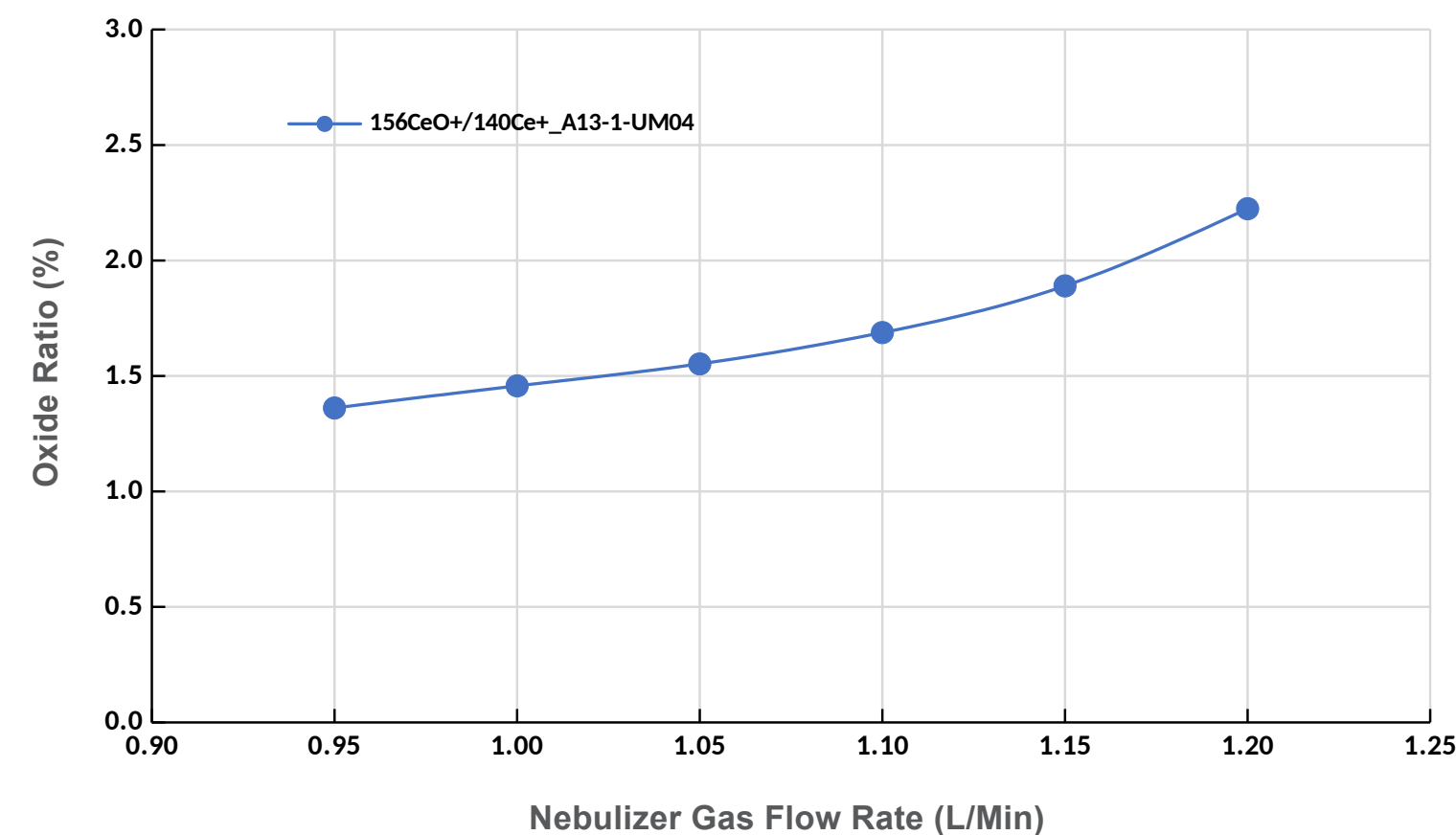
- Effect of nebulizer gas flow rate –high efficiency concentric (ICP-MS)
- A13-04-USS04
- Nebulizer sample flow constant at 0.4 mL/min
- The percent of droplet sizes less than 10 μ m increases as the nebulizer gas flow rate is increased.

Nebulizer Operating Conditions

Sensitivity Comparison (¹¹¹Cd)
Sample Flow Rate 350uL/min



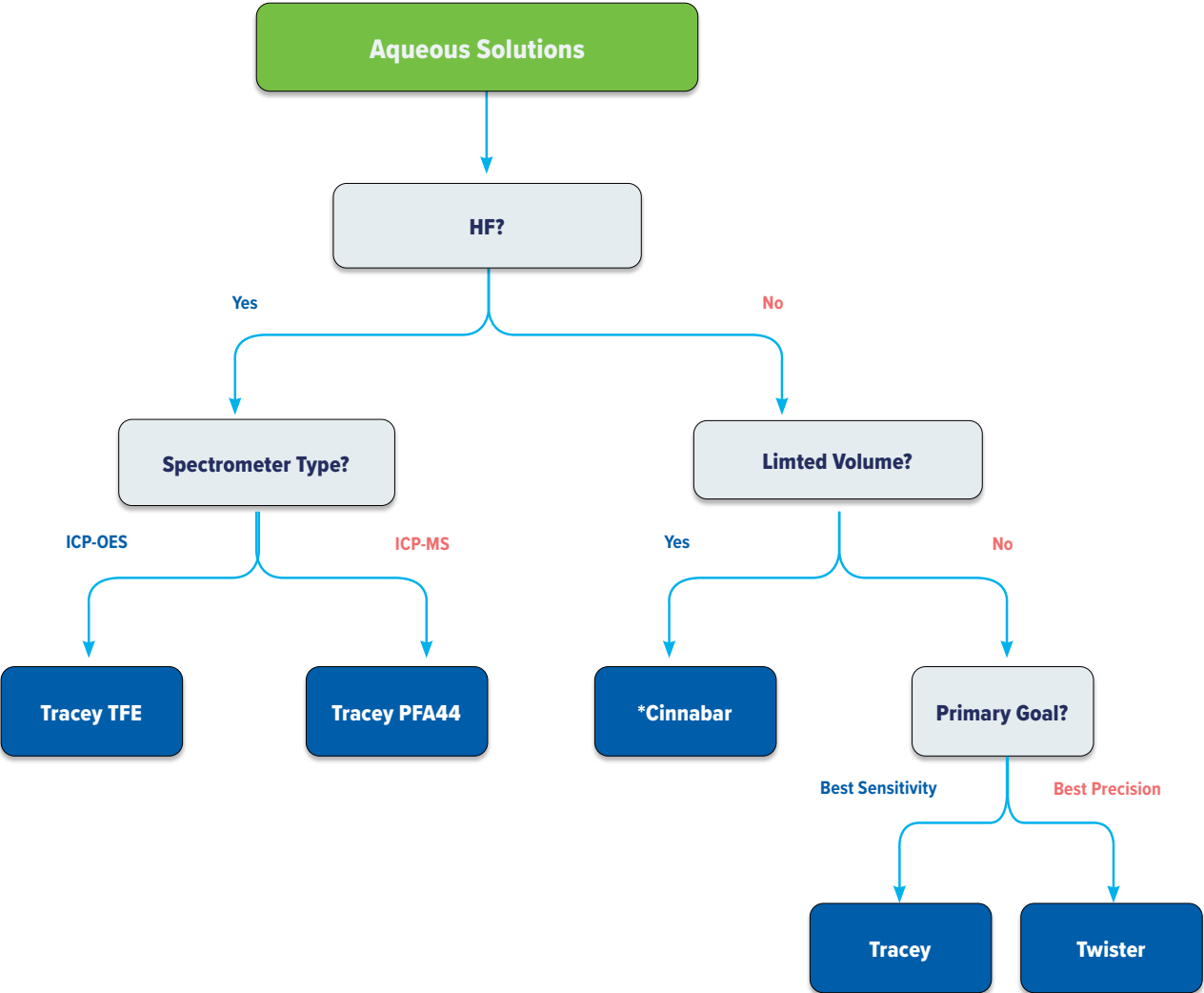
Oxide Ratio
Sample Flow Rate 350uL/min



Spray Chamber Selection

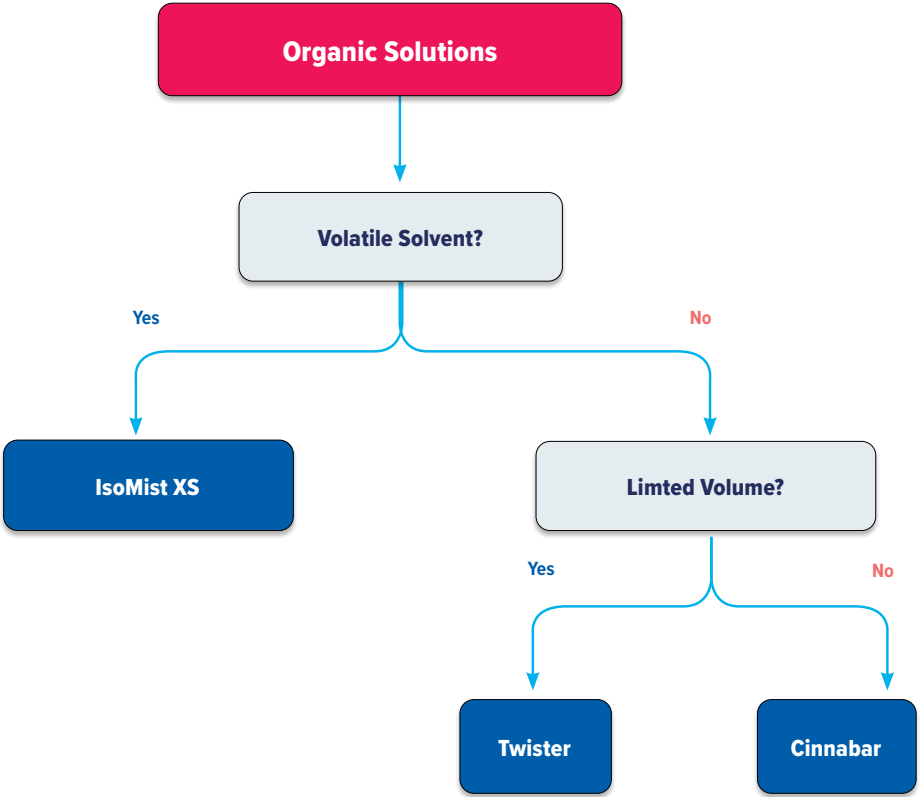
Aqueous

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

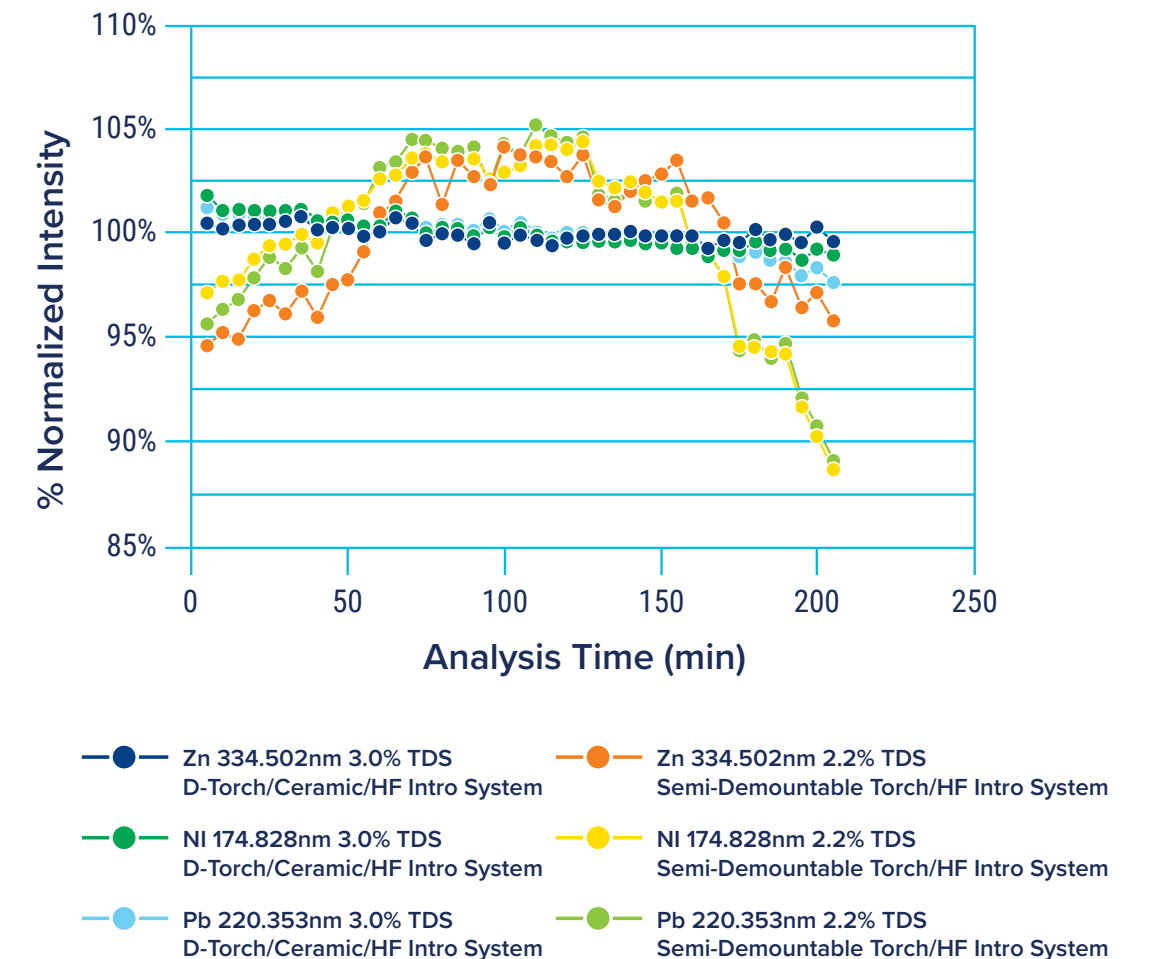
Demountable Torch = Application Flexibility



- 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**



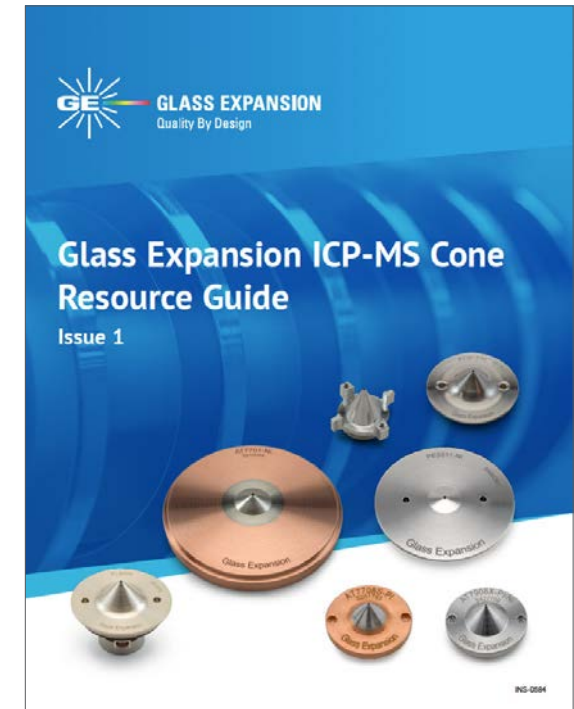
Nickel:

- 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

Asia Pacific

6 Central Boulevard
Port Melbourne VIC 3207
Australia

Phone: +61 3 9320 1111
Email: enquiries@geicp.com

Americas

31 Jonathan Bourne Drive,
Unit 7, Pocasset, MA 02559
USA

Phone: 508 563 1800
Email: geusa@geicp.com

Europe

Friedenbachstrasse 9,
35781 Weilburg,
Germany

Phone: +49 6471 3778517
Email: gegmbh@geicp.com



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