

# Better Solutions for Optimized ICP Analysis



**Dr. Ryan Brennan**  
President  
Glass Expansion, Inc.



From Digestion to Data:  
A Comprehensive Trace  
Metals Seminar Series



# Outline

## 1. Introduction

- GE Value Proposition and Support
- Overcoming SIS Challenges

## 2. Core SIS Components for Optimized Aerosol Generation

- Nebulizer Selection, Argon Humidifiers, and Maintenance
- Spray Chambers
- Torch and ICP-MS Cone Selection

## 3. New Product Spotlight

- Guardian Autosampler Probes
- Tracey™ BC Spray Chamber Series
- E-Torch™ series for ICP-OES

## 4. Conclusion

- Free SIS Review
- Q&A



# Value Proposition

## Experience:

- 40 years manufacturing ICP components

## Quality Control:

- Control complete manufacturing process, from raw material to finished product.
- Manufactured to exacting specifications
- **Guaranteed to meet or exceed OEM specifications**

## Glass Expansion Satisfaction Guarantee:

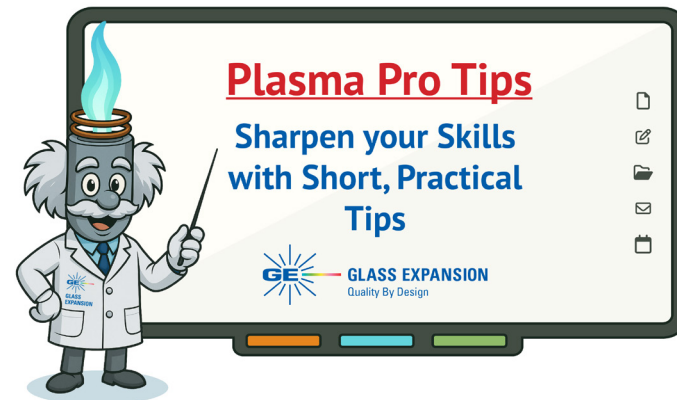
- We guarantee our products to meet or exceed performance expectations.

## Manufacturers Supported:

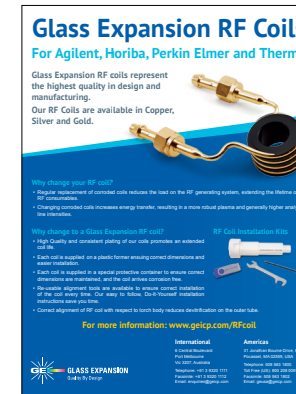
- Agilent®
- Analytik Jena
- Horiba
- PerkinElmer®
- Shimadzu®
- Spectro (Ametek)
- Teledyne CETAC
- Thermo®
- Others

# Support and Customer Service

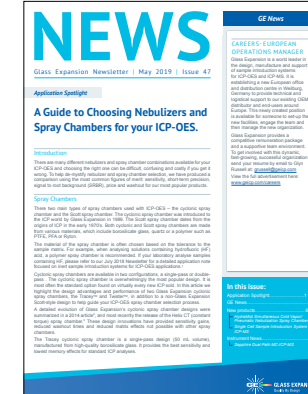
- Over 40 years of expertise
- Fully equipped R&D ICP Laboratory
- Technical team
- Application notes
- Industry News (**NEW**)
- Plasma Professor (**NEW**)
- Catalogs (**NEW**)
- Product flyers
- Website
- Product care advice
- Operating instructions
- Videos



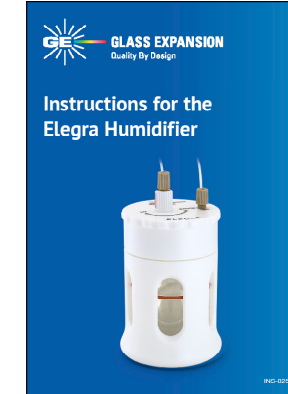
Plasma Professor



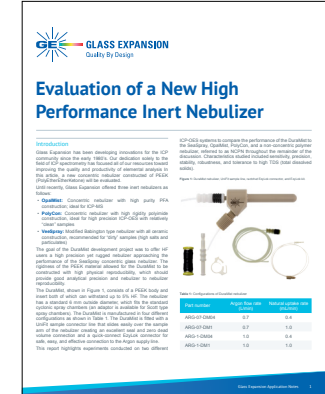
Flyers



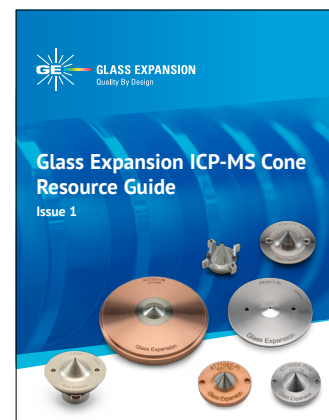
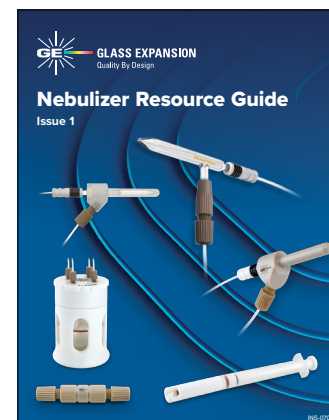
Newsletters



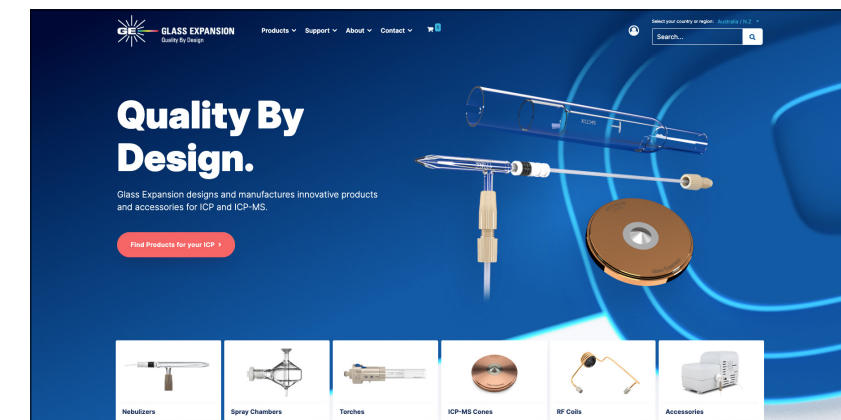
Instructions



Application Notes



Catalogs



Website

# Steps to Overcome SIS Challenges

## 1. Improve Data Quality:

- Select appropriate nebulizer, spray chamber, torch/injector, and cones
- Tailor components to sample type for accuracy, precision & sensitivity

## 2. Maximize Sample Throughput:

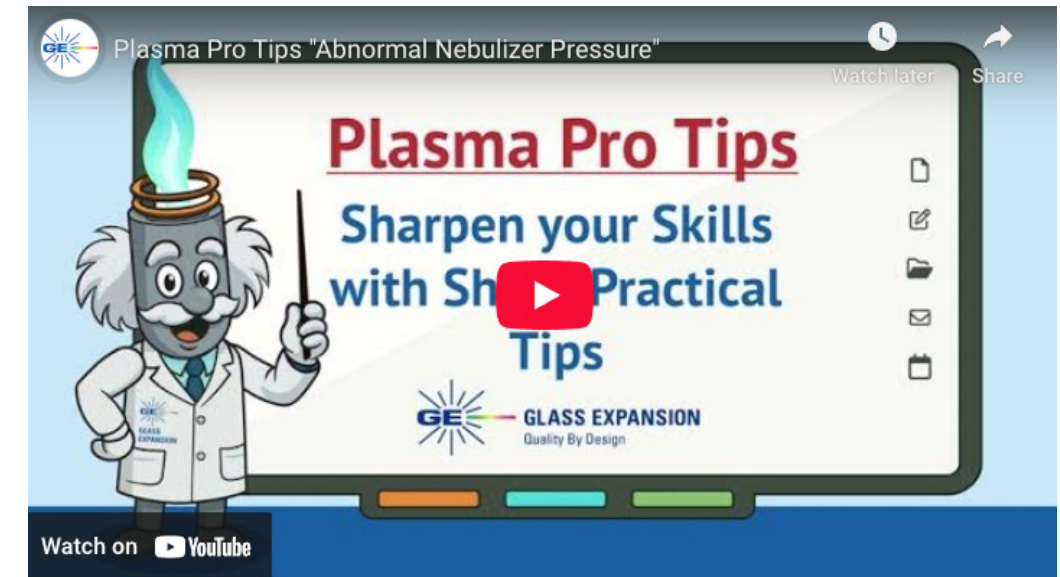
- Address carry-over and washout issues to improve efficiency

## 3. Enhance Performance with Accessories

- Use tools like Elegra, Eluo, Guardian In-Line Filter, and Guardian Autosampler Probe improve stability

## 4. Ensure Longevity & Consistency

- Implement proper care and cleaning routines
- Reduce downtime through preventive maintenance

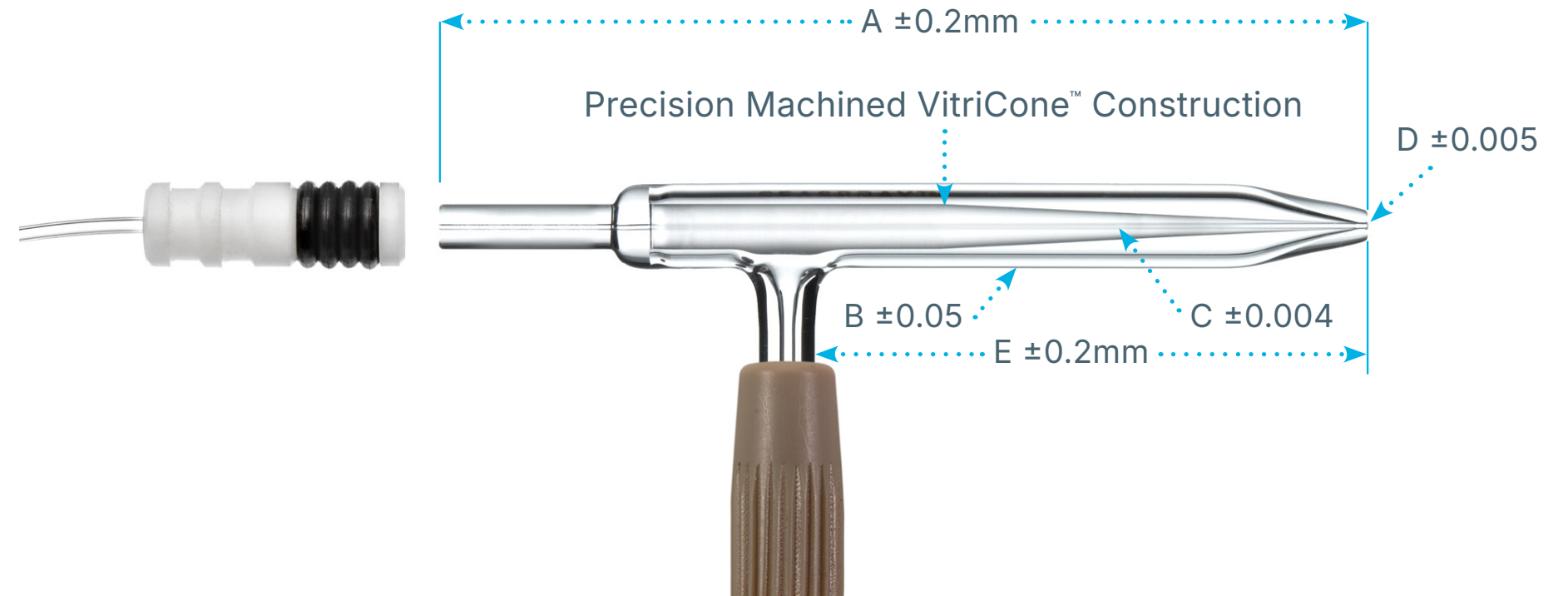


# Glass Expansion Nebulizers - Industry leaders

- Glass Expansion is the only manufacturer that takes thick-walled precision-bore tubing and machines the outside to a uniform aerodynamic shape. This guarantees a uniform - lowest dead volume sample channel, assuring tolerance to nasty samples and excellent reproducibility.
- No other manufacturer can match the precision and reproducibility of the 'VitriCone' construction, making it the most robust and dimensionally reproducible concentric nebulizer available.
- The Global Standard in Nebulizer Innovation



## Manufacturing Tolerance

- A. Controlled overall length precision
- B. Shell Diameter
- C. Full length precision bore capillary
- D. Precision formed jet nozzle
- E. Depth positioning stop



# Nebulizer Selection

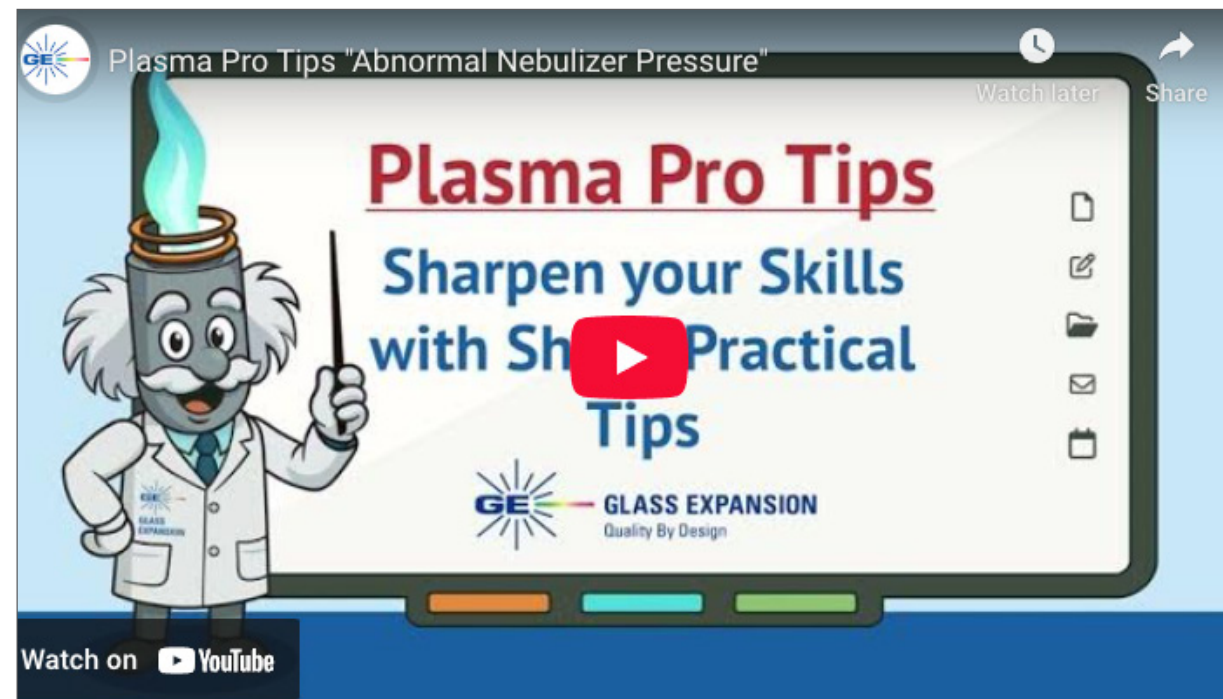
Selecting the right nebulizer requires careful consideration of various factors:

Nebulizer	Dead Volume $V_0$ ( $\mu\text{L}$ )	TDS (%)	Particulates ( $\mu\text{m}$ )	HF	Precision	Purity	Material	
SeaSpray™ MicroMist™ Conikal™ Slurry™ Quartz SeaSpray™		4	20	*200	No	High	Good	Glass
OpalMist™		4	15	*200	Yes	High	Excellent	PFA
DuraMist™		4	30	*200	Yes	High	Good	PEEK
VeeSpray™		100	30	550	Yes	Moderate	Good	Ceramic

\*Particle Size Tolerance ( $\mu\text{m}$ ): 200 = USS1, USS2, DM2, PFA2; 140 = PFA1, DM1; 100 = USS04, PFA04, DM04; 90 = UM02, UM01, UM005; 70 = PFA005, PFA01, PFA02

# Recommendation for frequent Nebulizer Blockages

- Identify the root cause of blockages: salts, particulates, or other contaminants
- Take preventive actions:
  - Use “Plasma Pro Tips” guidelines
  - Regular Maintenance
  - **Helpful Accessories:** (1) Particulates; (2) High TDS; (3) Eluo Nebulizer Cleaner; Magnifier Inspection Tool



# Helpful Accessories to reduce Nebulizer Blockages:

## Maintenance Tools:

### 1. Eluo Nebulizer Cleaning Tool

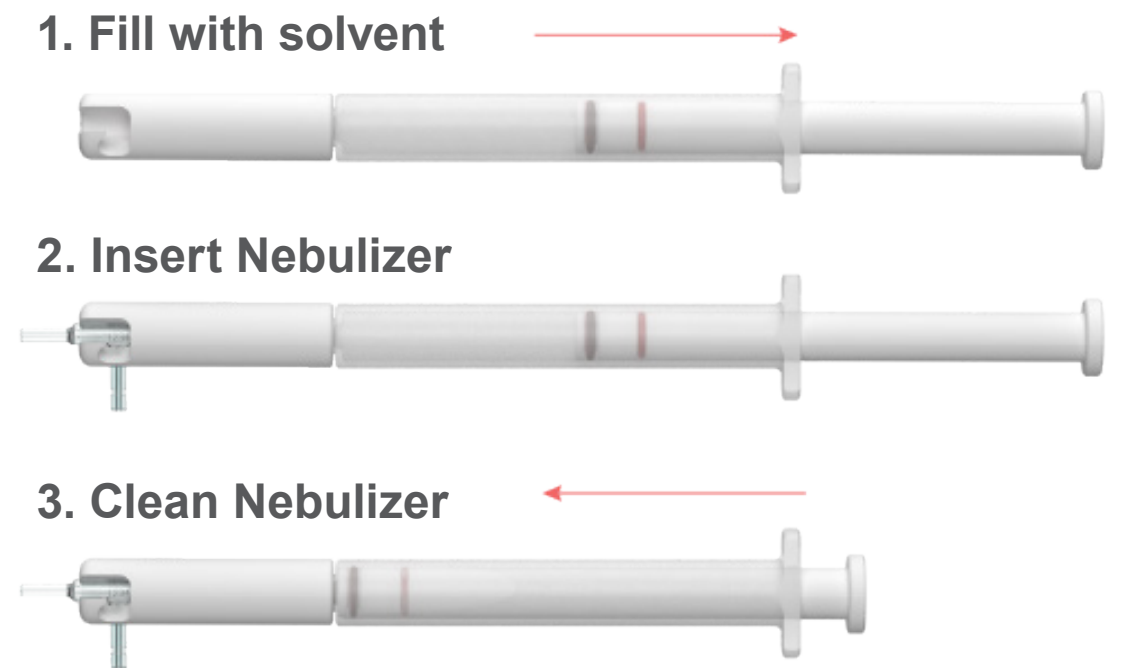
#### Why use it?

- Manual cleaning risks damage to delicate nebulizer channels
- **How it helps:** Safe, controlled cleaning using a soft stream of liquid
- Extends nebulizer life and maintains consistent performance

### 2. Glass Expansion Magnifier Inspection Tool

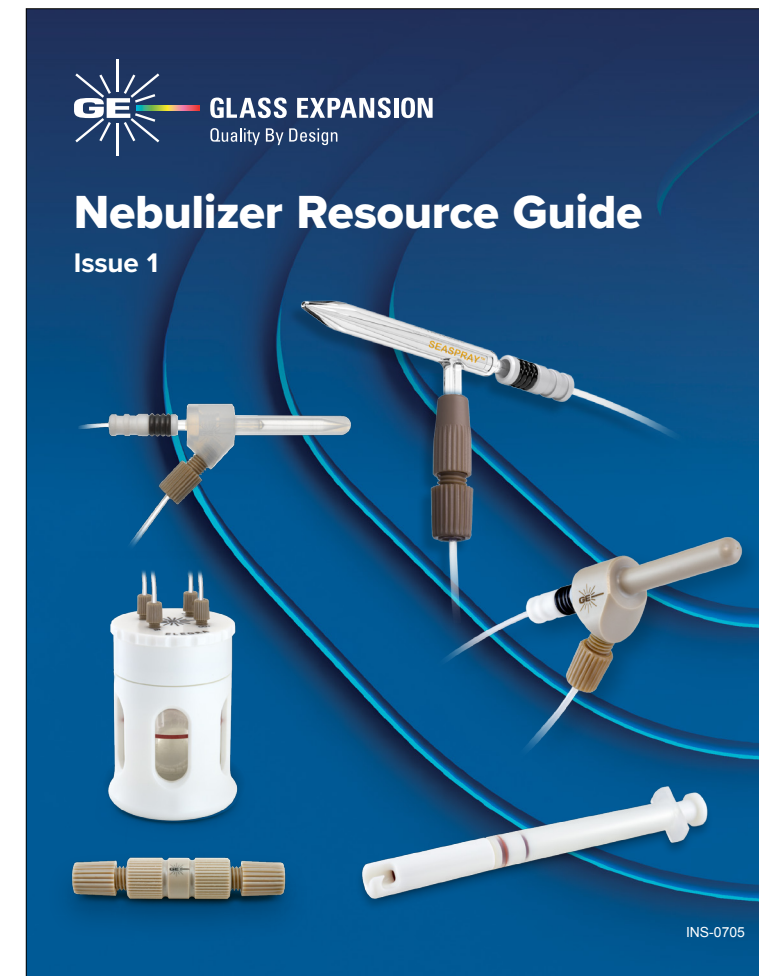
#### Why use it?

- Nebulizer tips and sample introduction components are tiny and hard to inspect
- Salt deposits or physical damage may go unnoticed until performance drops
- **How it helps:** Provides a clear, close-up view of nebulizer or injector tips
- Quickly identify wear, blockages, or salt build-up before issues escalate



# Nebulizer Resource Guide

- **Select with confidence** – Match the perfect nebulizer to your specific application.
- **Maximize performance** – Discover the advantages of each nebulizer model.
- **Solve problems fast** – Step-by-step troubleshooting when issues arise.
- **Extend lifetime** – Expert maintenance tips that save replacement costs.
- **Choose smart accessories** – Know exactly when (and why) you need them.



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# Samples With High TDS: Argon Humidifier

## Why address high TDS issues?

- Salt deposits form at the nebulizer and injector tip
- Leads to analytical drift or even plasma extinguishing

## How to solve it?

### 1. Elegra™ Argon Humidifier to prevent salt build-up

- Adds moisture to argon gas → prevents salt build-up and reduces maintenance
- Maintains stable plasma and consistent results during high TDS analysis
- **Elegra:** No power, heat, or pressurization required – compact, inert, and easy to integrate
- Superior performance: up to 60% more effective relative humidity than competing models
- Flexible configurations: single- or dual-channel versions with custom gas fittings
- Complements a high-TDS sample intro setup: **SeaSpray™ /DuraMist™** nebulizer, **Twister™** spray chamber, and **wide-bore injector**



SeaSpray™

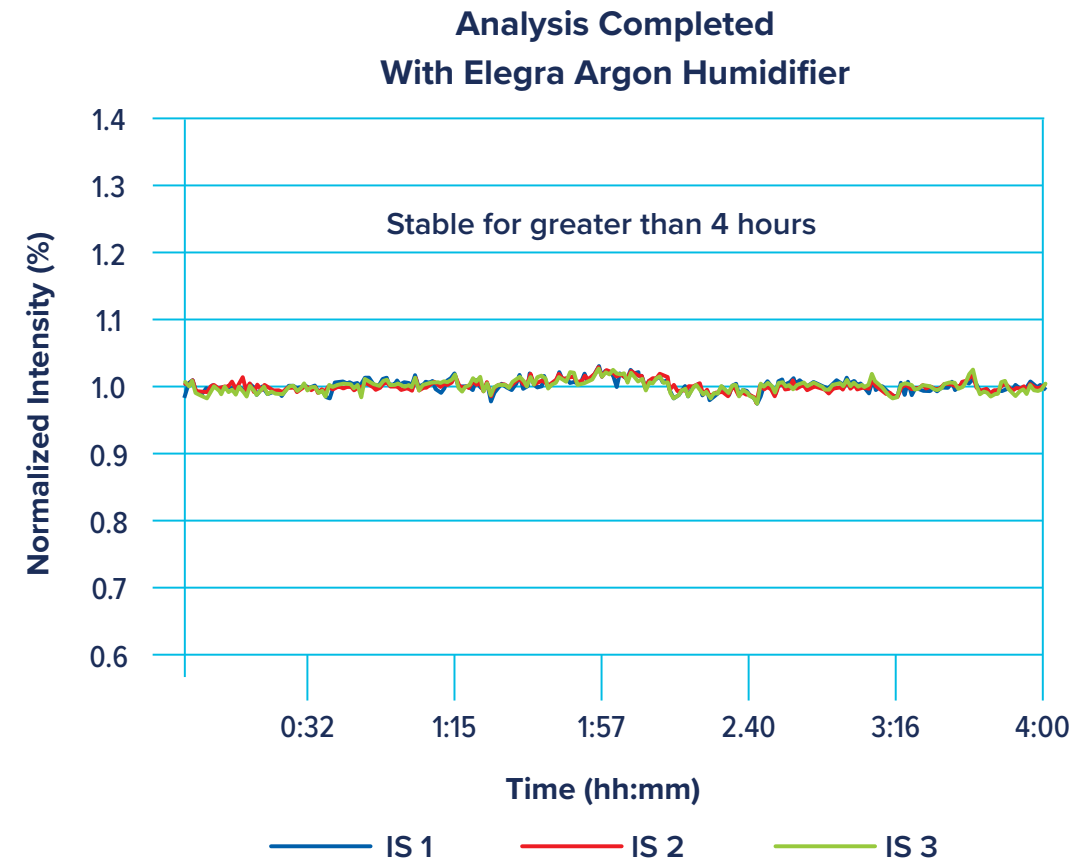
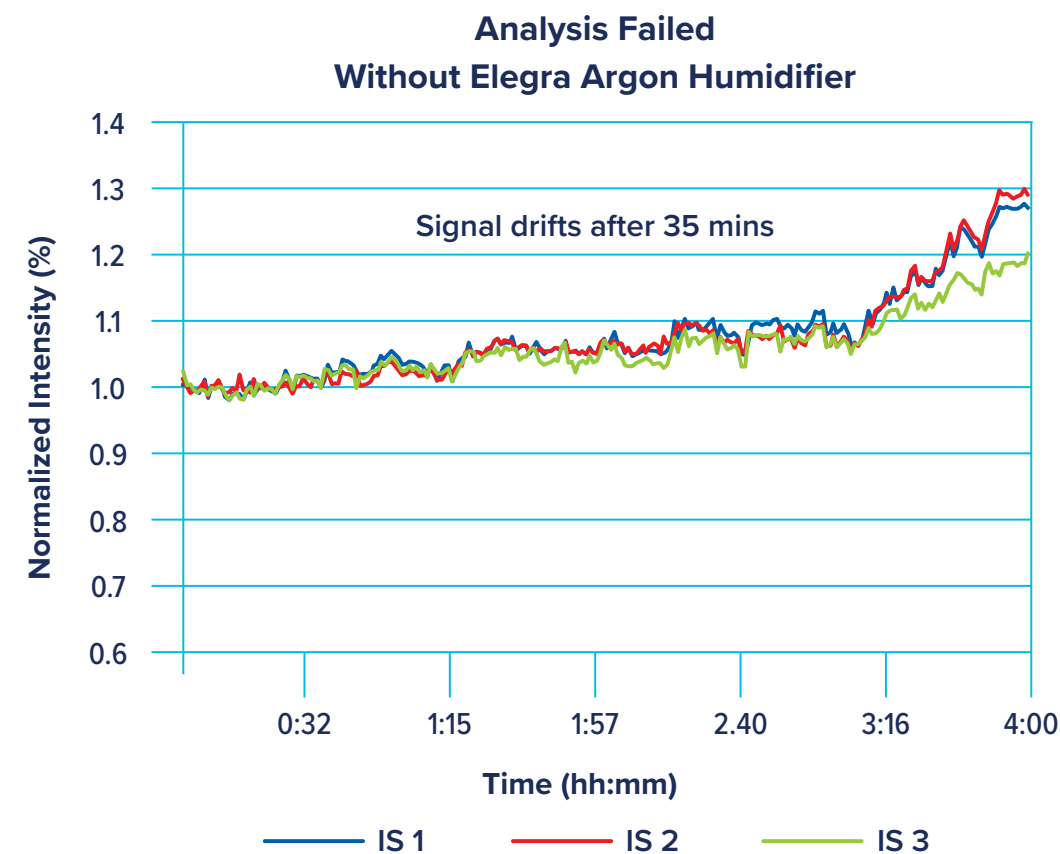


DuraMist™

# Samples With High TDS: Argon Humidifier

## Performance

- Tested to deliver over 4 hours of stable internal standard signal with high-salt samples, outperforming other humidifiers



## Elegra Application Note

**GLASS EXPANSION**  
Quality By Design

### A Comparison of ICP Accessory Argon Humidifiers

Author: Ryan Brennan, Justin Masone & Randy Mercurio

**Introduction**

It is standard operation to use dry argon as your ICP nebulizer gas in order to generate an aerosol and transport the sample to the plasma. However, when dealing with samples containing high amounts of total dissolved solids (TDS) you have an increased likelihood of salt deposits forming at the tip of the nebulizer and injector; this can result in a drift in signal or an extinguished plasma. In order to handle a challenging sample matrix, such as high TDS, it is important that you carefully optimize your ICP sample introduction system. This includes choosing a nebulizer with the ability to handle high TDS, a baffled cyclonic spray chamber to minimize droplet size, and a large bore injector to allow for longer run times. For optimum performance, you can also humidify the nebulizer gas before it contacts the sample, decreasing the likelihood of salt deposits forming at the nebulizer and injector tip. Adding an argon humidifier will reduce maintenance and the chance of an extinguished plasma due to a blocked nebulizer or injector.

In 2016 Glass Expansion introduced the Elegra Argon Humidifier, a compact inert design that would eventually replace the Capricorn, Glass Expansion's original humidifier design. The relative humidity (RH) added by the Argon humidifier will determine the efficiency and overall performance as to how well the accessory can slow and prevent salt build-up at the nebulizer and injector. As a comparison of humidification efficiency, the RH output of the Elegra was compared to another commercially available argon humidifier that requires a power supply and heating element, which we shall refer to as Brand-X throughout. The Brand-X model was specifically selected in this comparison as it is listed as the supplier's "enhanced humidification model." Additionally, the RH performance of the Elegra was compared to the Capricorn to prove equivalent humidification performance and a suitable replacement.

**Test Method**

All tests were performed in a stable environment of 21°C. To ensure accurate results, the tubing for each humidifier setup remained the same. A glass test cell was added in-between the humidifier and nebulizer where the RH measurements were taken. The experiment setup is shown below in Figure 1.

Figure 1. Experimental setup for relative humidity.

Each of these three gas connections was 700mm long by 1.0mm internal diameter.

The nebulizer used was a Seabrony (PN ABG-07-10002 and SN 523813) operating at 40 psi, and each humidifier was filled and prepared according to their instructions. The test cell was purged with Argon for an extended period after each test to ensure no moisture carried over. Measurements were taken in 5 minutes intervals, for 30 minutes of operation. The Brand-X humidifier was tested at both room temperature (un-heated) and with a two-hour warm-up period in heated mode.

Glass Expansion Application Notes 1

(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 a half... I will be ordering 2 more.")

Contract Laboratory - USA

# Spray Chambers: Transport Efficiency, Precision, and Washout

What are the common challenges encountered when using spray chambers?

## Application Suitability



- HF
- Organics
- Limited volume samples

## Transport Efficiency



- Loss of Sensitivity
- Poor Precision and Accuracy
- Inconsistent Signal Stability

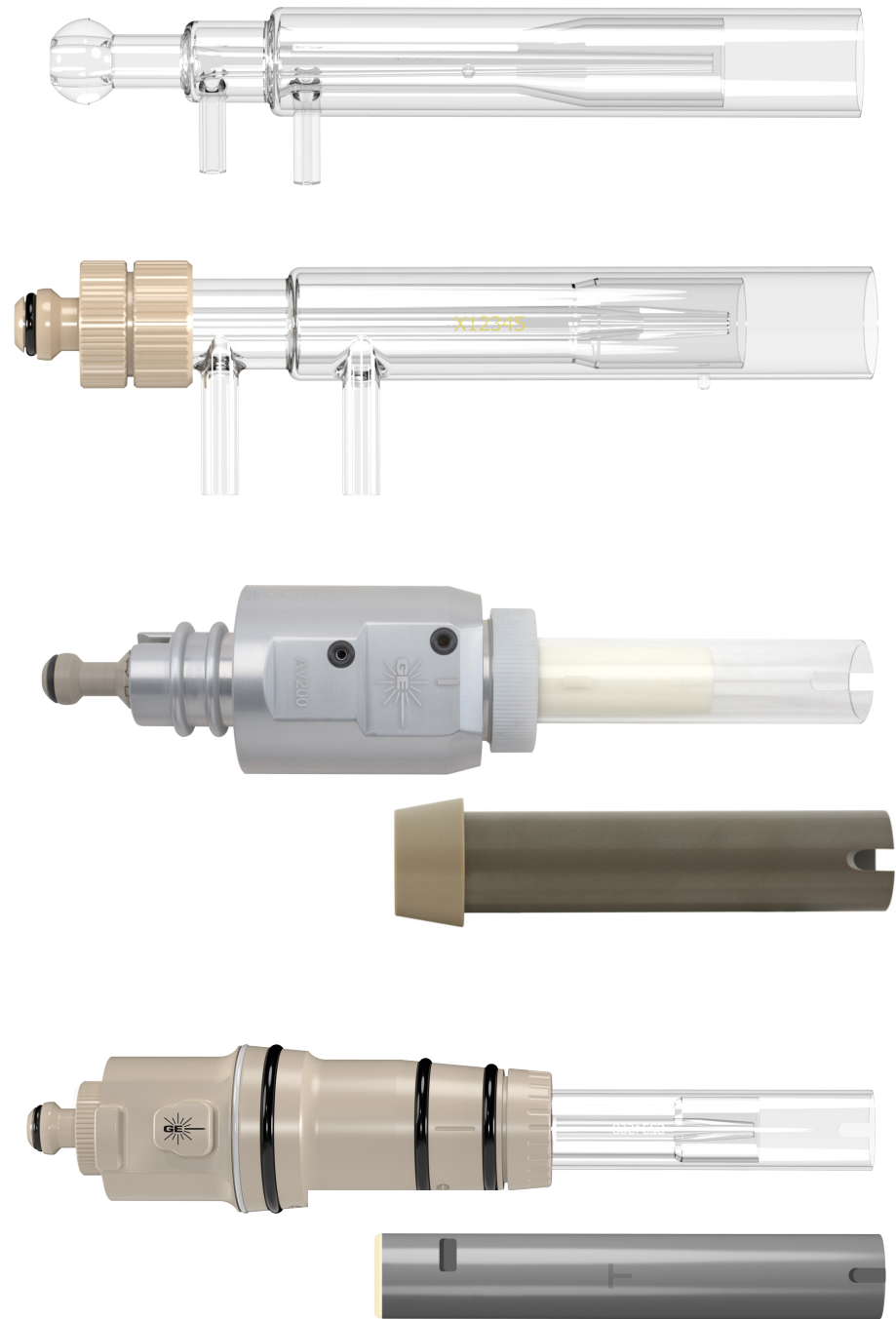
## Long washout Carryover



- Poor Precision
- Dead volume
- Compromised analytical results



# 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 and easier maintenance

### 3. D-Torch:

Removable: injector, outer tube (optional ceramic)

### 4. E-Torch:

Removable: injector, torch body (optional ceramic)

# ICP-MS Cone Material Selection

## Nickel Cones:

- **Balanced cost & performance**; standard for many applications
- Good **thermal & chemical resistance**; less prone to corrosion and deposition
- Runs **hotter** than copper, stays cleaner longer, more stable signals
- Suitable for **routine aqueous samples** (<5% acid, non-HF, non-organic)

## Nickel-Plated Cones:

- Ideal for samples with >5% acid concentration
- Nickel plating boosts chemical resistance while **retaining copper's efficient heat transfer**
- **Helps prevent overheating** and rapid orifice degradation, preserving sensitivity and stability

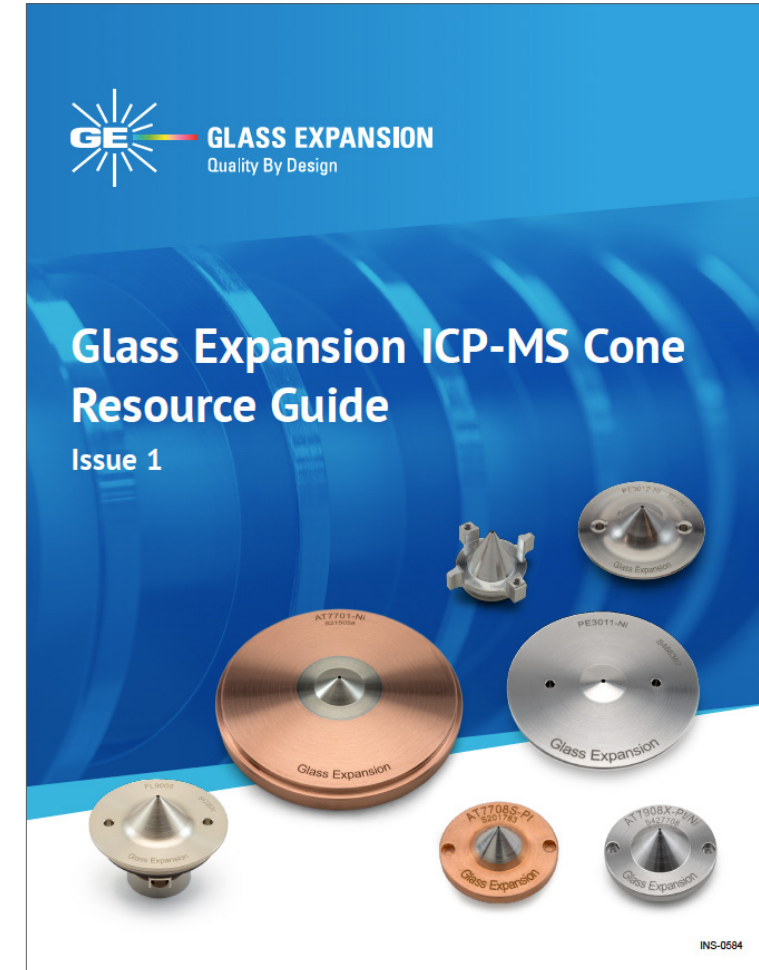
## Platinum Cones:

- Most durable, longest-lasting, but highest cost
- Excellent chemical resistance - ideal for **high-matrix, high acid**, or organic **solvent samples**
- Least efficient heat transfer → runs **hotter**, but stays **cleaner longer**
- Can be **refurbished 2-3 times** and **recycled** for reclaim value towards future purchases



# ICP-MS Cone Resource Guide

- How to choose the right cones for your application
- Advantages of different cone materials
- Expert tips on care and maintenance
- Cross-referenced OEM part numbers for easy ordering
- Why Glass Expansion is the trusted choice for ICP-MS cones

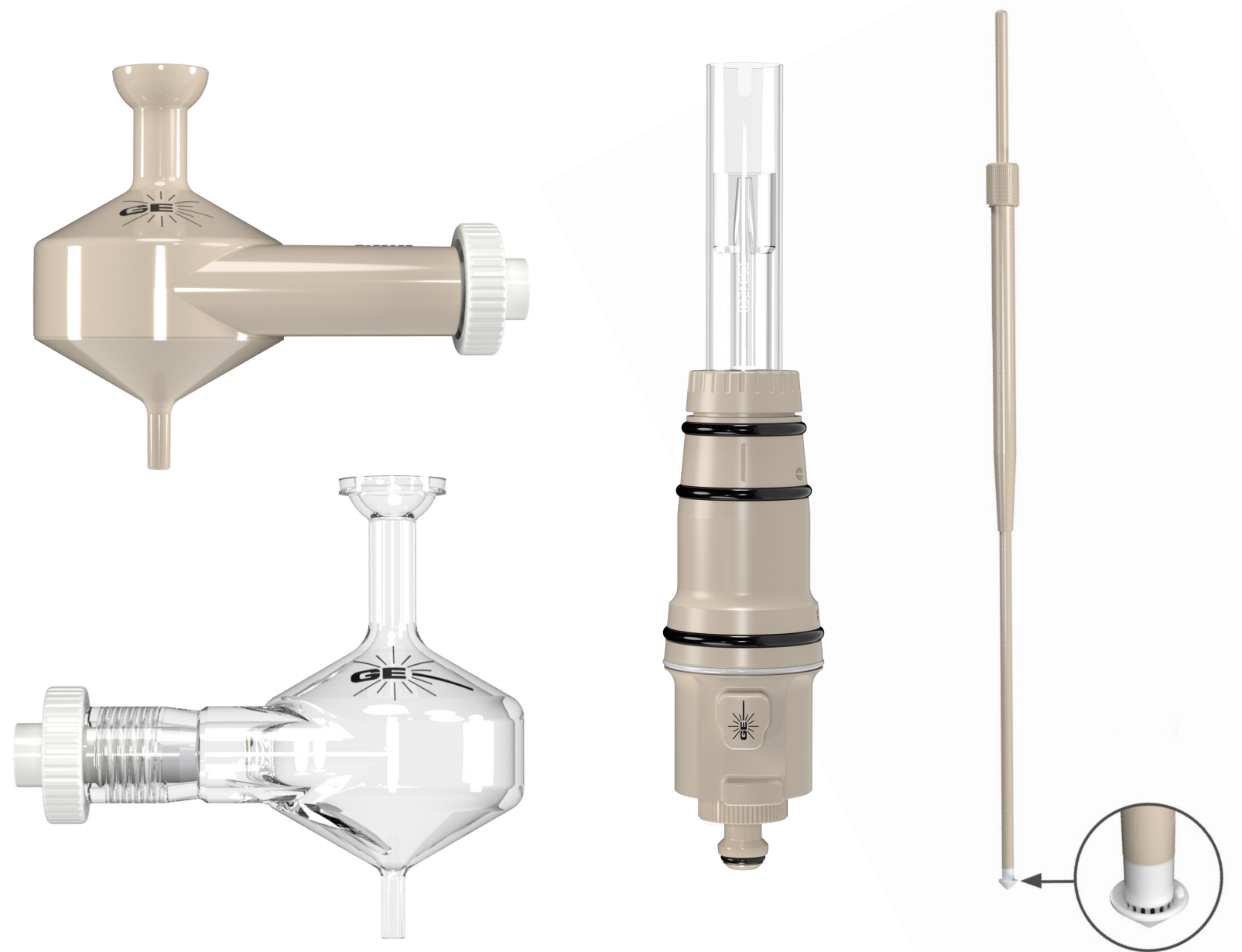


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# NEW Product Spotlight

- Guardian™ Autosampler Probe
- Tracey™ BC Spray Chambers
- E-Torch™



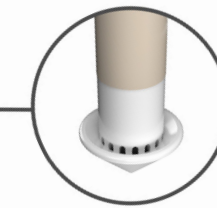
# NEW Guardian™ Autosampler Probe

## Features & Benefits:

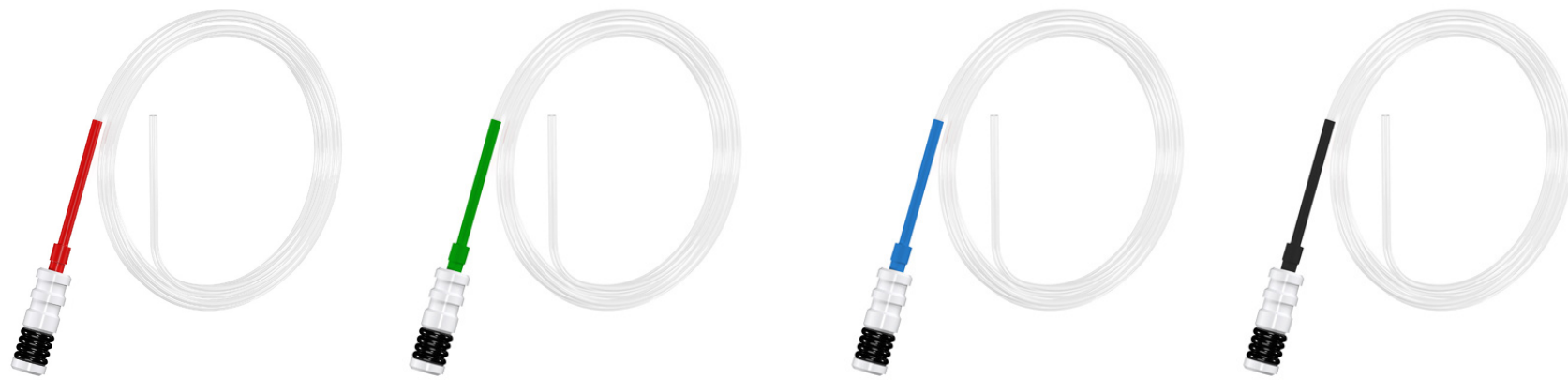
- Proprietary mechanical finish to improve wetting characteristics and prevent the beading of droplets.
- **Robust tip design** prevents crushed or damaged tips from misalignment.
- **Drip-resistant** to minimize cross-contamination, especially with oils.
- **Unique inbuilt particle filtering** prevents blockages in your nebulizer and capillary tubing.
- **Optimized ceramic filter tip** to minimize dripping and particulate blockages.
- **Completely inert construction** (Ceramic, PEEK, and PTFE) for strong acid/solvent resistance.
- **Interchangeable UniFit sample lines** (3000mm in length) to accommodate various IDs (e.g. 0.3, 0.50, 0.75 & 1.0mm)



Guardian Probe Assembly  
for ASX-200, 500, 800 Series  
P/N 70-803-1787



# NEW Guardian™ Autosampler Probe



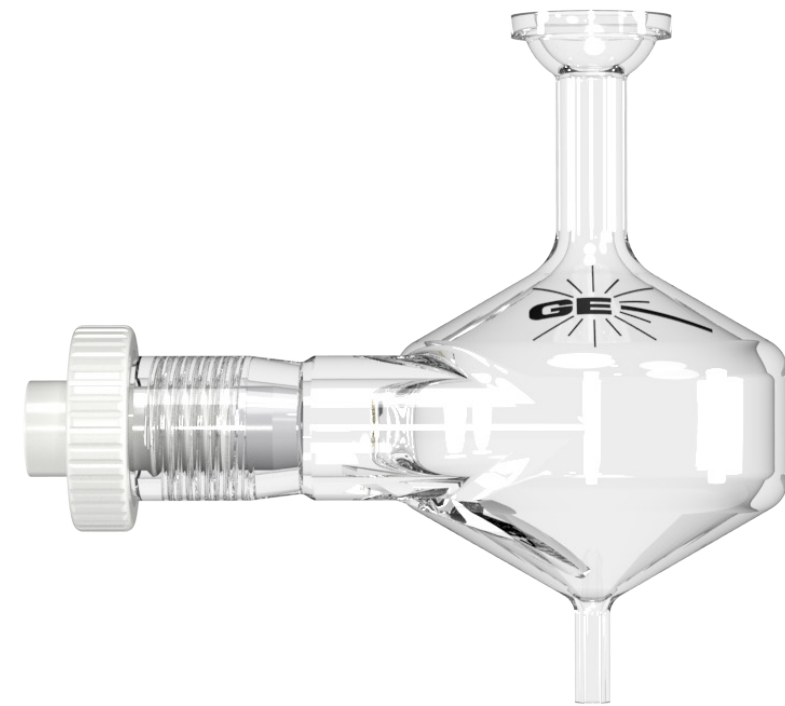
- Interchangeable UniFit™ sample lines IDs: 0.3, 0.50, 0.75 and 1.0mm - Easy to replace and maintain clean sample path.

Part Number	Description
70-803-1803	Guardian Probe Cetac ASX-200, 500, 800, 0.75mm Probe Connecting Line (Red)
70-803-1957	Guardian Probe for SPS3, SPS4, AIMS, 0.75mm Probe Connecting Line (Red)
70-803-2097	Guardian Probe for PerkinElmer S20 Series, 0.75mm Probe Connecting Line (Red)
70-803-2851	Guardian Probe for PerkinElmer S10, 0.75mm Probe Connecting Line (Red)
70-803-2836	Guardian Probe for PerkinElmer AS93, 0.75mm Probe Connecting Line (Red)
70-803-2872	Guardian Probe for Shimadzu AS-10 & AS-20 with Arm Assembly, 0.75mm Probe Connecting Line (Red)
70-803-2940	Guardian Probe for Cetac ASX-7400, 7600, 0.75mm Probe Connecting Line (Red)
70-803-2106	Guardian Probe for Thermo ISC-65, 0.75mm Probe Connecting Line (Red)

# NEW Tracey™ BC Spray Chamber

## Features & Benefits:

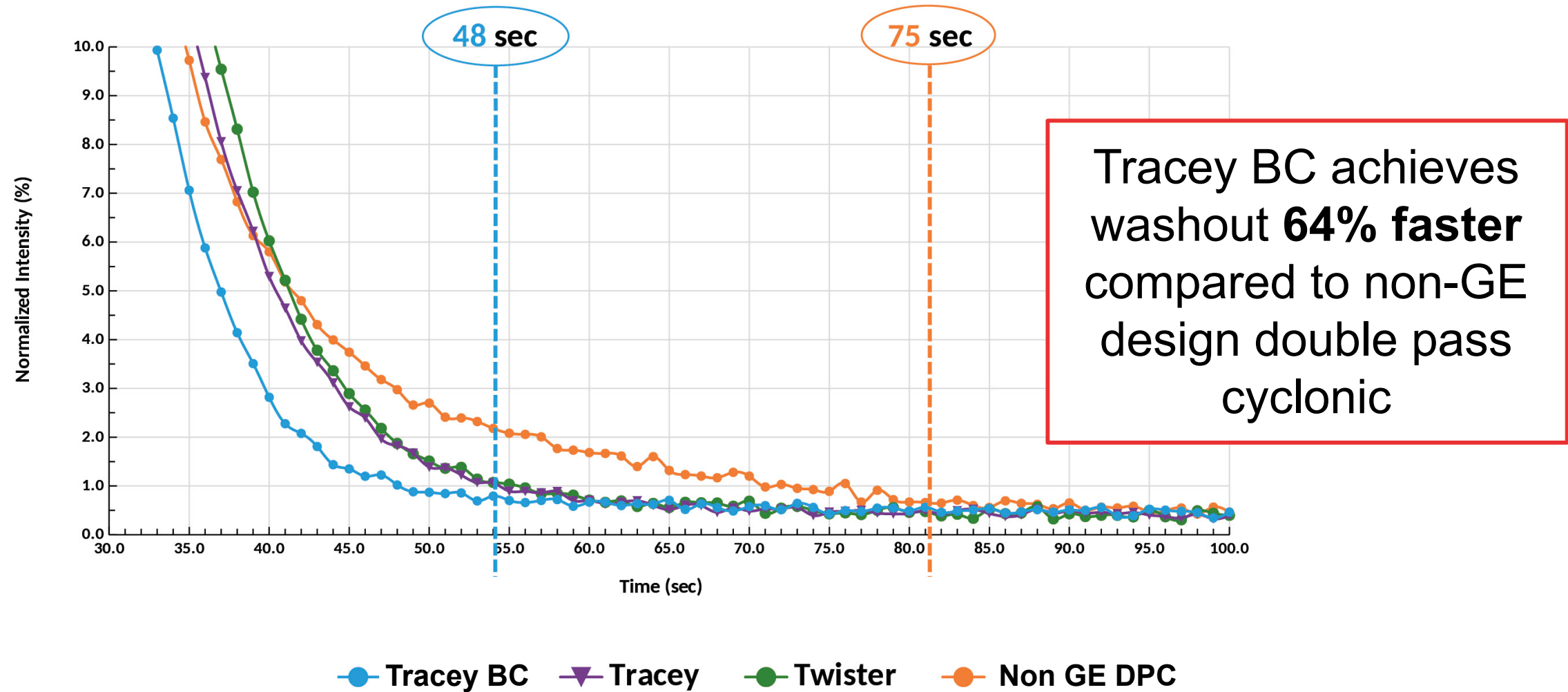
1. **Helix CT:** Reduces washout times and eliminates frequent replacements due to wear.
2. **Excellent Precision:** Short-term noise on average 0.5% or better providing excellent repeatability and stability.
3. **Cost-Effective:** More affordable than traditional glass spray chambers.
4. **Efficient Washout:** 30mL low-volume cyclonic chamber.
5. **Wide Compatibility:** Fits most common ICP-OES models.



Tracey™ BC Spray Chamber

# Tracey™ BC Spray Chambers - Improve Washout

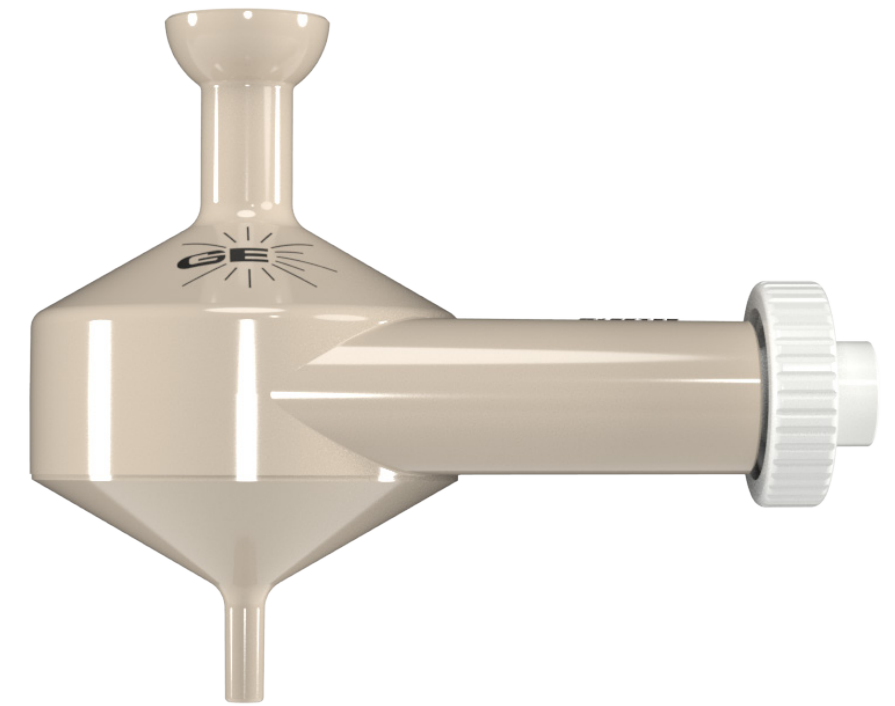
Washout Profiles for 1 ppm Hg:



# NEW Tracey™ BC PEEK Spray Chamber

## Features & Benefits:

- **HF Resistance:** With resistance up to 5%
- **Superior Wetting:** PEEK material maintains excellent wetting properties with routine laboratory cleaning.
- **Compact Design:** Lightweight and compact, eliminating the need for additional spray chamber brackets.
- **No Internal Surface Treatment:** Unlike TFE or PFA, this spray chamber requires no internal surface treatment while maintaining excellent precision.

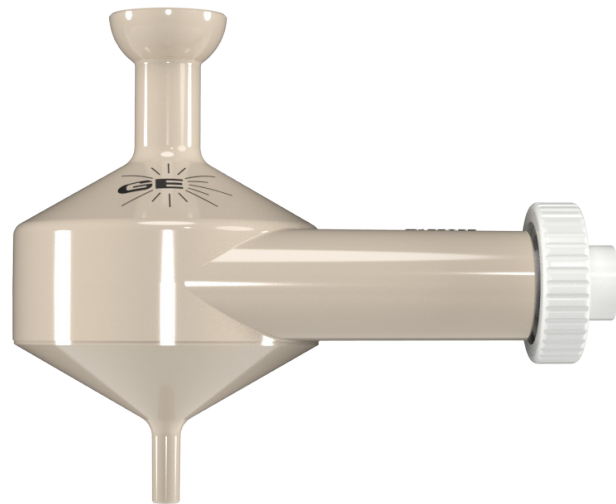


Tracey™ BC PEEK  
Spray Chamber

# Comparison of Tracey BC PEEK to the PTFE Tracey

Below are the average intensity and RSD results from 41 optimization checks using the PEEK and PTFE spray chambers.

- The Optimization Solution contains 2 ppm Pb, As, and Mn in 1% HNO<sub>3</sub>.
- \*Comparison conducted by Specialty Chemicals Manufacturer – USA



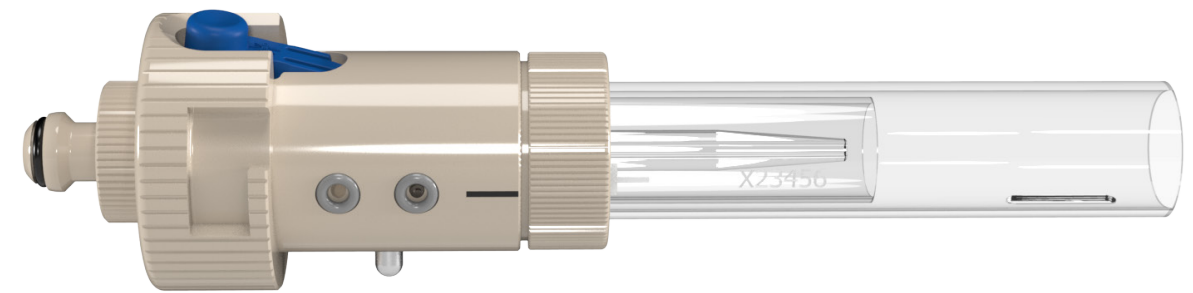
	% Increase in intensity	%RSD
Pb	74%	0.65
As	90%	0.69
Mn	68%	0.68



# NEW E-Torch™ for ICP-OES

## Benefits

- Made from PEEK, PTFE & Quartz
- Interchangeable injectors (Quartz, Ceramic, Sapphire)
- Compatible with any ball joint spray chamber
- Performance equivalent to the D-Torch
- Ceramic tube set available on request for HF and high TDS applications
- **User-friendly tube set and injector assembly simplifies deposit removal during maintenance and allows oven cleaning of carbon deposits.**



**NEW!** P/N 30-808-4388  
E-Torch for Thermo® PRO Duo



**NEW!** P/N 30-808-4466  
E-Torch Agilent 5000 Series SVDV, VDV

# Aggressive Sample Matrices: Torch Selection

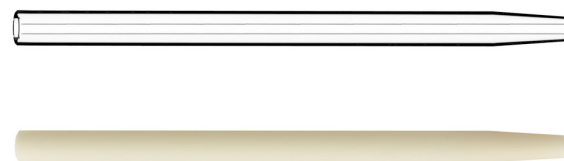
**Examples:** Soils, wastewater, brines, high-acid digests, organics, lithium fusions

## Challenges:

- High salt deposits and plasma temperatures shorten quartz torch life
- Frequent torch replacement increases cost of ownership
- O-ring failures or gas leaks can destabilize plasma or prevent ignition

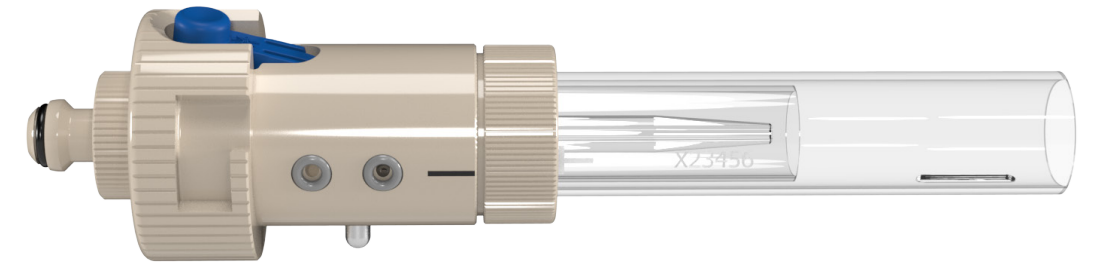
## Mitigation:

- Use a Demountable Torch → replace only the outer tube, lowering cost of ownership
  - *Narrow bore quartz: 1.0mm or less: volatile organics*
  - *Large bore quartz: 2.0mm or greater: High TDS*
  - *Ceramic (alumina): HF-containing samples*
  - *Platinum/Sapphire Injectors: Inert applications*
- Ferrule-based design: Secure injector seating, fewer leak points



**Upgrade:** Optional ceramic outer tube → resists devitrification, lasts longer, and maintains plasma stability

**Benefits:** Ideal for high-TDS, salty, or organic samples; hotter, more robust plasma improves sensitivity



**NEW!** E-Torch for Thermo® PRO Duo  
P/N 30-808-4388

Comparison of Quartz tube set to Ceramic Outer tube set		
Element	% Increase in Sensitivity	%RSD
Zn (213) λ	17%	0.36
Ni (231) λ	19%	0.57
Mn (257) λ	14%	0.52



**NEW!** Ceramic Outer Tube Set  
P/N 31-808-4502

# Comparative Torch Ownership Costs

**NEW!** Agilent® 5000 Series E-Torch

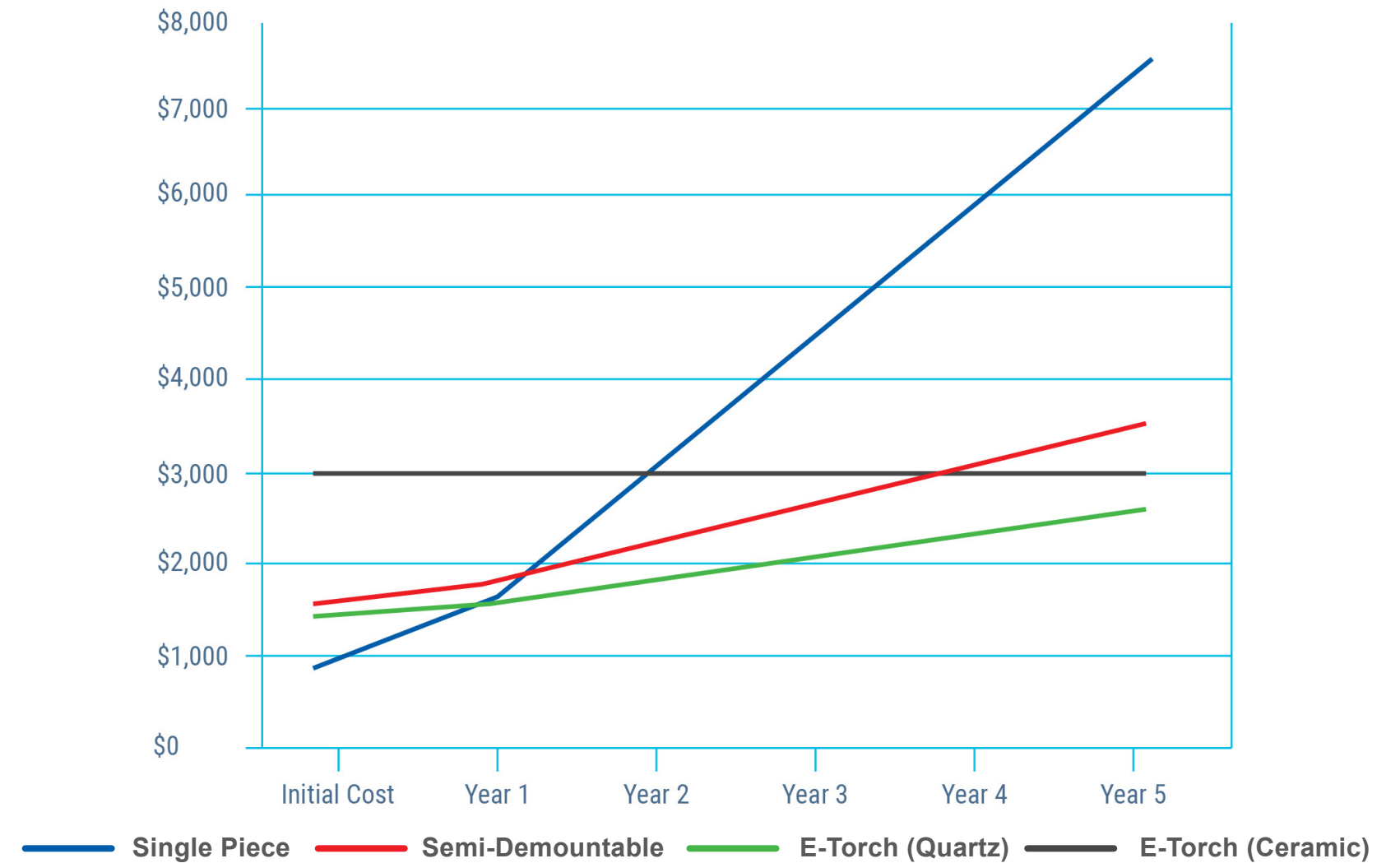


**Quartz  
tube set**



**Ceramic  
tube set**

**Comparative torch ownership costs versus the E-Torch**



# Summary

## 1. Improve Data Quality:

- Select appropriate nebulizer, spray chamber, torch/injector, and cones
- Tailor components to sample type for accuracy, precision & sensitivity

## 2. Maximize Sample Throughput:

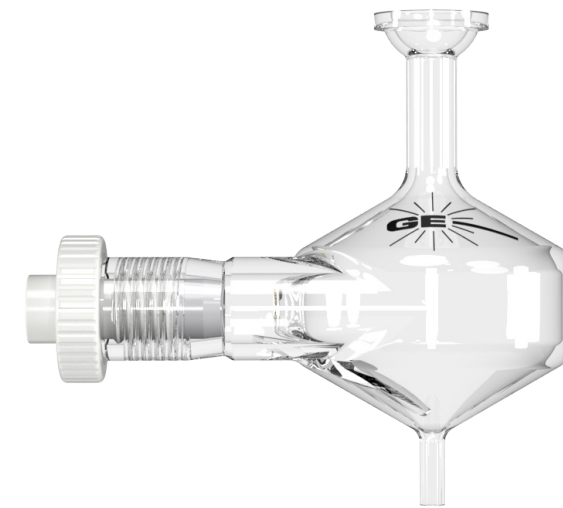
- Address carry-over and washout issues to improve efficiency

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- Use tools like Elegra, Eluo, Guardian In-Line Filter, and
- Guardian Autosampler Probe improve stability

## 4. Ensure Longevity & Consistency

- Implement proper care and cleaning routines
- Reduce downtime through preventive maintenance



# Want a **FREE** review of your Sample Introduction System?

- ✓ Optimize your sample introduction system components.
- ✓ Identify other performance enhancing accessories available for your ICP.
- ✓ Discuss any sample introduction challenges.
- ✓ Explore ways to reduce operating costs.
- ✓ Obtain quotes.

Contact by email: [geusa@geicp.com](mailto:geusa@geicp.com)



# Thank You

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**GLASS EXPANSION**

Quality By Design

[www.geicp.com](http://www.geicp.com)