GLASS EXPANSION
Quality By Design

Dedicated, High-Performance Sample Introduction System (HP-SIS) for Used Oils and Volatile Organics

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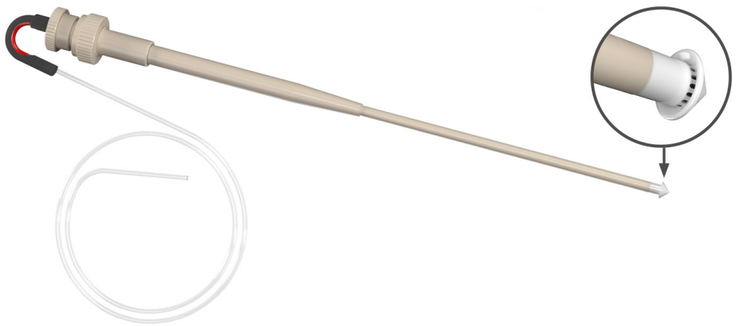
ICP Technical Specialist,
Glass Expansion, Inc.

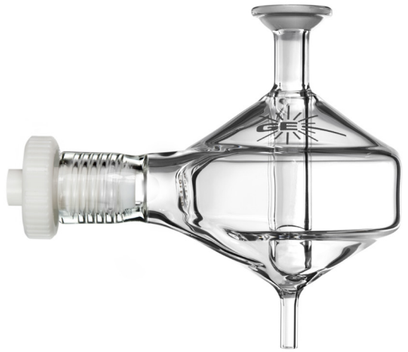
World leaders in sample introduction systems for ICP-OES and ICP-MS for over 40 years

Helpful ICP Accessories for Used Oil & Volatile Organics



Guardian™
Autosampler Probe

Slurry™ DC Nebulizer



Twister™ Spray Chamber

D-Torch™ and
Ceramic Outer Tube

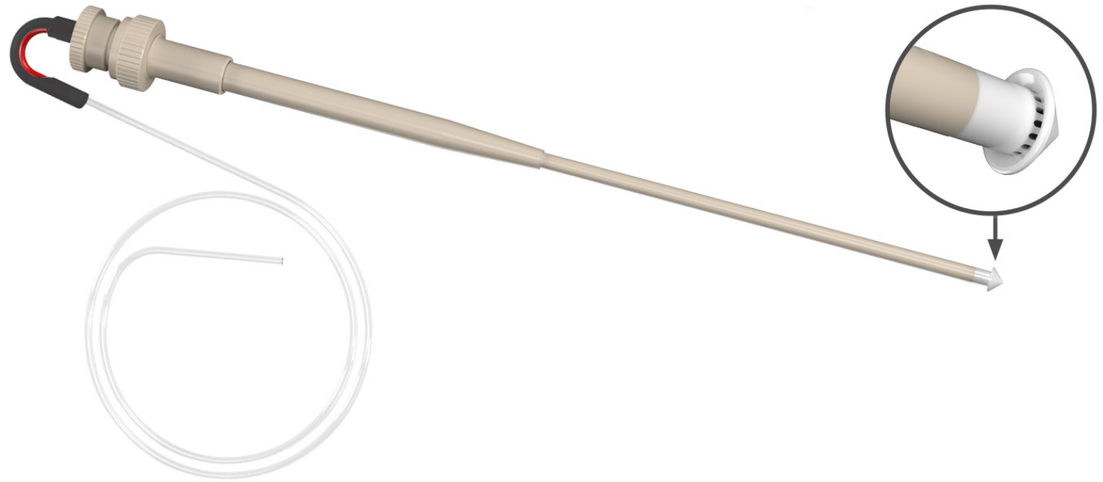
IsoMist™ XR Temperature Controlled
Spray Chamber

Eluo™ Nebulizer Cleaning
Tool

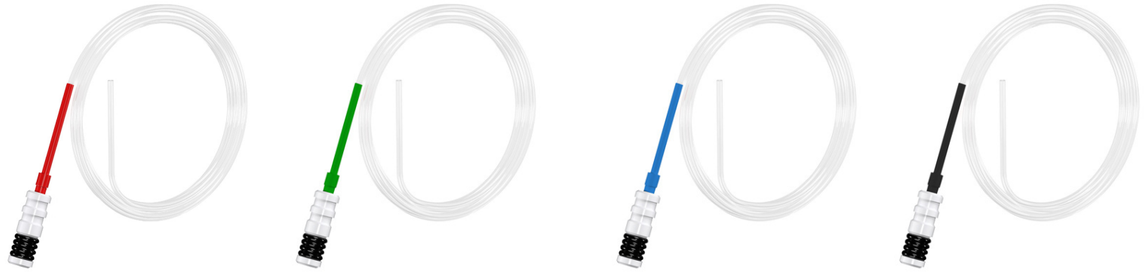
Guardian™ Autosampler Probe

Key Features:

- **Robust tip design** prevents crushed or damaged tips from misalignment
- **Drip-resistant** to minimize cross-contamination, especially with oils
- **Built-in particle filter** prevents blockages in your nebulizer and capillary tubing.
- **Chemically inert construction** made from **Ceramic, PEEK, and PTFE** for strong acid/solvent resistance
- **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

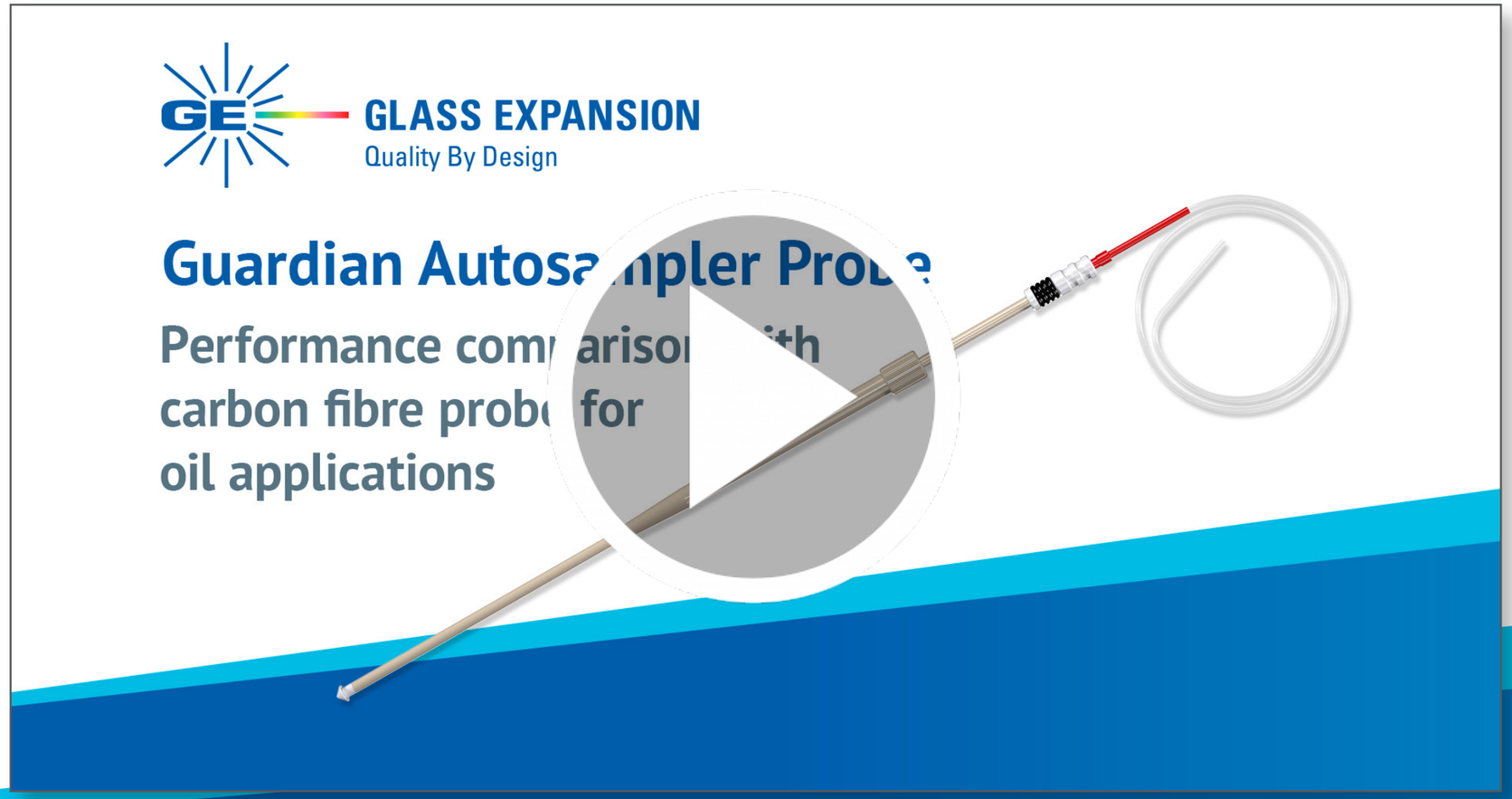


Guardian™ Autosampler Probe
Suited for Aim Lab and Agilent SPS4 Series Autosamplers



Guardian™ Probe Performance Comparison Video

Below is a performance comparison of the Guardian Autosampler Probe against a regular carbon fibre probe for oil applications.



Guardian™ Autosampler Probe

Customer Testimonials:

- *Overall, the guardian probe has been the perfect selection for our applications using ICP-OES. We normally run an organic matrix (1:9 dilutions of semi-refined corn oil samples in kerosene), and the Agilent brand probe we were using previously had excessive issues with dripping between samples in their SPS4 autosampler system.* ***The guardian probe has not had any dripping*** *or leaking issues since its installation, and we are still using the same one we ordered in August. Not only has the probe exceeded performance expectations; it is marginally cheaper than the lesser-performing competition.* ***The time we would spend re-analyzing samples and calibration curves due to dripping has been reclaimed, thanks to the probe.*** *I hope my insight may prove helpful to your team, and thank you once again for providing solutions for the troubles of trace analysis!*
  Contract laboratory - USA

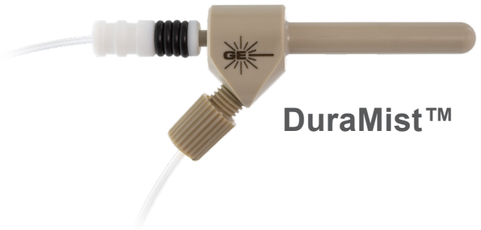
- *We have been utilizing the Guardian Probe in our operations for more than six months, and it is with pleasure that we report its remarkable performance.* ***The probe has demonstrated robustness and reliability in handling various sample types.*** *Notably, we have found that it remains unclogged, even during the analysis of samples containing particulates, which we typically allow to settle before initiating the analytical process. To further safeguard the integrity of our nebulizers, we have adopted the use of the Guardian In-Line Particle Filters, effectively preventing any obstruction to the nebulizer.* ***As a result of this precaution, it seems we have fewer nebulizer failures*** *compared to previous experiences.*
  Contract laboratory - Australia

Eluo™

Extend nebulizer performance and lifetime with proper maintenance

Conikal™
SeaSpray™
MicroMist™
Slurry™

P/N 70-ELUO



DuraMist™

P/N 70-ELUO-OPD

OpalMist™

Slurry™ DC Nebulizer - Ideal for Used Oil Analysis

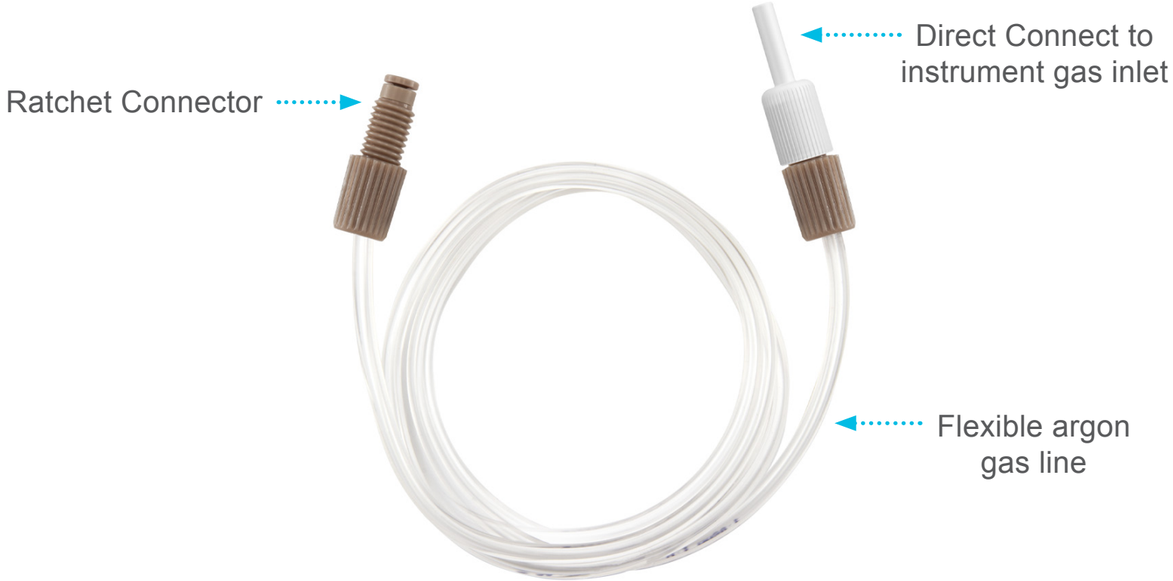
The Slurry nebulizer excels at exactly what it sounds like, the analysis of slurries. It is the ideal choice for **analysis of used engine oils for wear metals.**

- **High tolerance to particulates, typically up to 150 µm**
- Material: Borosilicate glass
- High physical reproducibility ~ 1%.
- TDS tolerance, typically ~ 1%.
- Slurry nebulizers have a natural liquid uptake of 4.0 mL/min but operate best between 1.5 - 2.5 mL/min
- Designed for 40psi

DC Nebulizer - Benefits

Thermo Fisher Scientific ® PRO ICP-OES

- Inert, metal-free argon connector
- Ratchet fitting ensures leak-free gas connection
- Direct plug-in gas line connection to instrument



The Global Standard in Nebulizer Innovation

No other manufacturer can match the precision and reproducibility of the **'VitriCone' construction**, making it the **most robust and dimensionally reproducible concentric nebulizer available.**

Manufacturing Tolerance

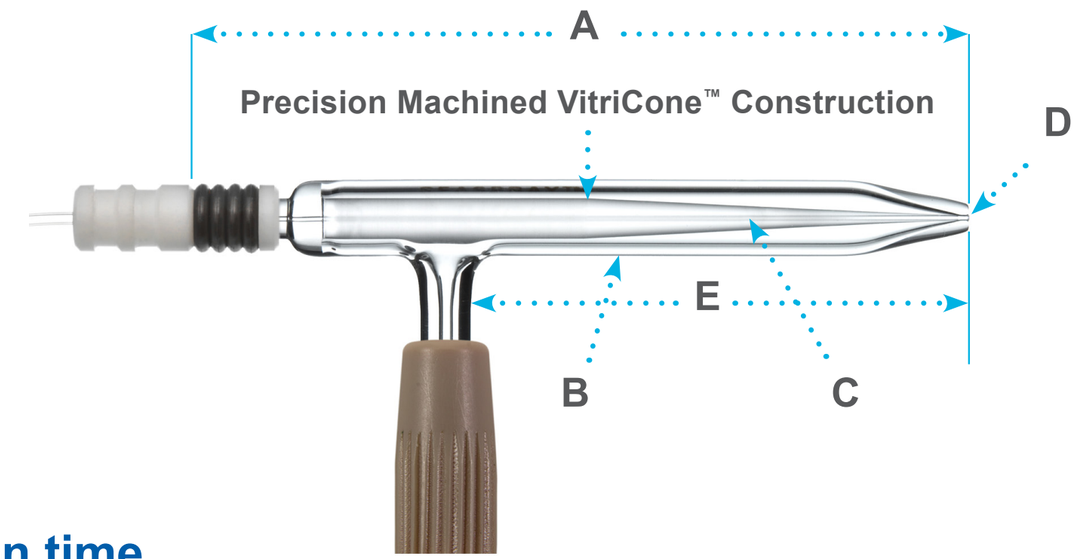
A. Controlled overall length precision **+/- 0.2 mm**

B. Shell Diameter **+/- 0.05 mm**

C. Full length precision bore capillary **+/- 0.004 mm**

D. Precision formed jet nozzle **+/- 0.005 mm**

E. Insertion positioning stop **+/- 0.2 mm**



✓ **Reproducible production eliminates optimization time.**

✓ **Consistent capillary bore reduces clogging by a factor of two.**

Common Nebulizer Models for Used Oil Analysis

Nebulizer Model	Cost
Slurry™	
V-Groove (Glass)	
Enhanced V-Groove (Glass)	
Enhanced V-Groove (ULTEM)	
Enhanced V-Groove (PEEK)	

Slurry™ 36% More Cost Effective than the average cost while still providing the best overall analytical performance

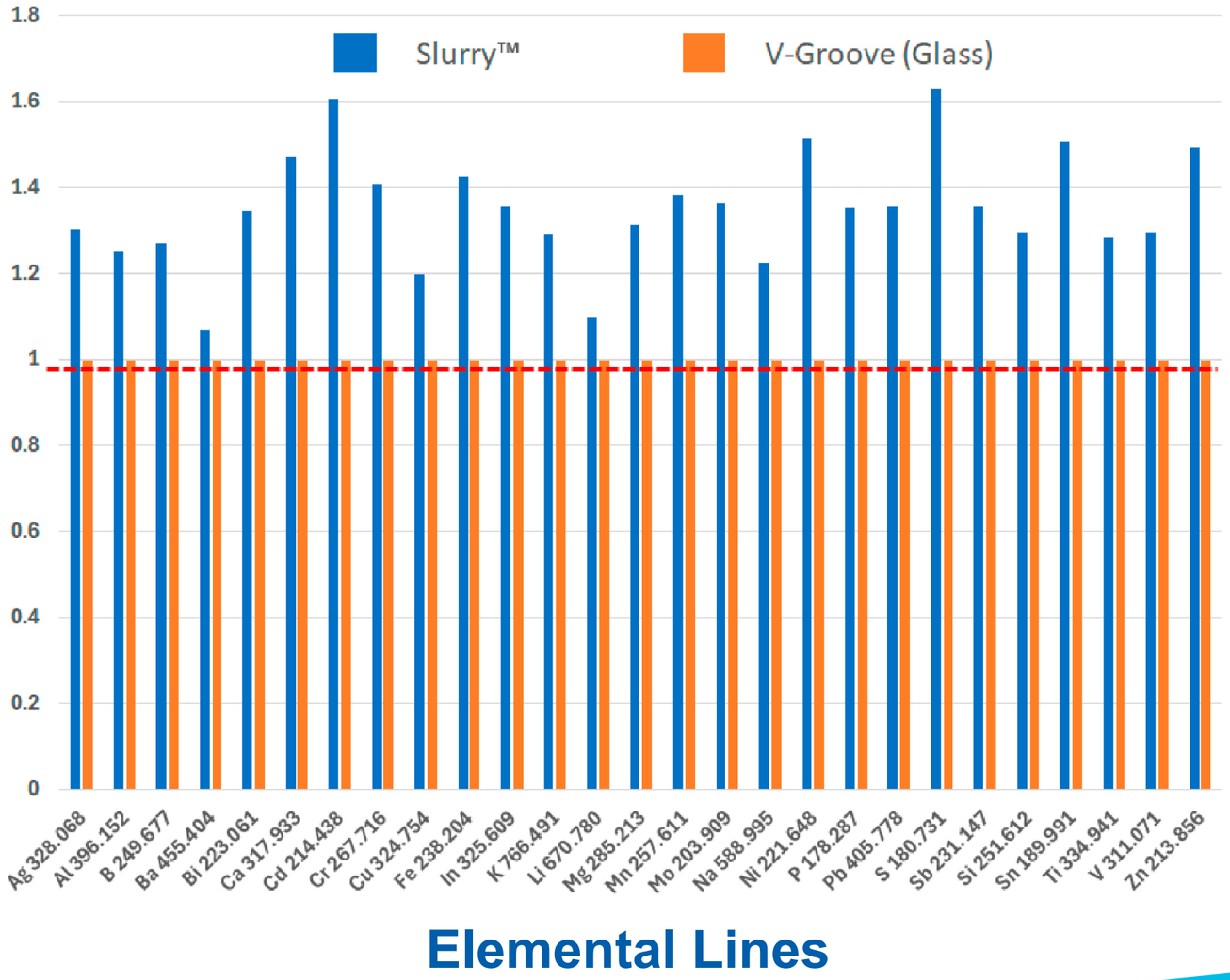
A Comparison of Nebulizers Using New Organic Solvent

- Inorganic Ventures compared the analytical performance of the Slurry™ and V-Groove nebulizer using their new bio-based organic solvent (IV-77742).
- Twister™ spray chamber was used with both nebulizers.
- Used a 5 ug/g (ppm) calibration standard to compare sensitivity and precision.
- Final sample matrix was 1:10 w/w dilution with 10% Organometallic hydrocarbon oil standard (90% IV-77742).
- Analysis was performed with Spectro ARCOS III ICP-OES in Radial (SOP) mode.

Slurry™

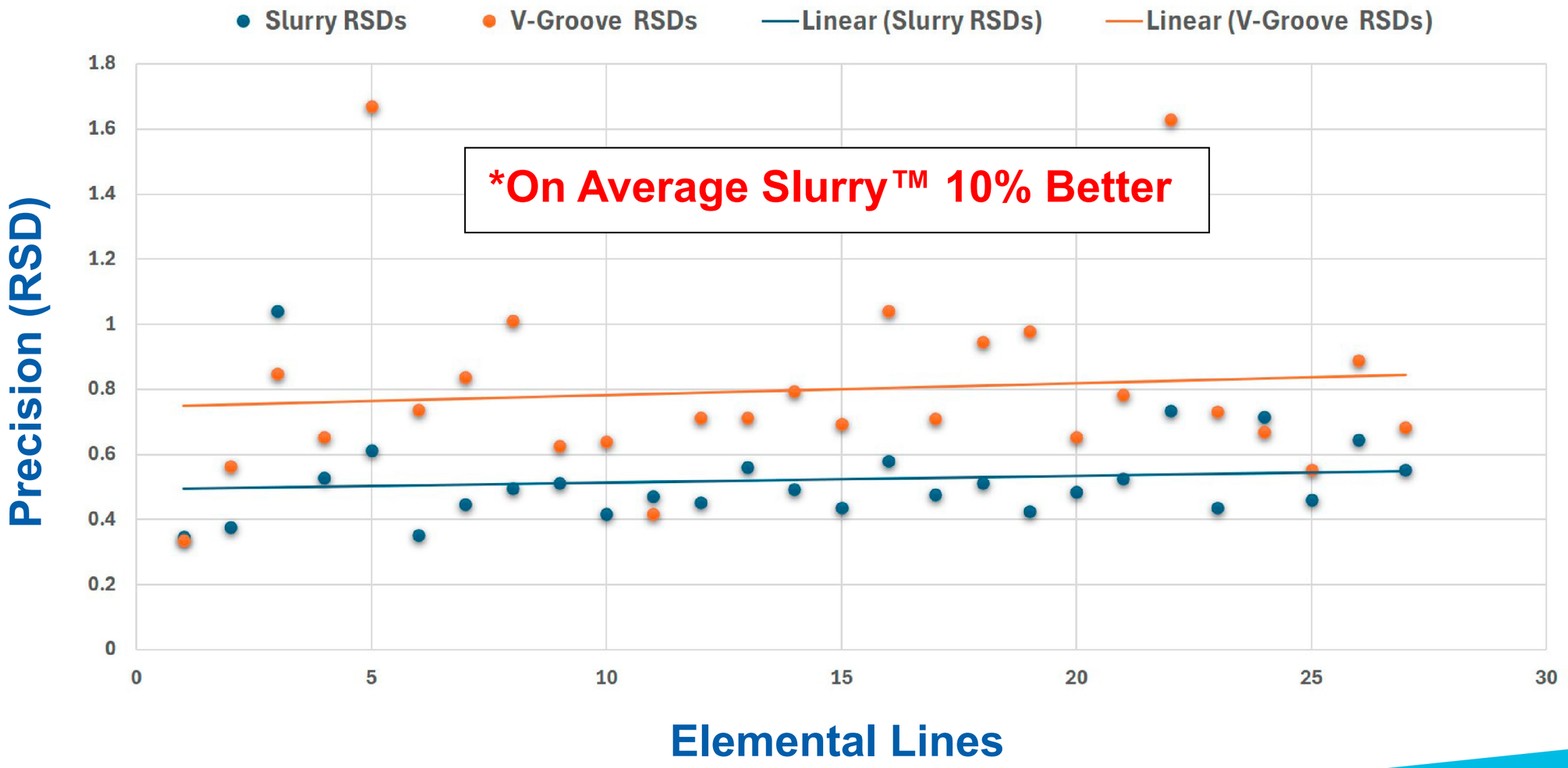
V-Groove Glass

Nebulizer Intensity Comparison



***On Average Slurry™ 35% Better**

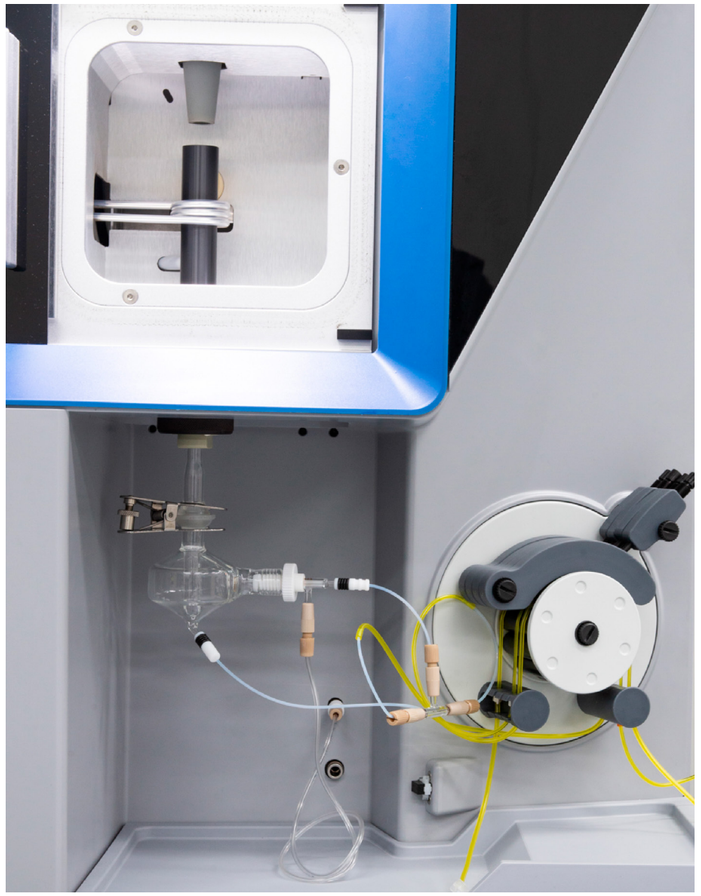
Nebulizer Precision Comparison



A High Performance Sample Introduction System (HP-SIS)

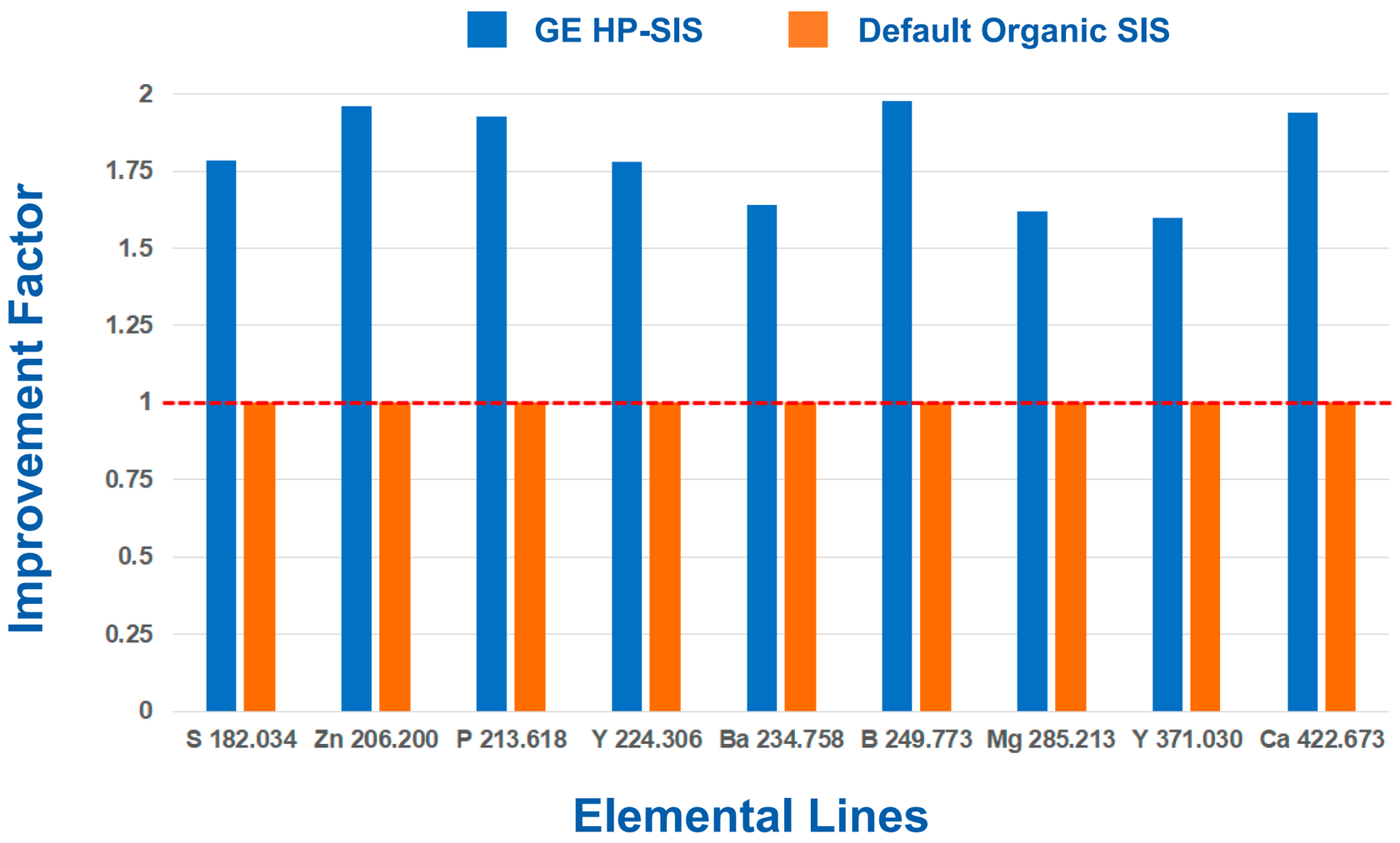
- Guardian™ probe, Slurry™ nebulizer, Twister™ spray chamber, and fully ceramic D-Torch™ compared to the default Organic SIS.
- Used a multi-element calibration standard to compare intensity.
- Final sample matrix was 1:10 w/w dilution with odorless kerosene.
- Analysis was performed with Thermo PRO XP Radial.

Default Organic SIS



HP-SIS for Thermo Fisher Scientific ® PRO ICP-OES

Intensity Comparison



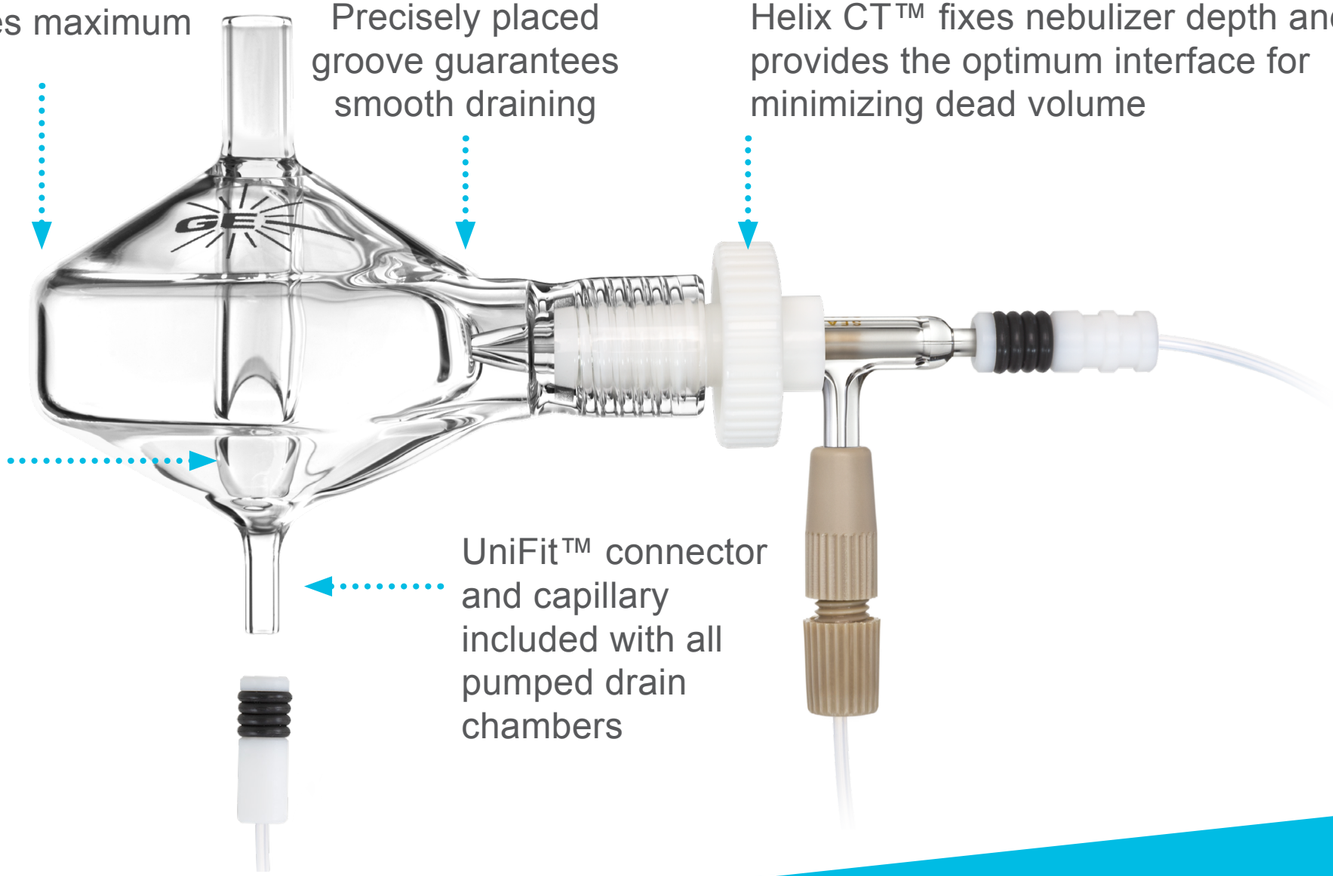
Average 80% increase in sensitivity across all analytes with GE HP-SIS

Spray Chambers

Vertical wall ensures maximum transport efficiency

Precisely placed groove guarantees smooth draining

Helix CT™ fixes nebulizer depth and provides the optimum interface for minimizing dead volume

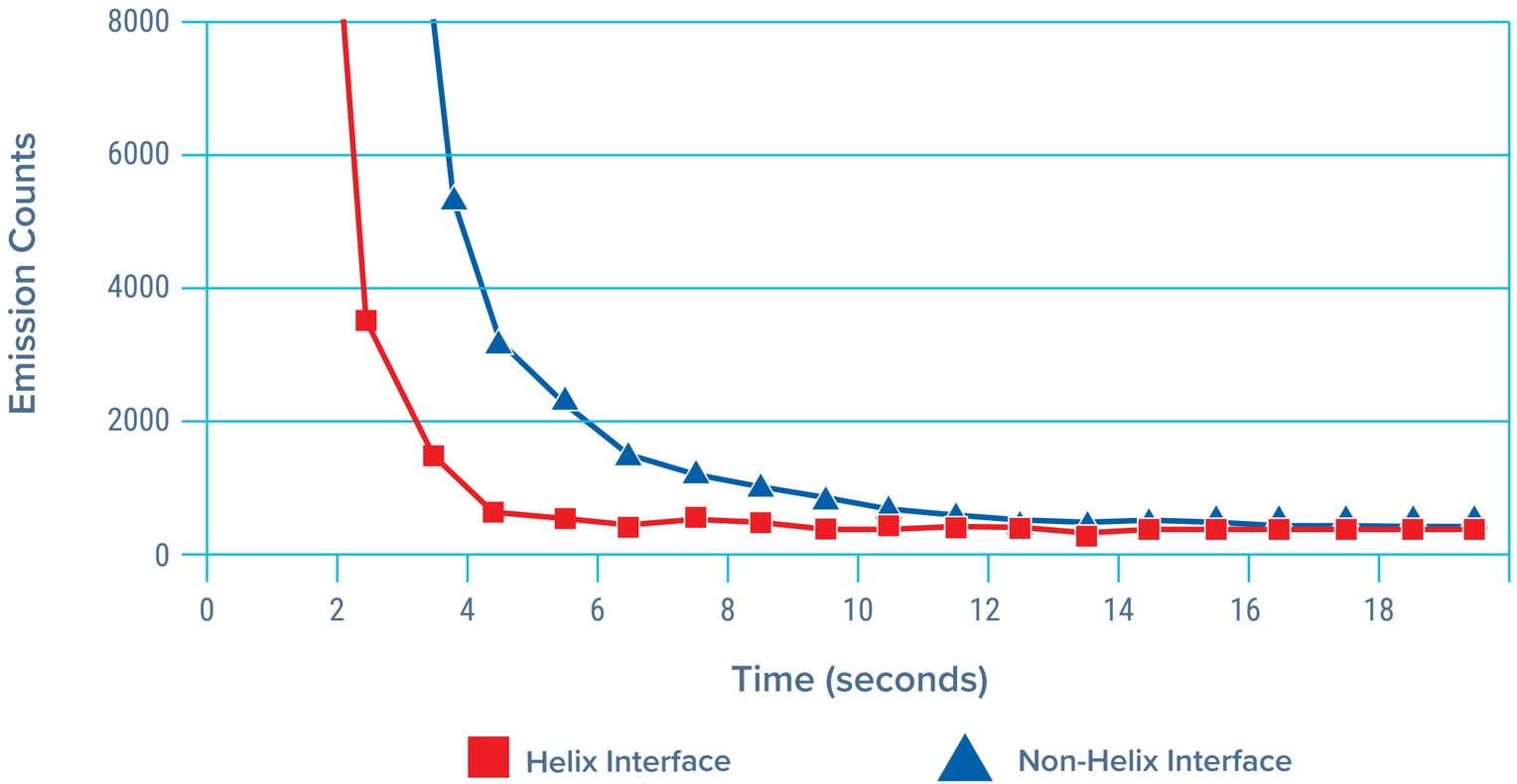


Baffle cut at angle and fused to bottom prevents droplet formation

UniFit™ connector and capillary included with all pumped drain chambers

Helix CT™ - Washout Comparison

✓ Faster washout = Higher throughput in high-volume used oil labs

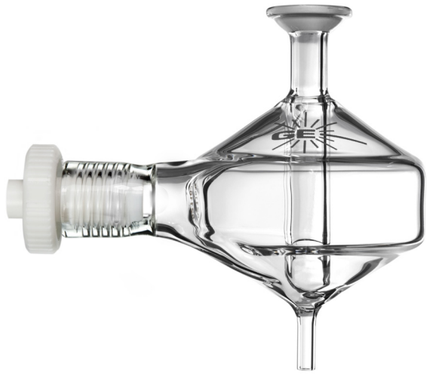


Non-Helix Interface

Twister™ vs Tracey™

✓ **Twister more suitable for high matrix samples, improved short-term precision, and solvents**

Metric	Twister™ Benefit	Why for Used Oils?
Signal to Noise Ratio (SNR)	Improved	Better detection limits
Droplet Size	Narrower distribution	Improved plasma robustness and stability
Precision	Enhanced short-term	Fewer failures and re-runs



Twister™

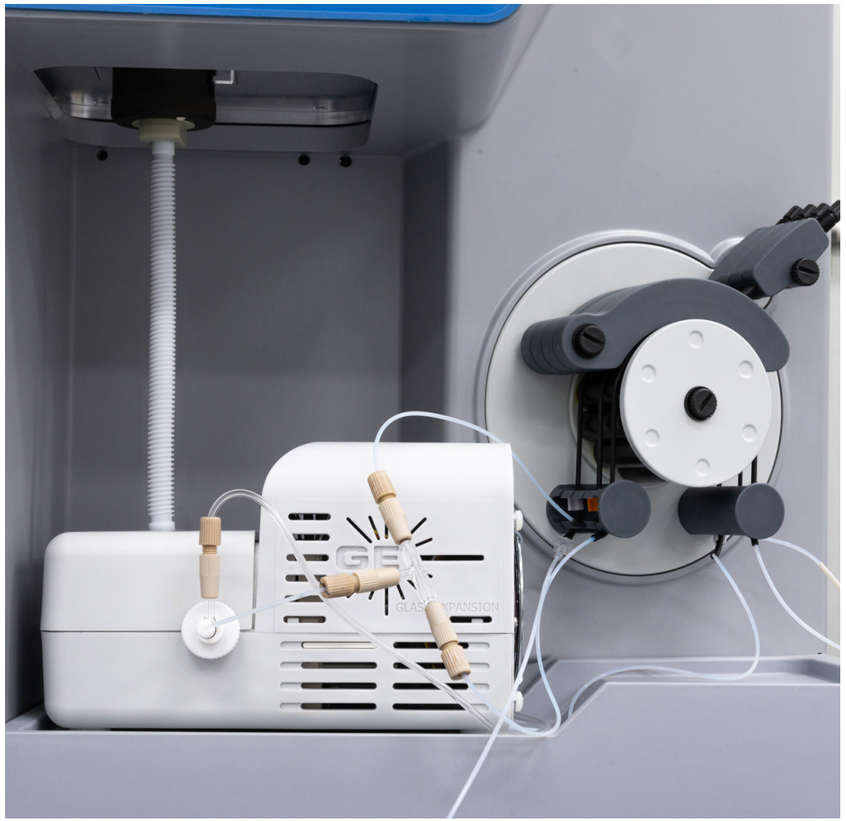
Tracey™

Spray Chambers

Limitations of Room Temperature Spray Chambers

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

IsoMist XR™

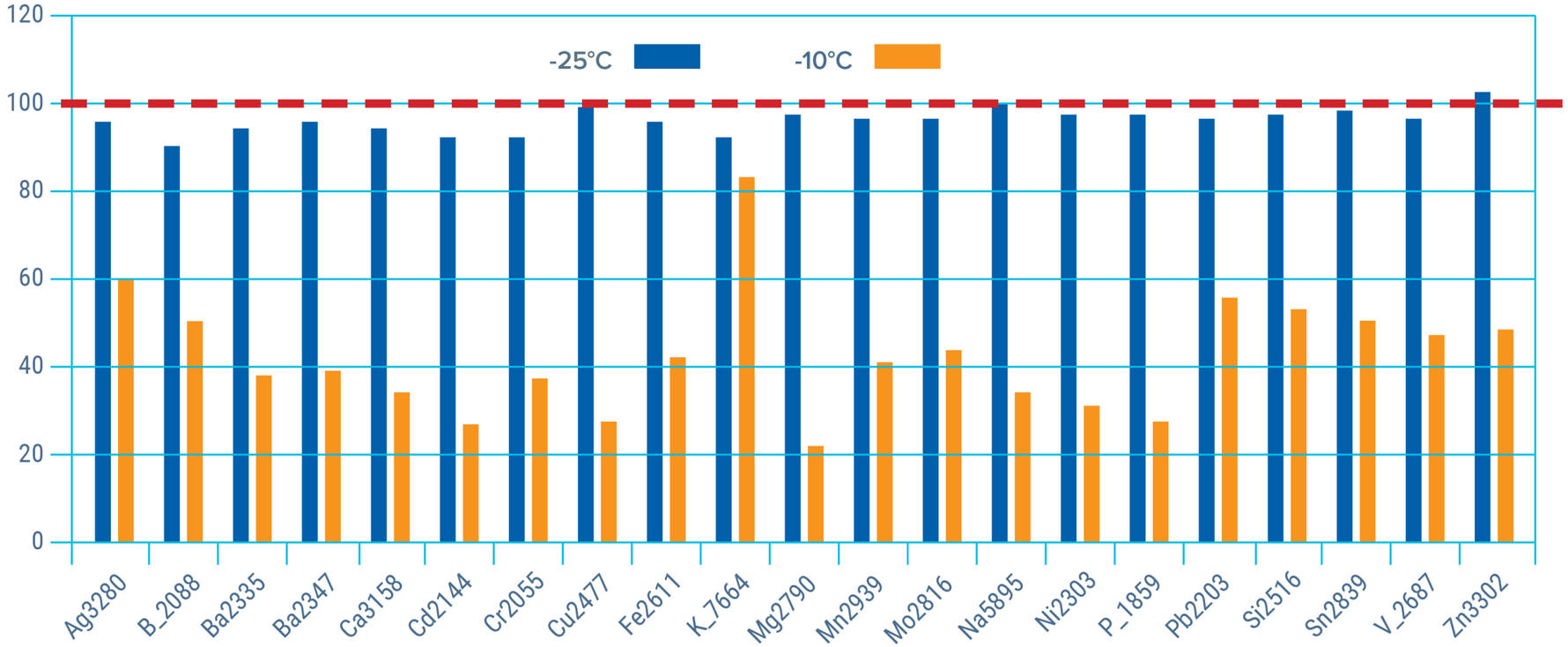


IsoMist XR for Thermo Fisher Scientific ® PRO ICP-OES

- Powerful dual-stage electronic Peltier.
- Temperature range of -25 to 80°C, in 1°C increments.
- Perfect accessory for volatile organics and fuels, such as naphtha and gasoline.
- Improve plasma stability and detection limits.
- Interchangeable glass, quartz, and PFA cyclonic spray chambers.

IsoMist XR™ and Naphtha

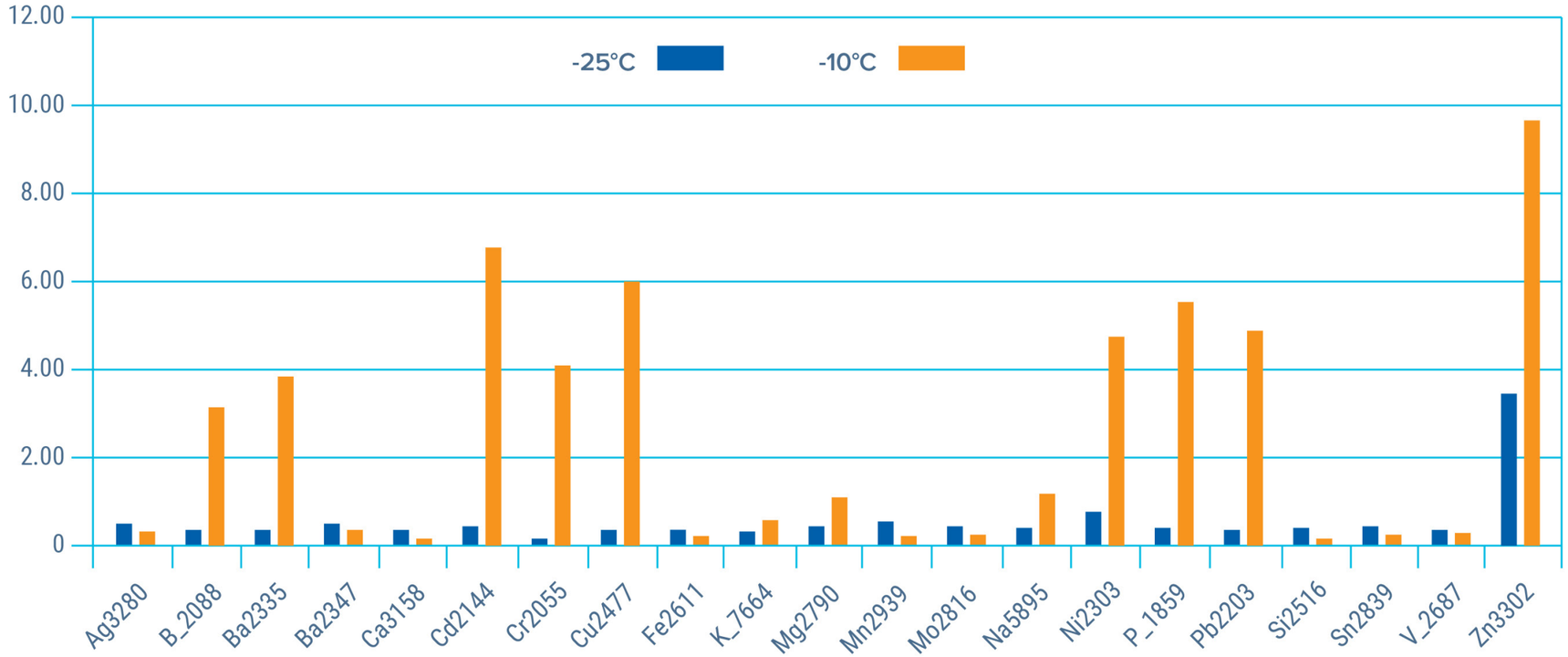
Significantly improved accuracy at -25°C



Expected Value (100 ppm)

IsoMist XR™ and Naphtha

Significantly improved precision (%RSD) at -25°C



Torches

D-Torch™

The D-Torch is a cost-effective alternative for any laboratory with a moderate workload.

- Replace just outer tube (fastest to degrade)
- Alumina intermediate tube, which resists wear and is tolerant to high temperatures, high TDS and acid attack
- Easy to switch injector from HF-resistant, to large-bore quartz (high TDS), to small-bore quartz (organics)
- **Optional ceramic outer tube which does not devitrify or suffer from premature fractures like quartz**
- Economical price as you only replace the outer tube

D-Torch Thermo Fisher Scientific ® PRO ICP-OES

D-Torch™

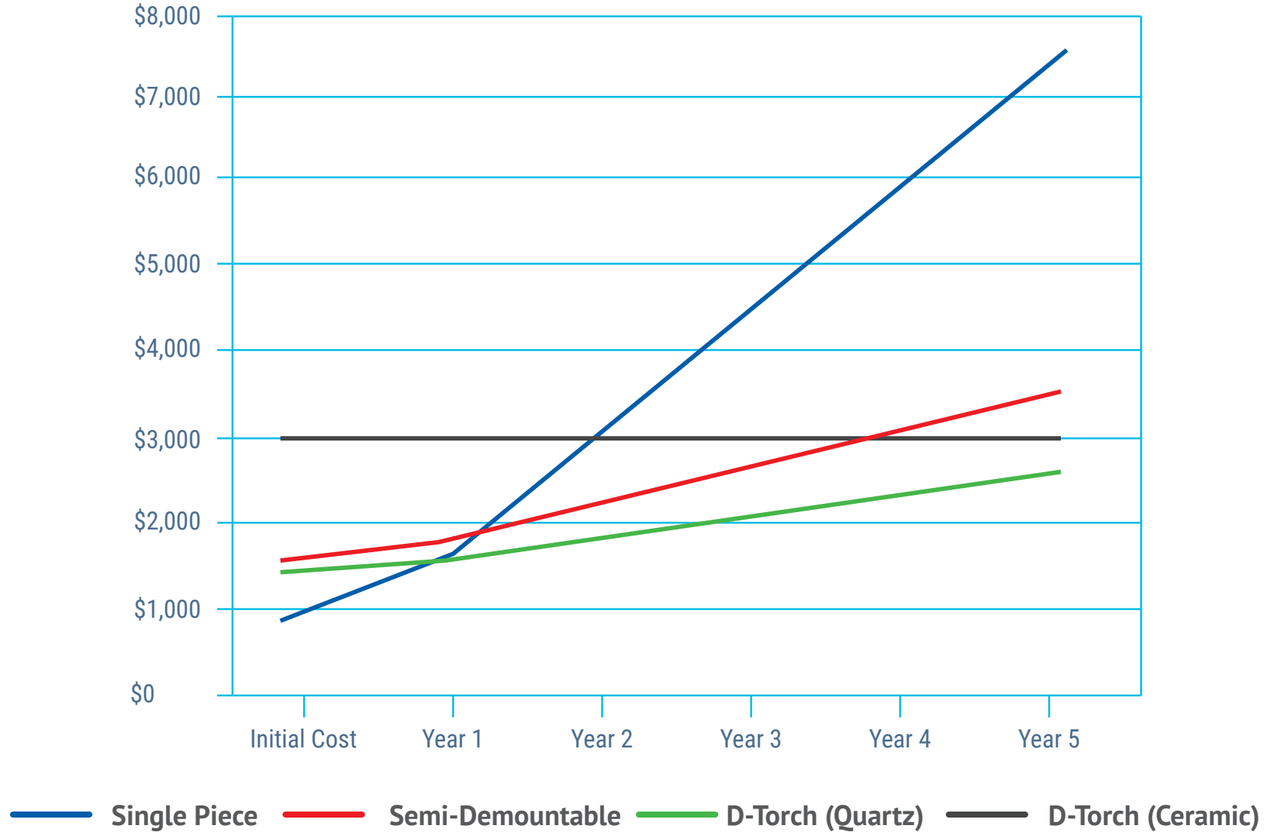
- **D-Torch™ with ceramic outer tube is ideal for:**
- Analyses at the detection limit as the hotter plasma increases sensitivity
- **Monitoring of wear metals in engine oils, as quartz outer tubes often suffer cracking and shortened lifetimes due to thermal shock**
- Analysis of fusion samples where the lithium salts rapidly attack quartz
- Measuring high TDS samples that will quickly devitrify the quartz outer tube

D-Torch Thermo Fisher Scientific ® PRO ICP-OES

Comparitive Torch Ownership Costs

Agilent ® 5000 Series D-Torch

Comparative torch ownership costs versus the D-Torch



Want a FREE review of your Sample Introduction System?

Please contact me by email (geusa@geicp.com) to:

- ✓ 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.

Thank You

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