



GLASS EXPANSION

Quality By Design

Trouble-Free ICP: Maximize Performance and Minimize Downtime



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www.geicp.com

Who are Glass Expansion?

GE has been specializing in sample introduction components—from the probe to the cones—for ICP and ICP-MS instruments since 1983:

- Many ICP and ICP-MS vendors package GE parts as part of the standard configuration
- Support all major ICP and ICP-MS instruments
- Provide sample introduction components for over 50 different ICP and ICP-MS models

Industry Standard Trademark Designs

For more than 40 years, Glass Expansion has been designing and manufacturing high quality ICP sample introduction components.



Tracey™ & Twister™
Cyclonic Spray Chambers



SeaSpray™ & MicroMist™
Nebulizers



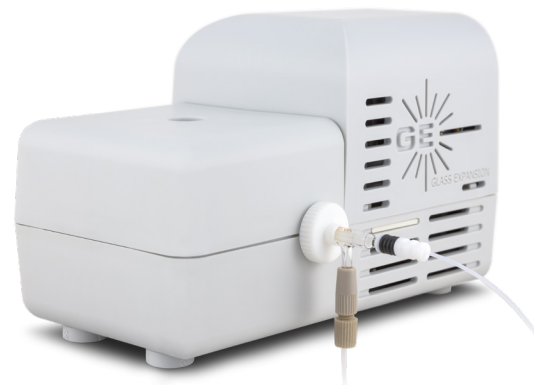
Helix™ CT Interface



Guardian™ Inline
Particle Filter



D-Torch™



IsoMist™ XR



TruFlo™

Manufacturers Supported

- Agilent®
- Analytik Jena
- GBC Scientific
- Hitachi
- Horiba
- Nu Instruments
- PerkinElmer®
- Shimadzu®
- SPECTRO (Ametek)
- Standard BioTools™ (Fluidigm)
- Teledyne CETAC
- Teledyne Leeman
- Thermo™



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Products Offered

- Autosampler Probes
- Pump Tubing
- Nebulizers
- Spray Chambers
- Torches
- Cones
- RF Coils
- Fittings, Connectors, & Adaptors
- Performance Enhancing Accessories



Helpful ICP Resources

Glass Expansion ICP Resources

As a world leader in research, design and manufacturing of high quality ICP sample introduction components, Glass Expansion places the same value on customer support, with www.geicp.com offering you a wealth of resources.



Webinars, covering tips & tricks, product selection & product highlights.



Library of Application Notes & Newsletter Application Spotlights.



Instructional videos to aid in product assembly.

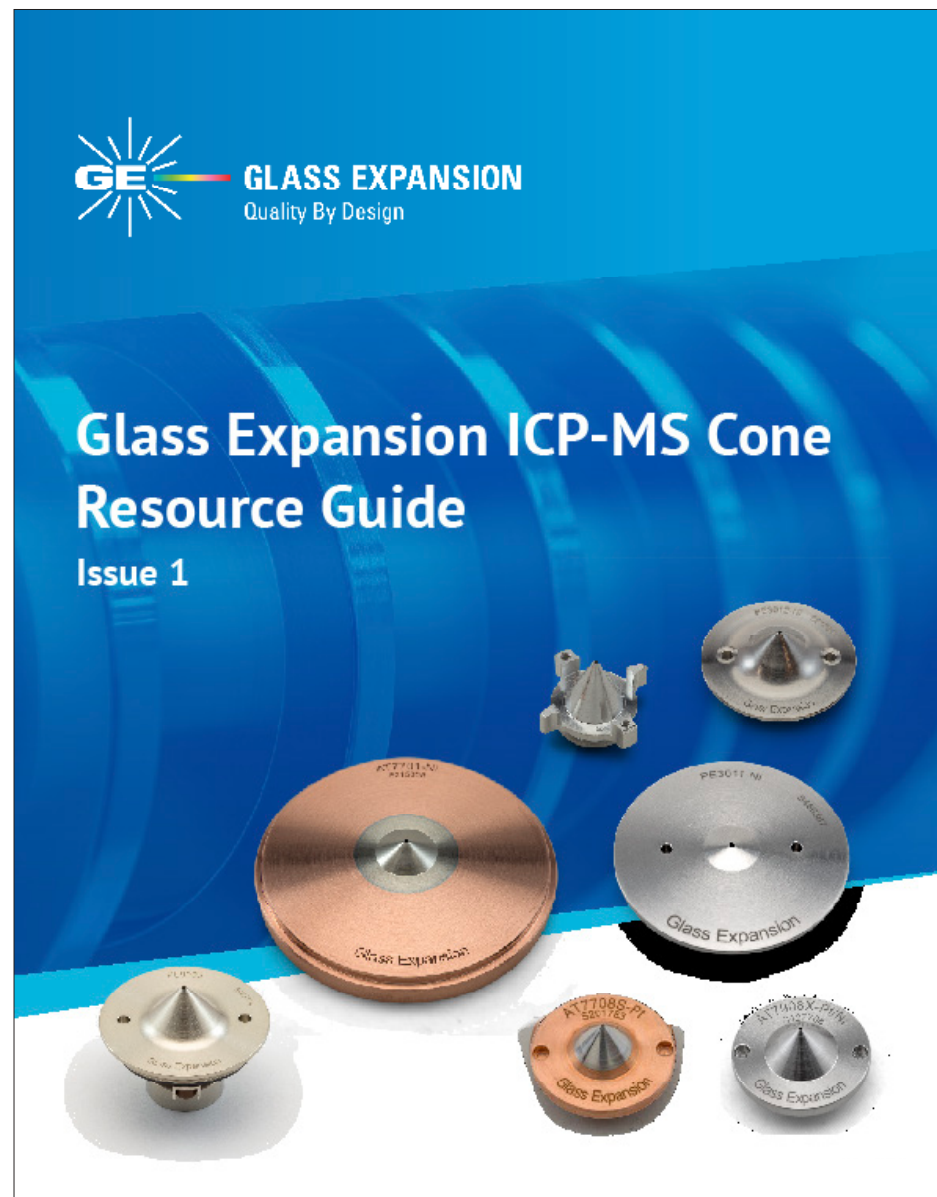


Full-color Catalogue organized by ICP-OES and ICP-MS models.

Click on the buttons above to take you to our ICP resources.

- Webinars
- Application and Technical Notes
- Product Assembly Guides
- Full Color Catalog Organized by ICP Model

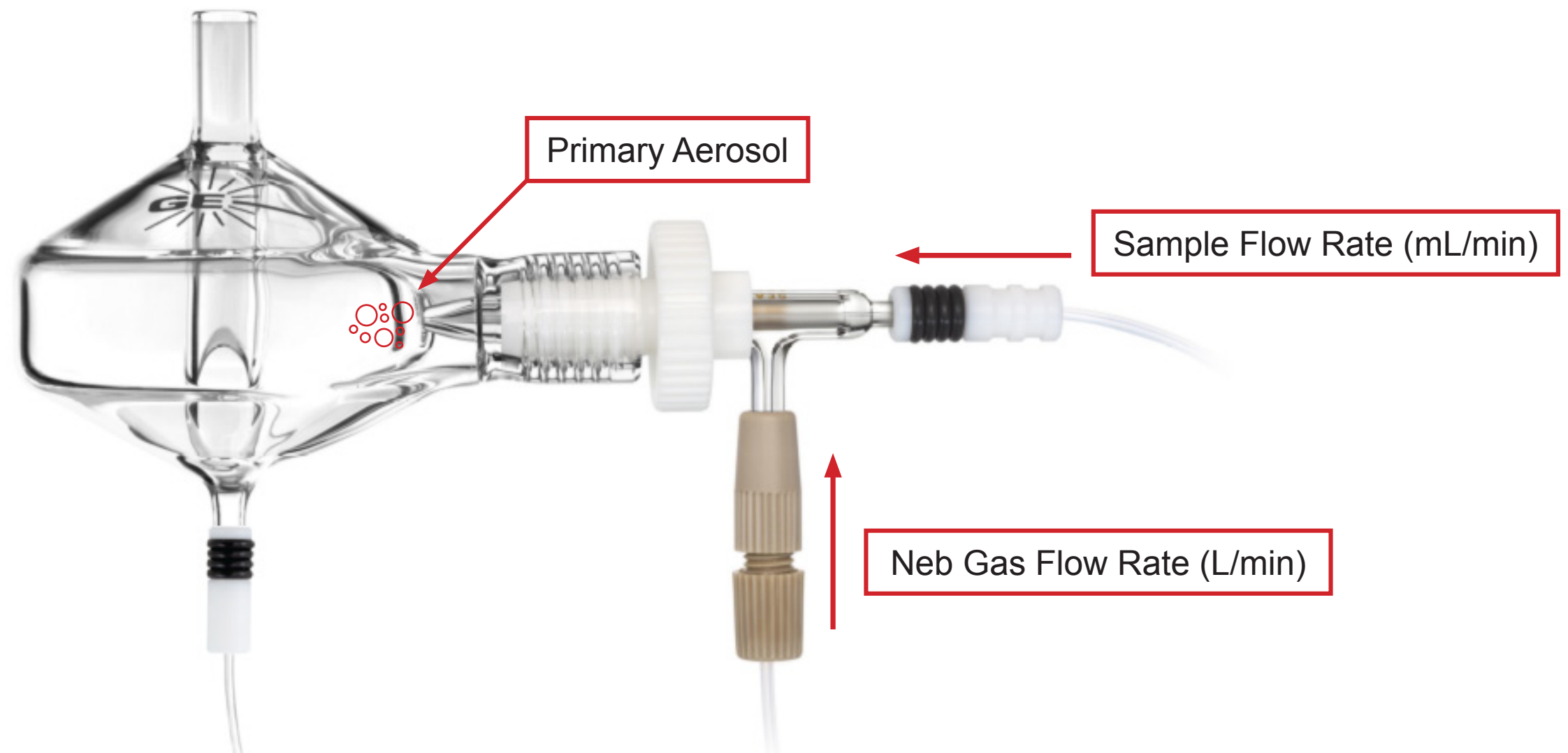
Cone Resource Guide



- **Guidance on cone selection**
 - Advantages of different cone raw materials
 - Selection based on matrix and performance
- **Tips on Care and Maintenance**
- **Organized by ICP-MS Model**
 - Cross-reference OEM product numbers

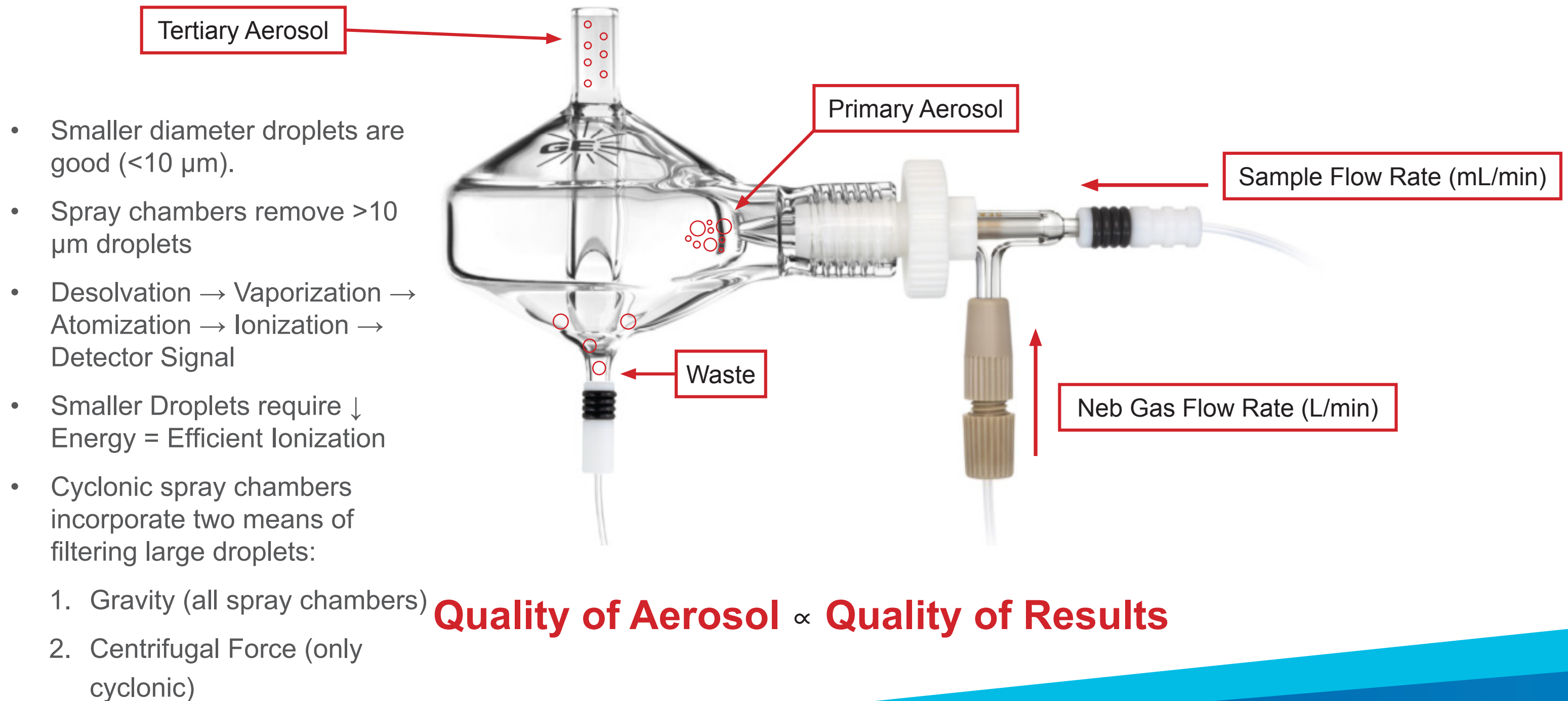
Basics of Aerosol Generation

- Primary aerosol generated by nebulizer.
- Droplet size decreases as the argon gas velocity increases and sample liquid velocity decreases.
- Therefore, high argon flow and pressure combined with low sample flow and pressure yields the smallest droplet size.






Quality of Aerosol \propto Quality of Results

Basics of Aerosol Generation



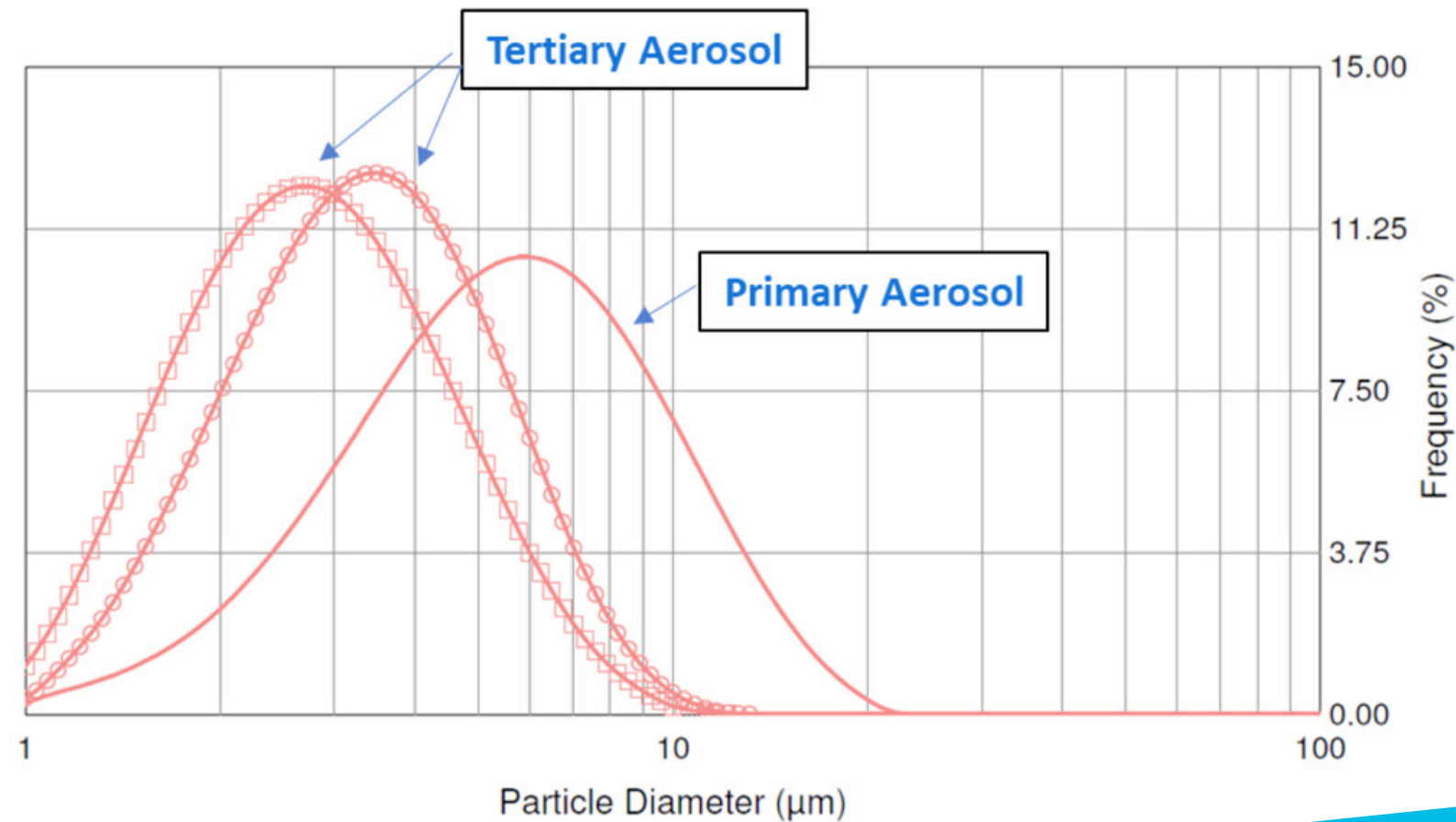
Basics of Aerosol Generation

- Droplet size
- Primary Aerosol
- Tertiary Aerosol

Sample Introduction System	
	MicroMist - Primary Aerosol
	MicroMist & Tracey - Tertiary Aerosol
	MicroMist & Twister - Tertiary Aerosol



Tracey™



Twister™

Common Problems: “Real World” Samples

Perfect samples are nice — but they do not exist in the “real world”:

- Clogged nebulizers and injectors
- Torch devitrification
- Destabilization of plasma
- Increased oxide formation
- Long washout times / carryover
- Long stabilization times
- Signal suppression
- Signal drift
- Poor precision (RSDs)
- Carbon build-up
 - » Orifice occlusion
 - » Signal drift
 - » Carbon-based polyatomic interferences

Glass Expansion Nebulizer Product Line

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

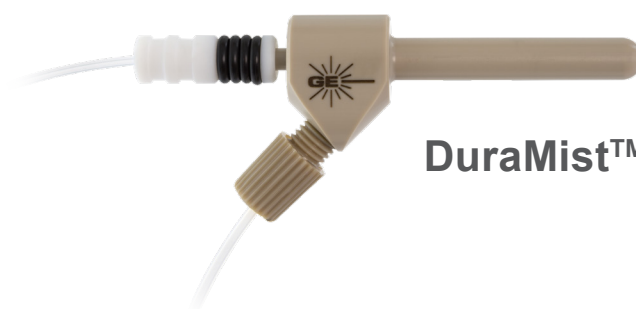
*Varies with nebulizer uptake



Conikal™
SeaSpray™
MicroMist™
Slurry™



OpalMist™

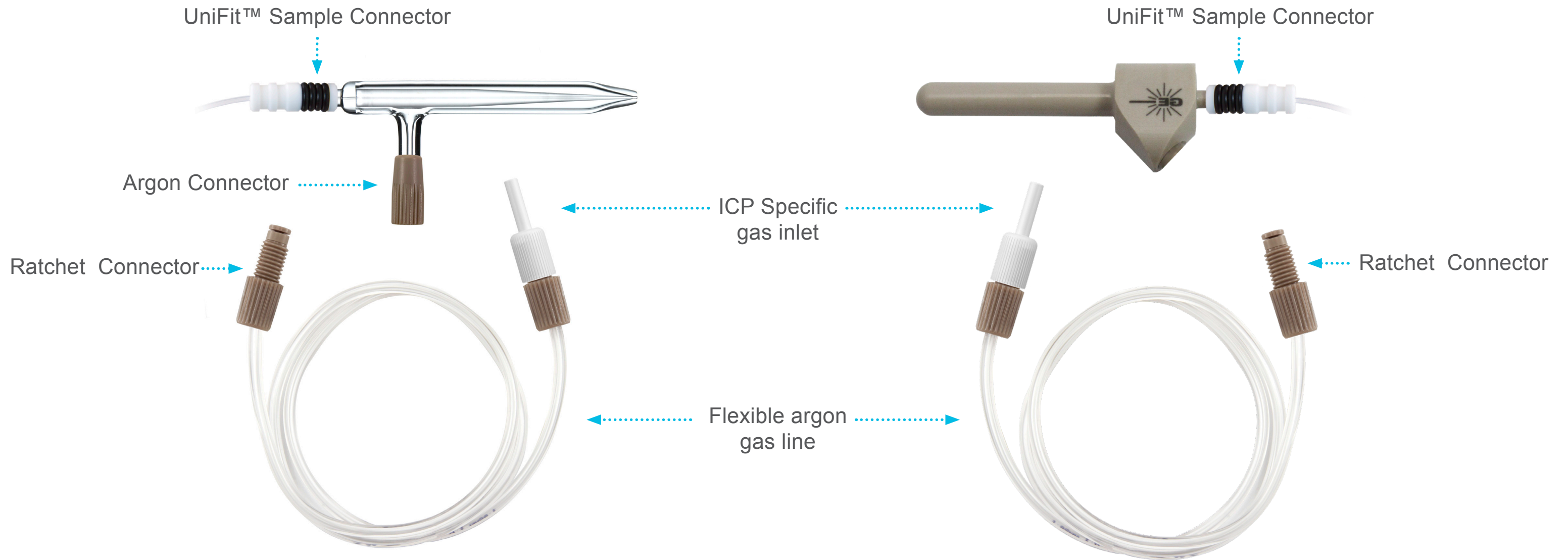


DuraMist™



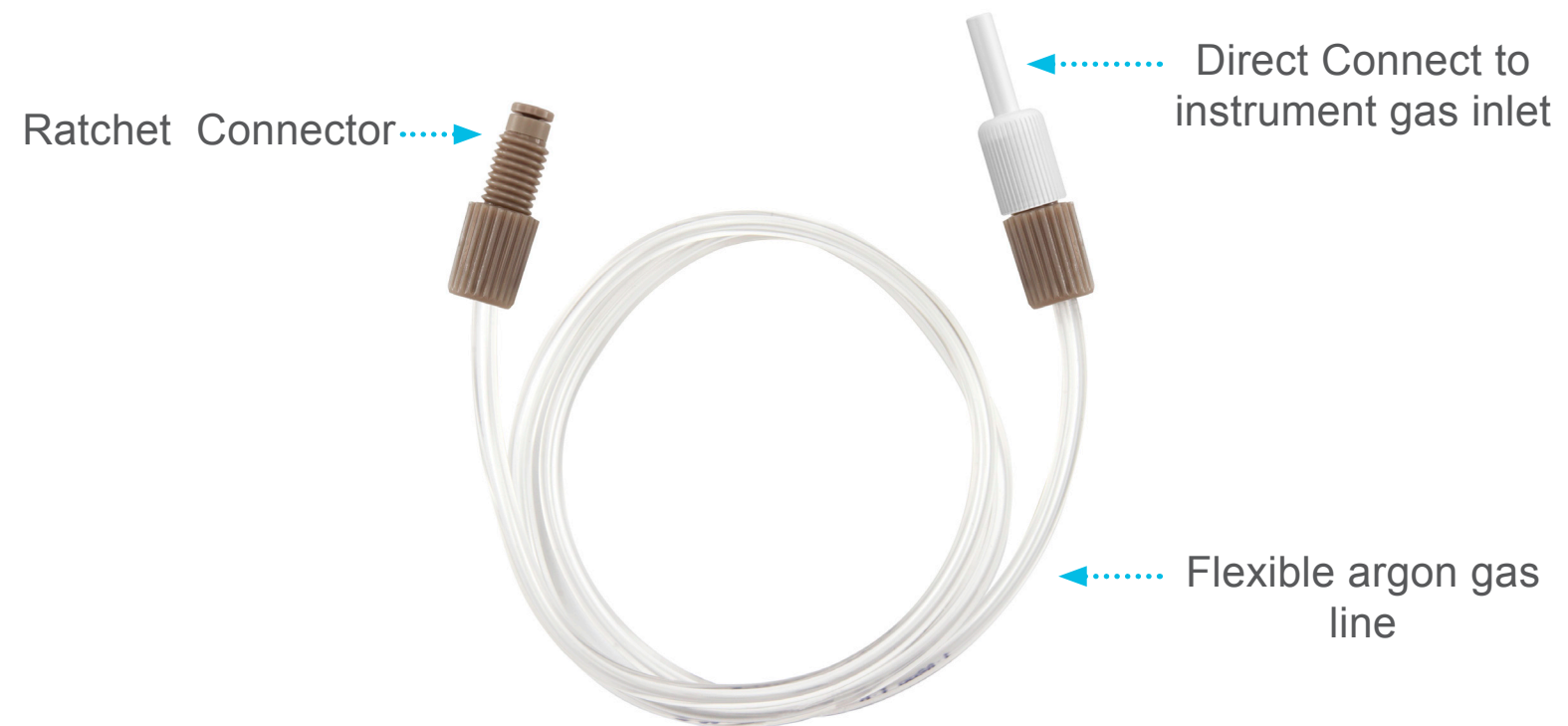
VeeSpray™

DC Nebulizer - Direct Connect



DC Nebulizer - Benefits

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



Glass Expansion DC Gas Lines

Manufacturer	Model	P/N Prefix	Gas Line Included
Agilent®	Vista/700-ES, 4100/4200	A11-	70-803-0969
Agilent®	7700/7800/7900/8800/8900	A13-	70-803-1105
Agilent®	5100/5110/5800/5900	A13-	70-803-1105
Analytik Jena®	ICP-MS	A61-	70-803-2002
Analytik Jena®	ICP-OES	A13-	70-803-1105
Horiba® Jobin Yvon	All Models	A13-	70-803-1105
Leeman	All Models	A11-	70-803-0969
Nu Instruments	ICP-MS	A51-	70-803-1858
Nu Instruments	TOF-ICP-MS	A52-	70-803-2044
PerkinElmer®	Optima/Avio	A21-	70-803-1070
PerkinElmer®	Elan/NexION 300/350	A22-	70-803-1049
PerkinElmer®	NexION 1000/2000/5000	A23-	70-803-1449
Radom	MICAP – OES™ 1000	A70-	70-803-2054
Shimadzu®	All Models	A41-	70-803-1311
Spectro™	All Models	A21-	70-803-1070
Thermo Fisher Scientific®	PRO, 6000/7000, Q/RQ/TQ, X-Series & Neoma	A31-	70-803-1105
Thermo Fisher Scientific®	Neptune	A32-	70-803-1468



P/N 70-803-0969



P/N 70-803-2002



P/N 70-803-1105



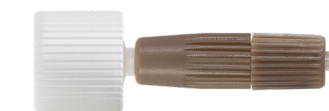
P/N 70-803-2044



P/N 70-803-1070



P/N 70-803-2054



P/N 70-803-1049



P/N 70-803-1468



P/N 70-803-1449



P/N 70-803-1311



P/N 70-803-1858



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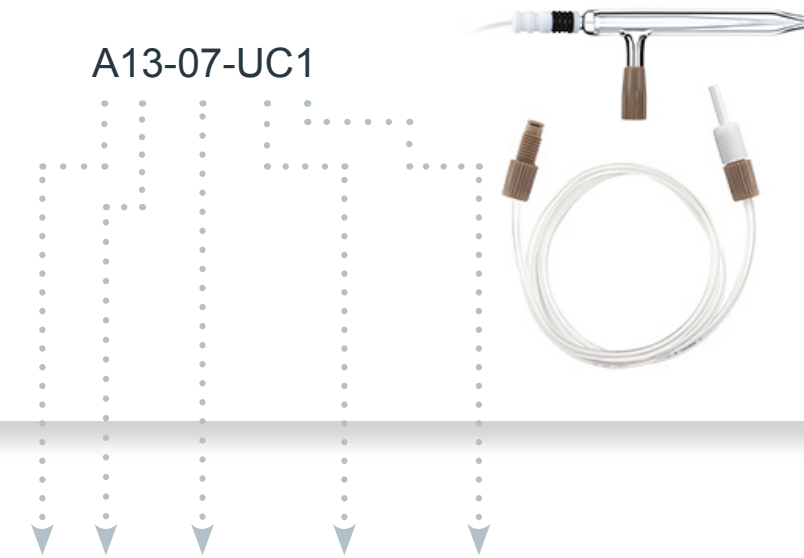
Glass Expansion Nebulizer Part Numbers Explained

Glass DC Nebulizers

Conikal

1mL/min uptake

A13-07-UC1



A**#**-**yy**-**ZZ****nnn**

A Gas pressure rating of 40 psi

Gasline fitting type eg:
13 = Suitable for Agilent® 5000 Series

yy The argon flow in L/min eg. 07=0.7L/min

ZZ Nebulizer model type:

UC = Conikal U-Series nebulizer

US = Slurry U-Series nebulizer

USS = SeaSpray U-Series nebulizer

UM = MicroMist U-Series nebulizer

CV = Ceramic VeeSpray v-groove nebulizer

DM = DuraMist HF resistant nebulizer

PFA = OpalMist PFA HF resistant nebulizer

nnn Aspirated uptake at nominal argon flow, in mL/min eg:

UC1 = 1mL/min

UM04 = 0.4mL/min

PFA005 = 0.05mL/min

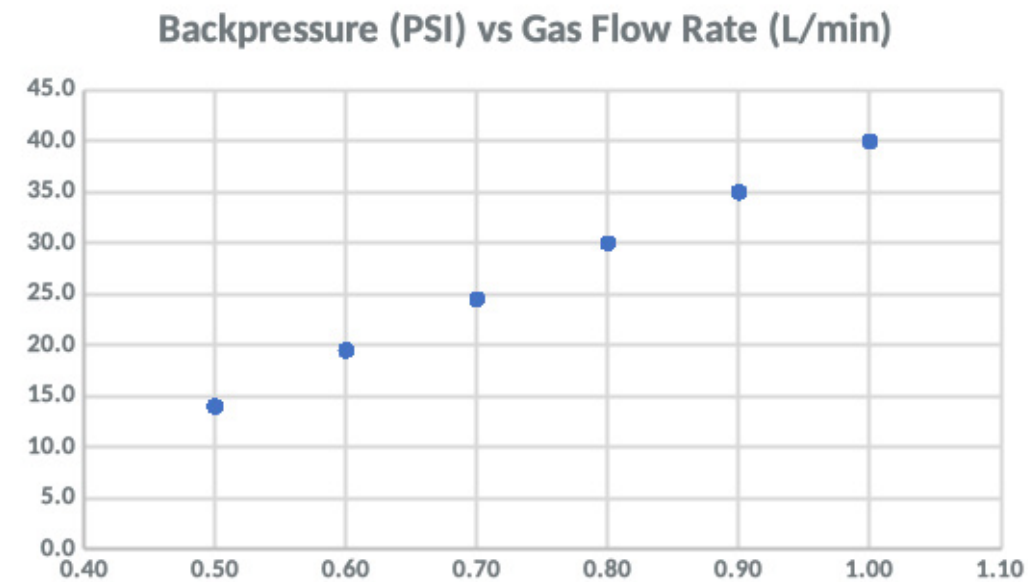


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Important Nebulizer Operating Parameters

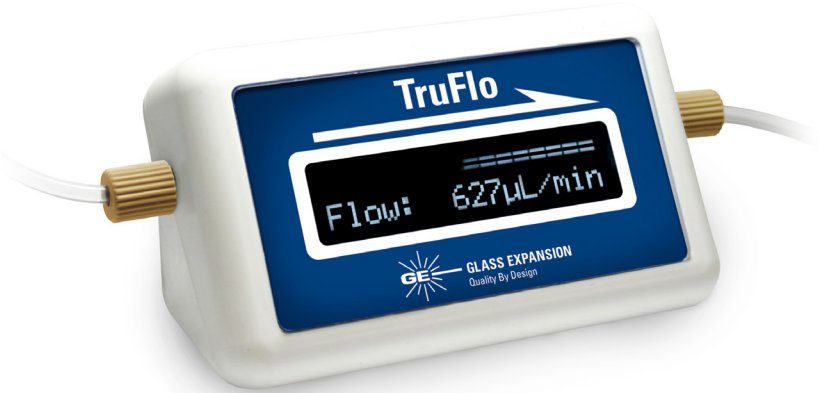
Example: GE P/N A13-1-UM04X

Backpressure (PSI)	Gas Flow (L/min)
14.0	0.50
19.5	0.60
24.5	0.70
30.0	0.80
35.0	0.90
40.0	1.0



- Optimum nebulizer gas flow = 1.0 L/min (40 psi)
- Sample uptake rate \leq 0.4 mL/min

Helpful Accessories



TruFlo™ Sample Monitor



Elegra™ Argon Humidifier



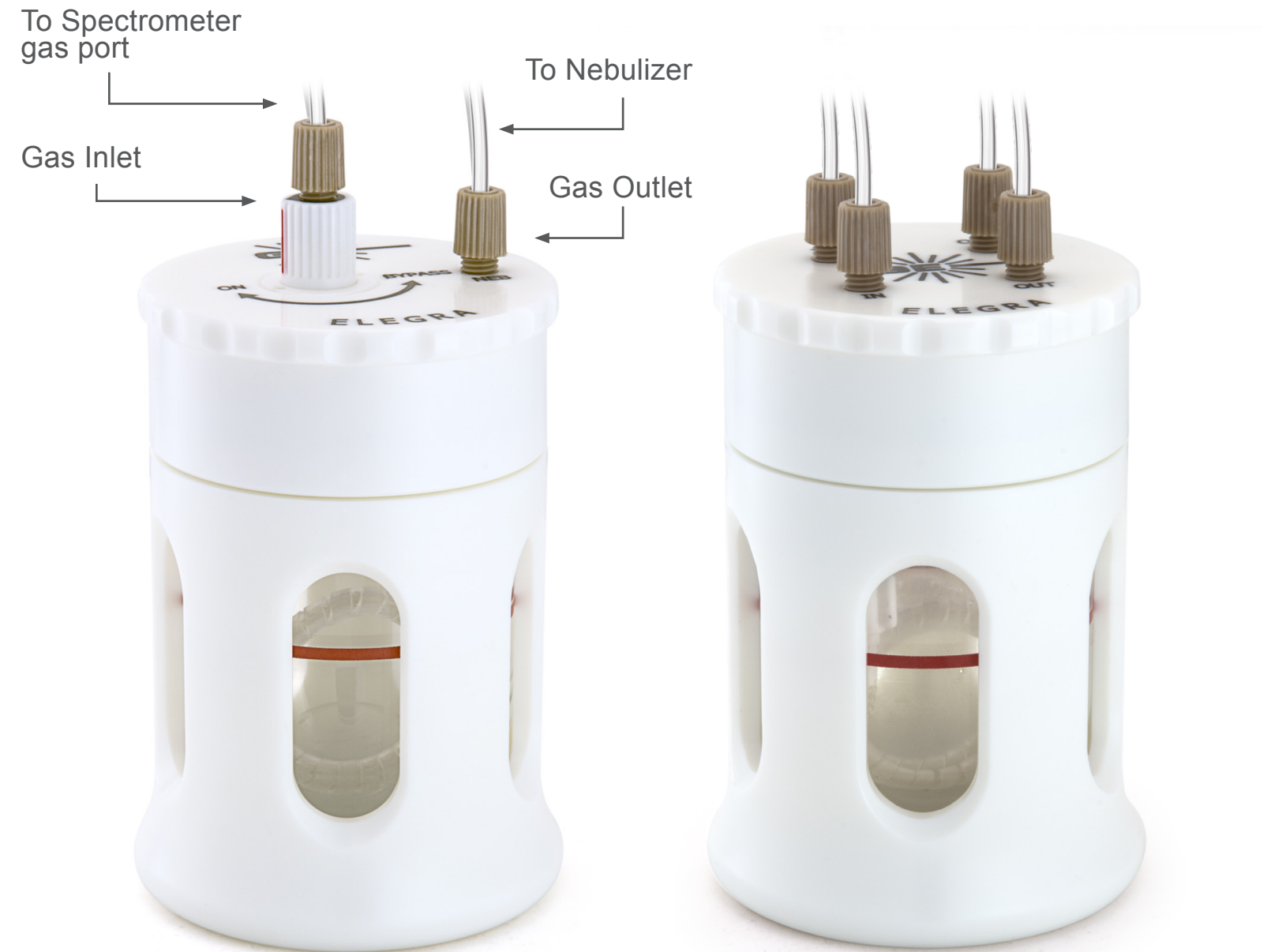
Guardian™ Inline Particle Filter



Eluo™ Nebulizer Cleaning Tool

Elegra Argon Humidifier

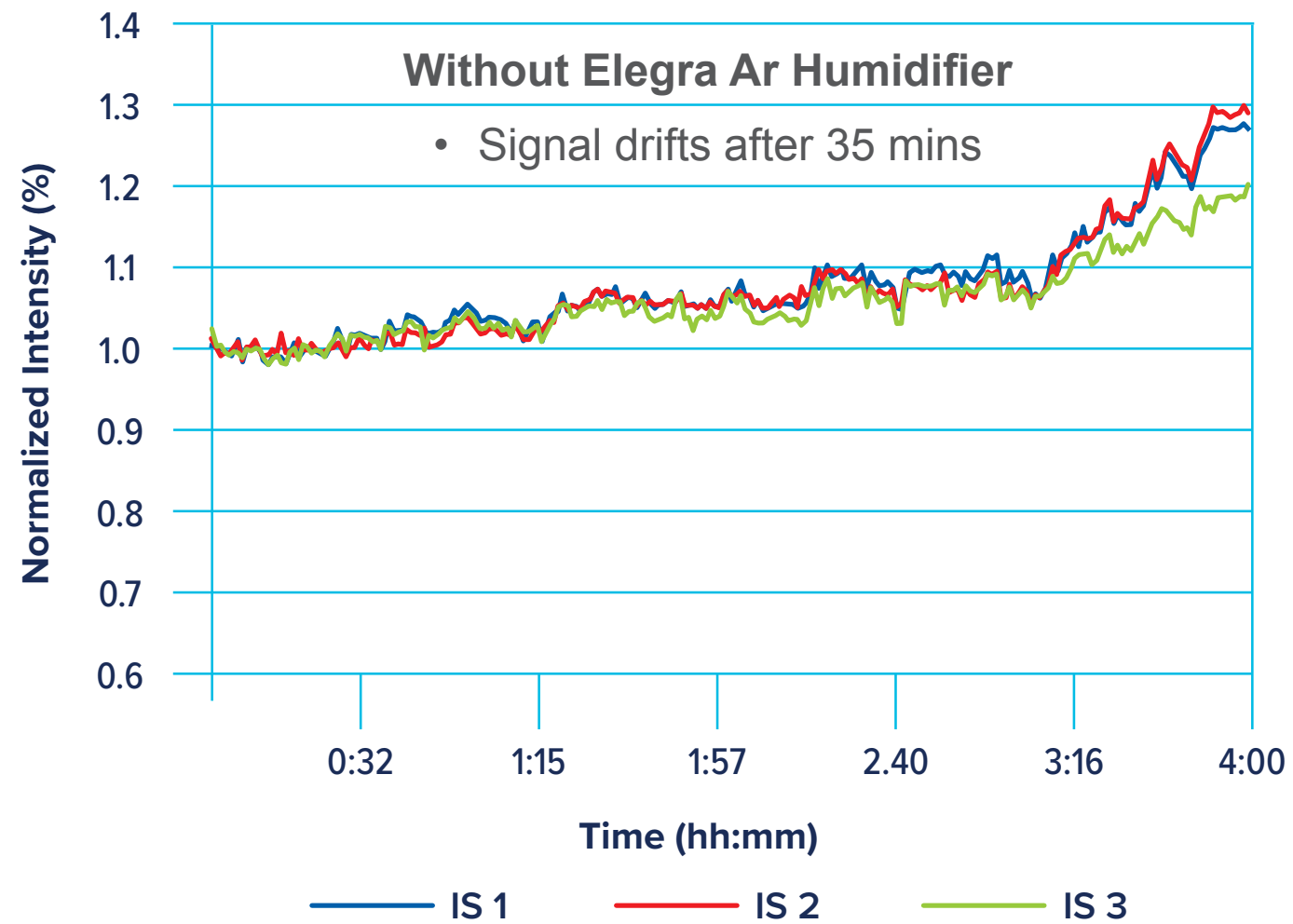
- Compact & cost effective design
- No heating or electric power required
- Non-pressurized water reservoir
- Membrane humidification technology
- Improved signal stability for samples with high TDS
- Inert metal free construction
- Dual-Channel version allows simultaneous humidification of nebulizer & aux. gas



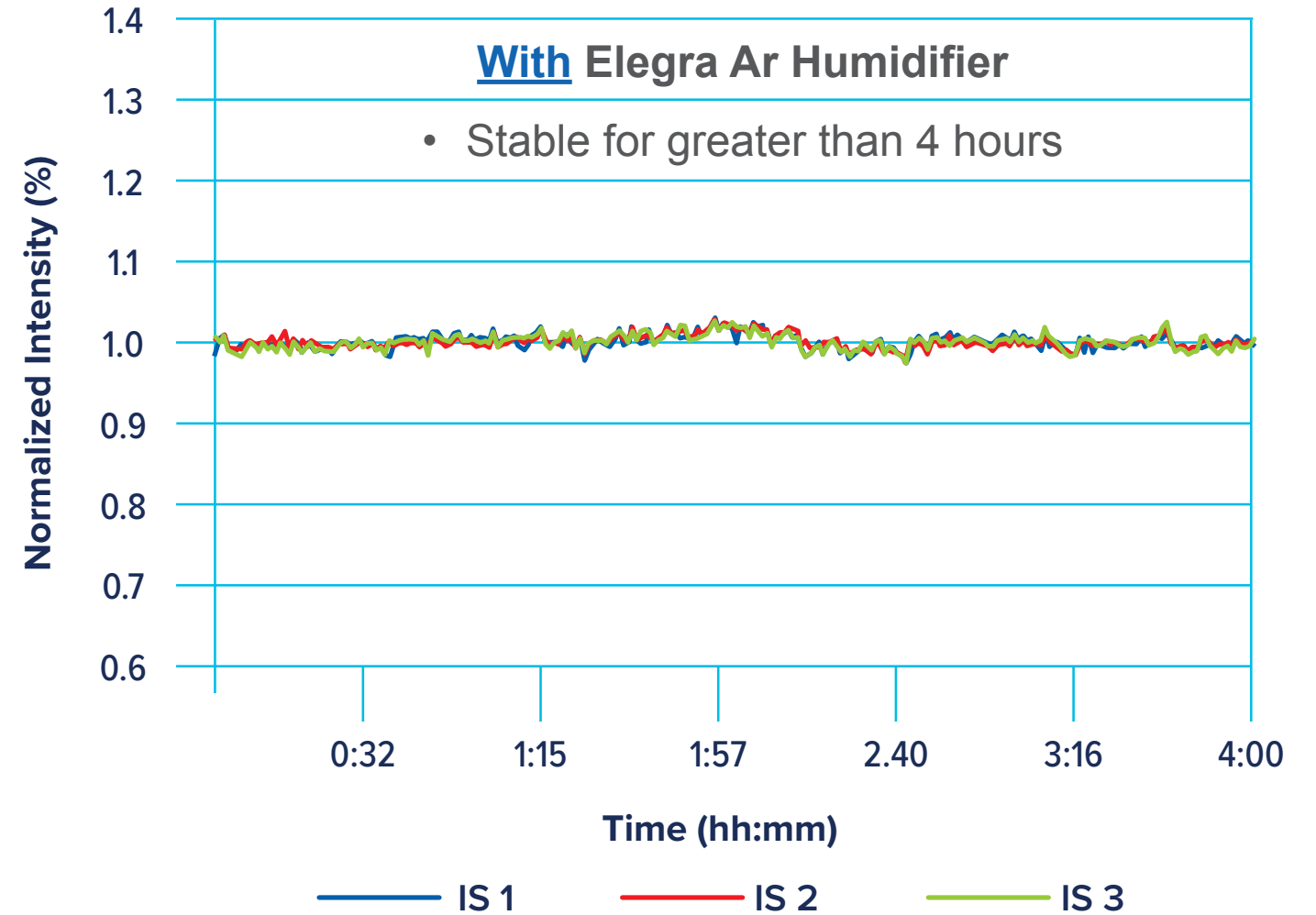
Stability in 0.5% Lithium Metaborate

Internal Standard Signal for Three Lines

Analysis Failed



Analysis Completed



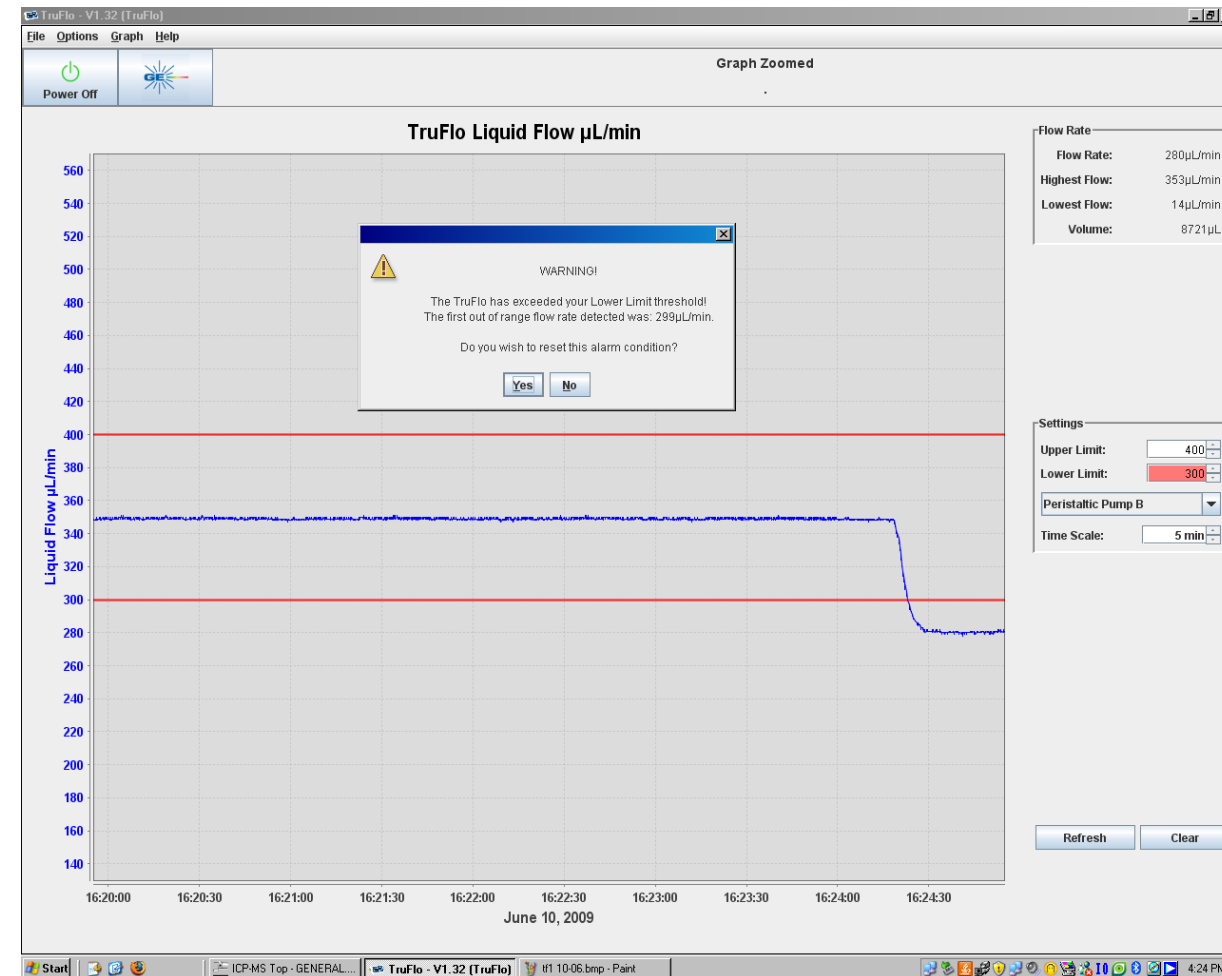
TruFlo



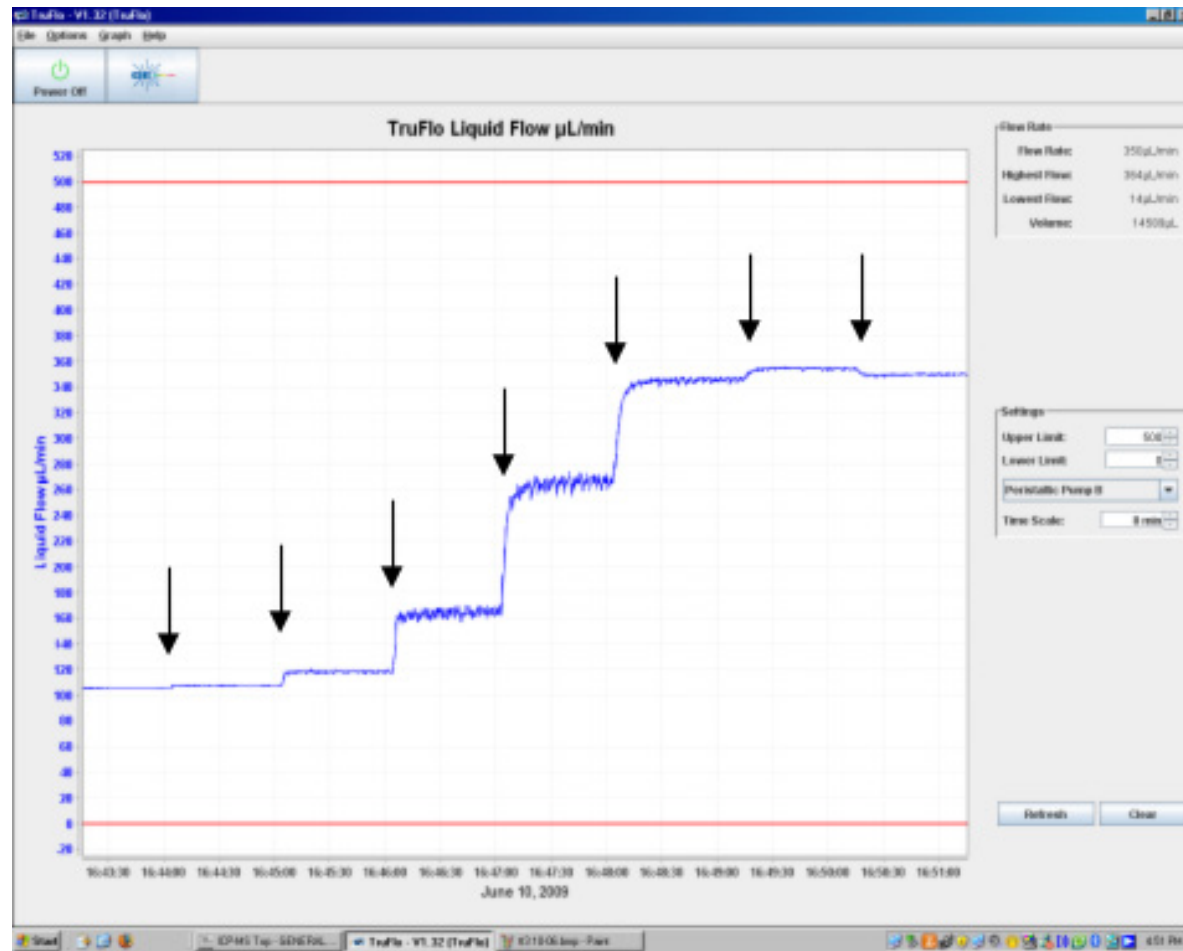
- Continuous real-time flow measurement.
- Eliminates guess work.
- Sounds an out-of-range alarm.
- Suitable for all ICP-OES and ICP-MS models.
- HF resistant models available.

Features of TruFlo

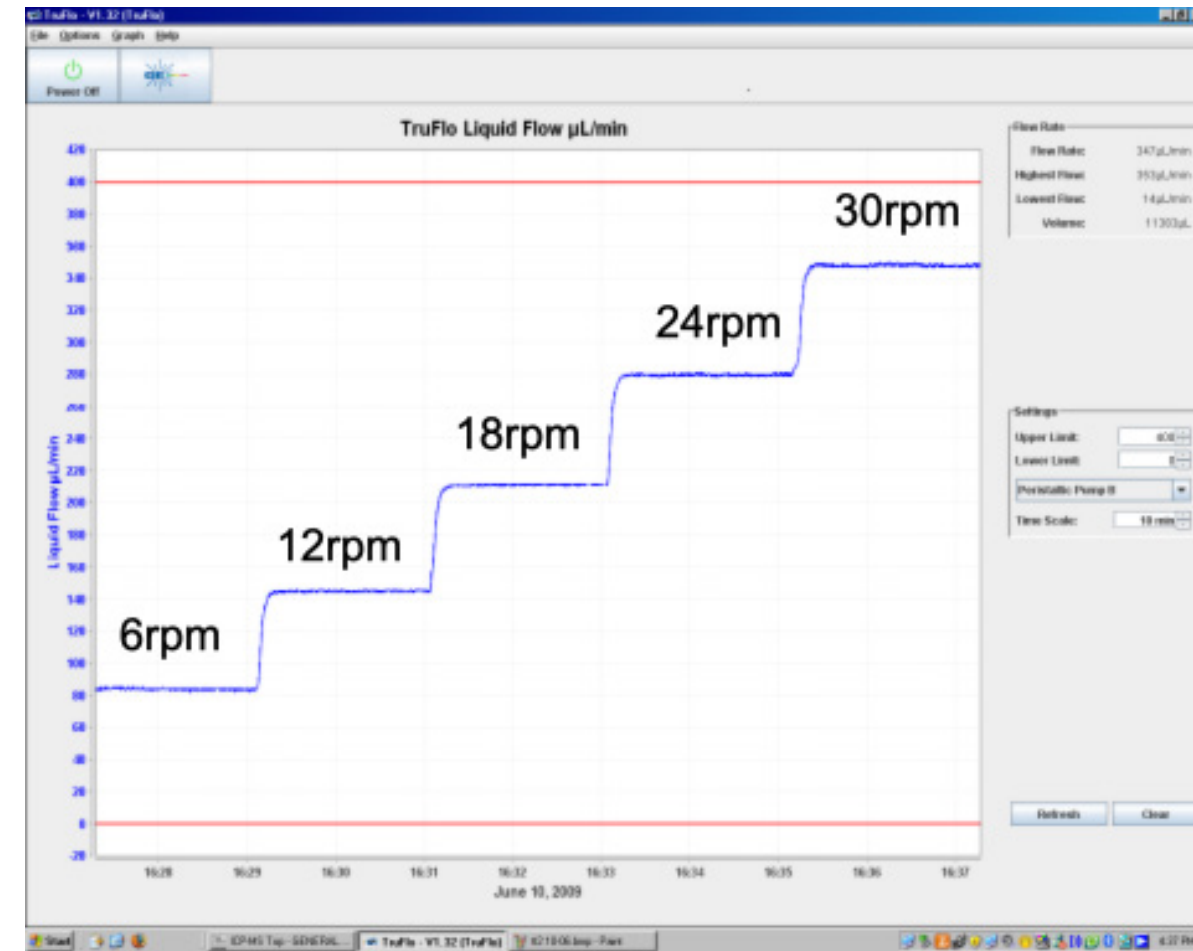
- Adjustable damping
- Settable alarm limits
- Digital display
- Recordable graph
- Range: 0.05 to 4ml/min



Graphic Benefits



Adjusting pump tension



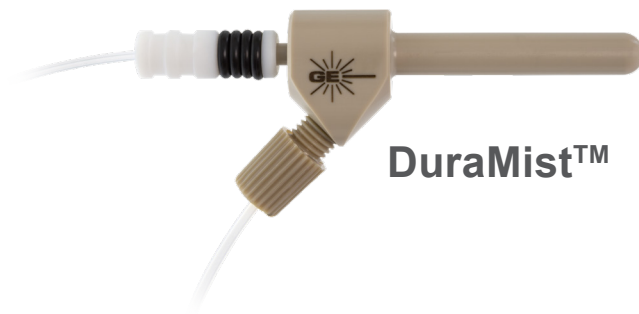
Uptake rate vs. pump speed

Eluo™

Nebulizer Maintenance Made Easy



Conikal™
SeaSpray™
MicroMist™
Slurry™



DuraMist™



OpalMist™



P/N 70-ELUO



P/N 70-ELUO-OPD

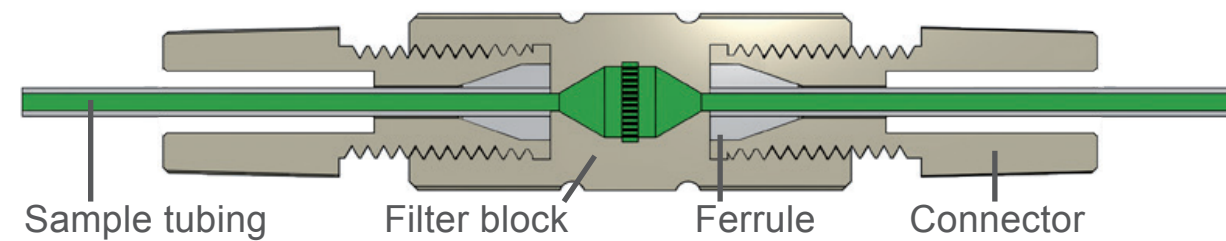


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Guardian™

In-Line Particle Filter

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



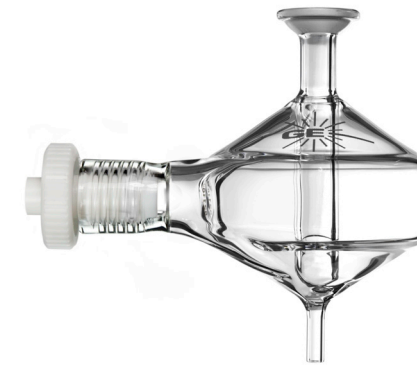
Glass Expansion Cyclonic Spray Chambers



Cinnabar



Tracey



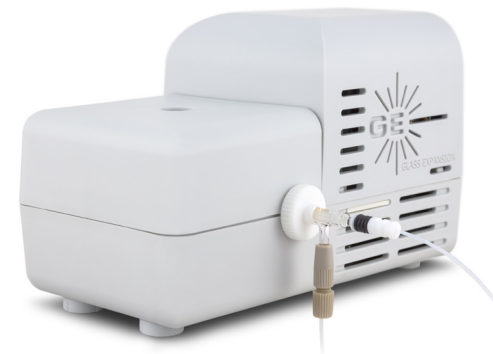
Twister



Twinnabar



PTFE (Tracey & Twister)



IsoMist XR

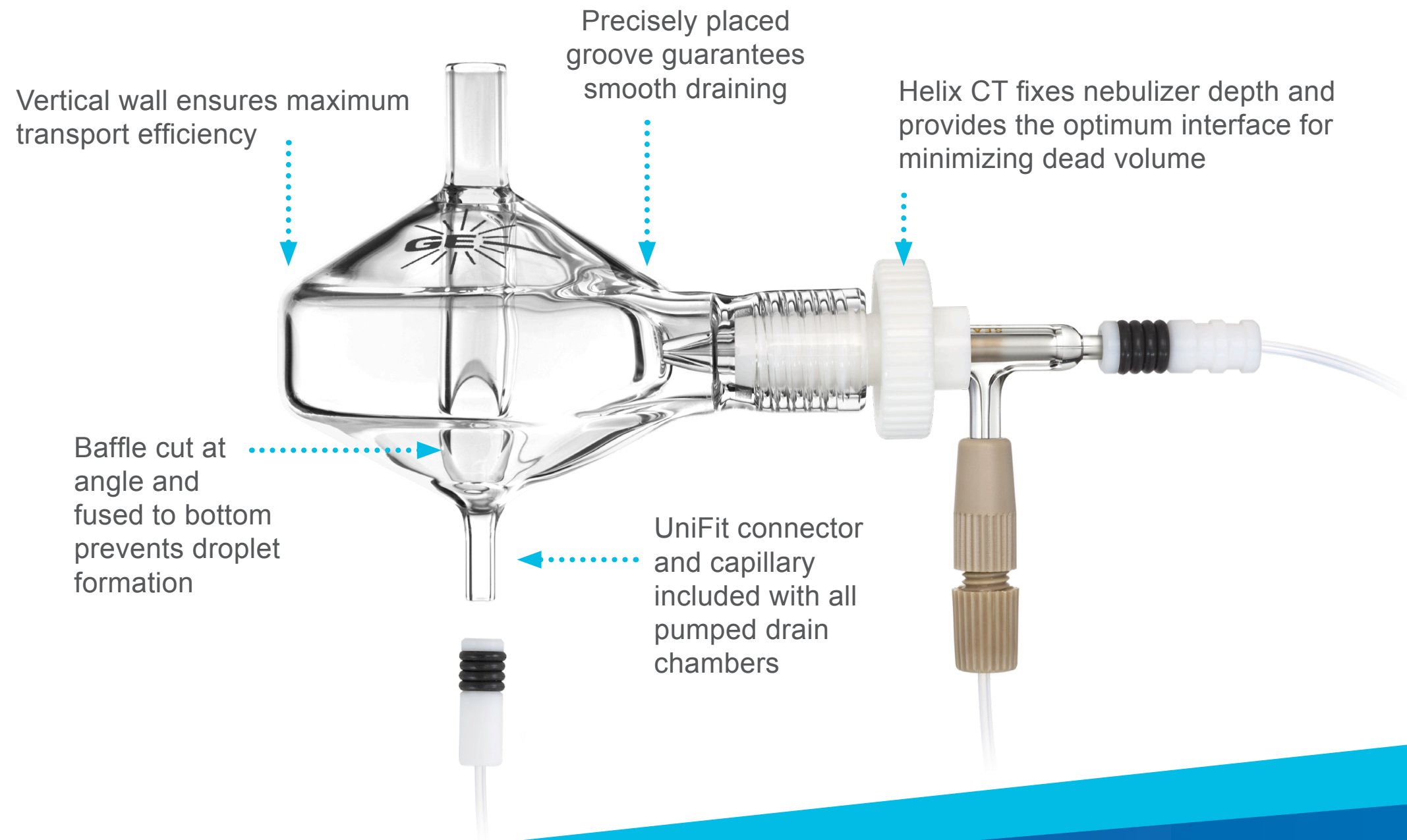


PCC



PFA Tracey

Spray Chambers



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Helix CT Interface

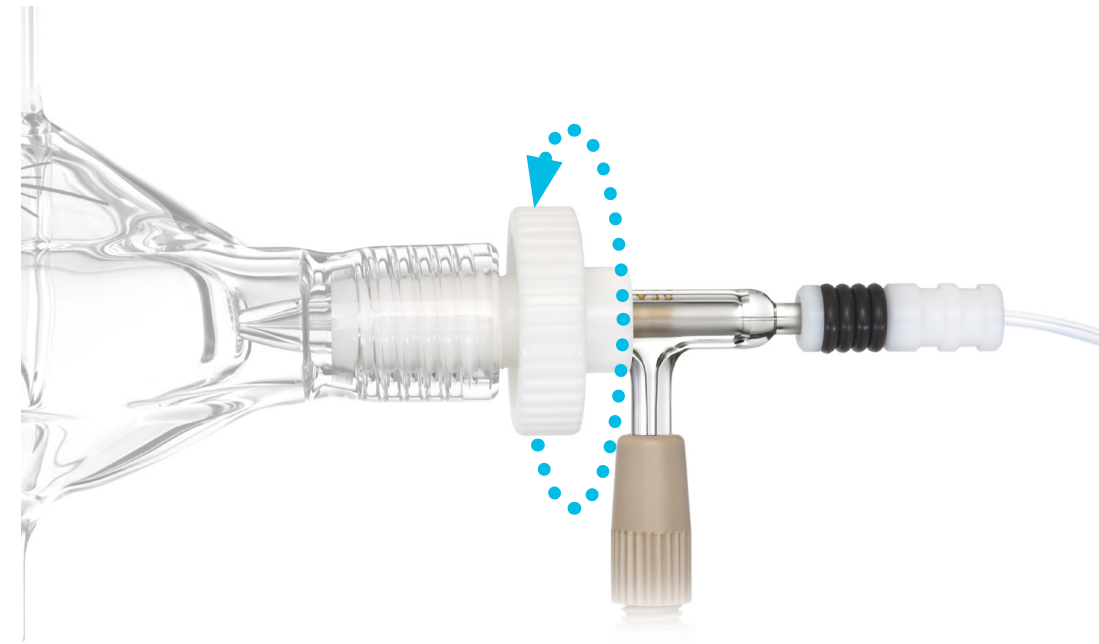
The new Helix locking screw with built-in torque control mechanism allows for a consistent seal of the PTFE ferrule against the nebulizer - making it impossible to overtighten or undertighten while ensuring a gas-tight seal each and every time.



Helix CT Locking Screw



Helix CT Seal

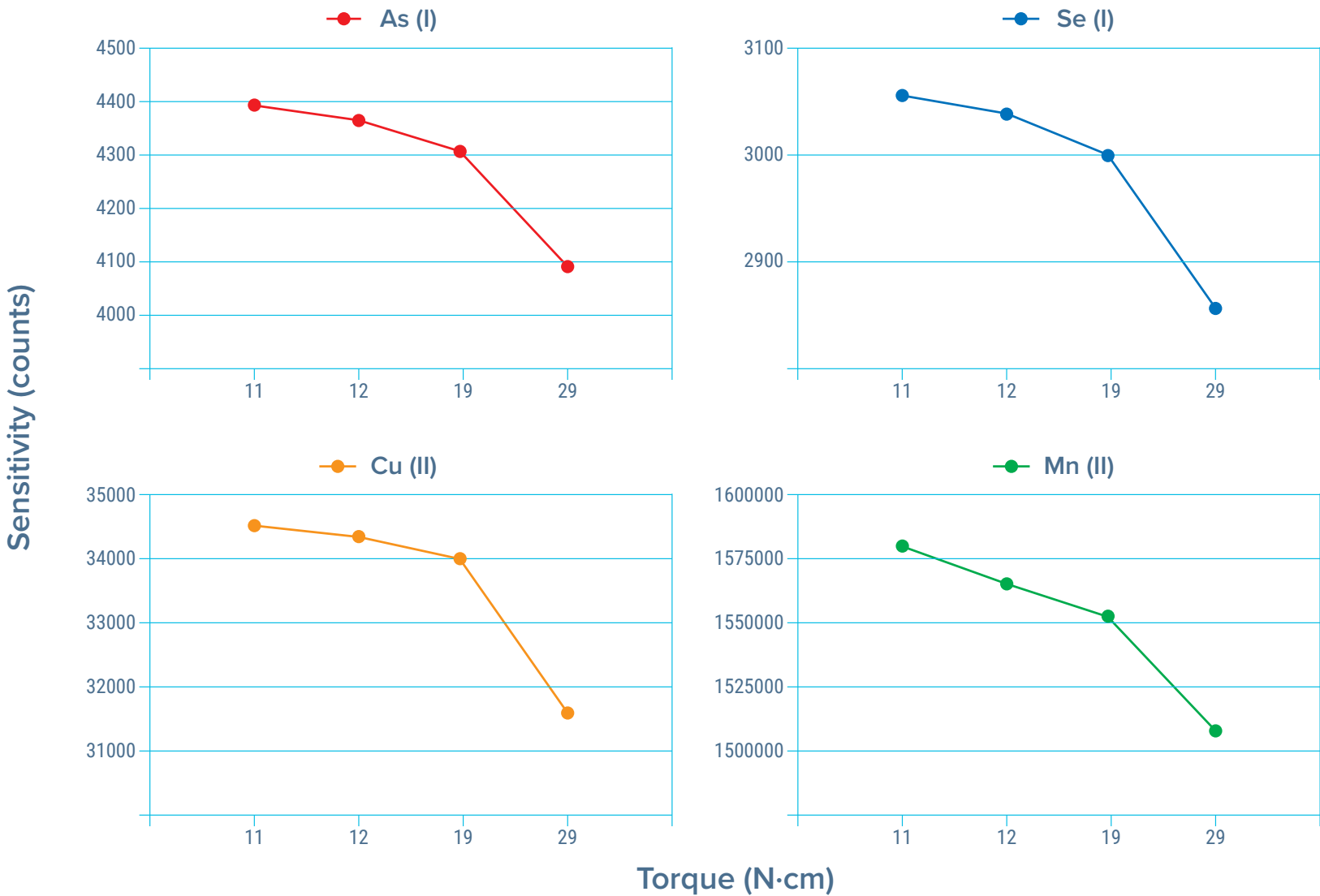


Tighten the nebulizer in place and seal the spray chamber by turning the knurled knob of the Helix CT further clockwise by hand until the ratchet mechanism clicks.



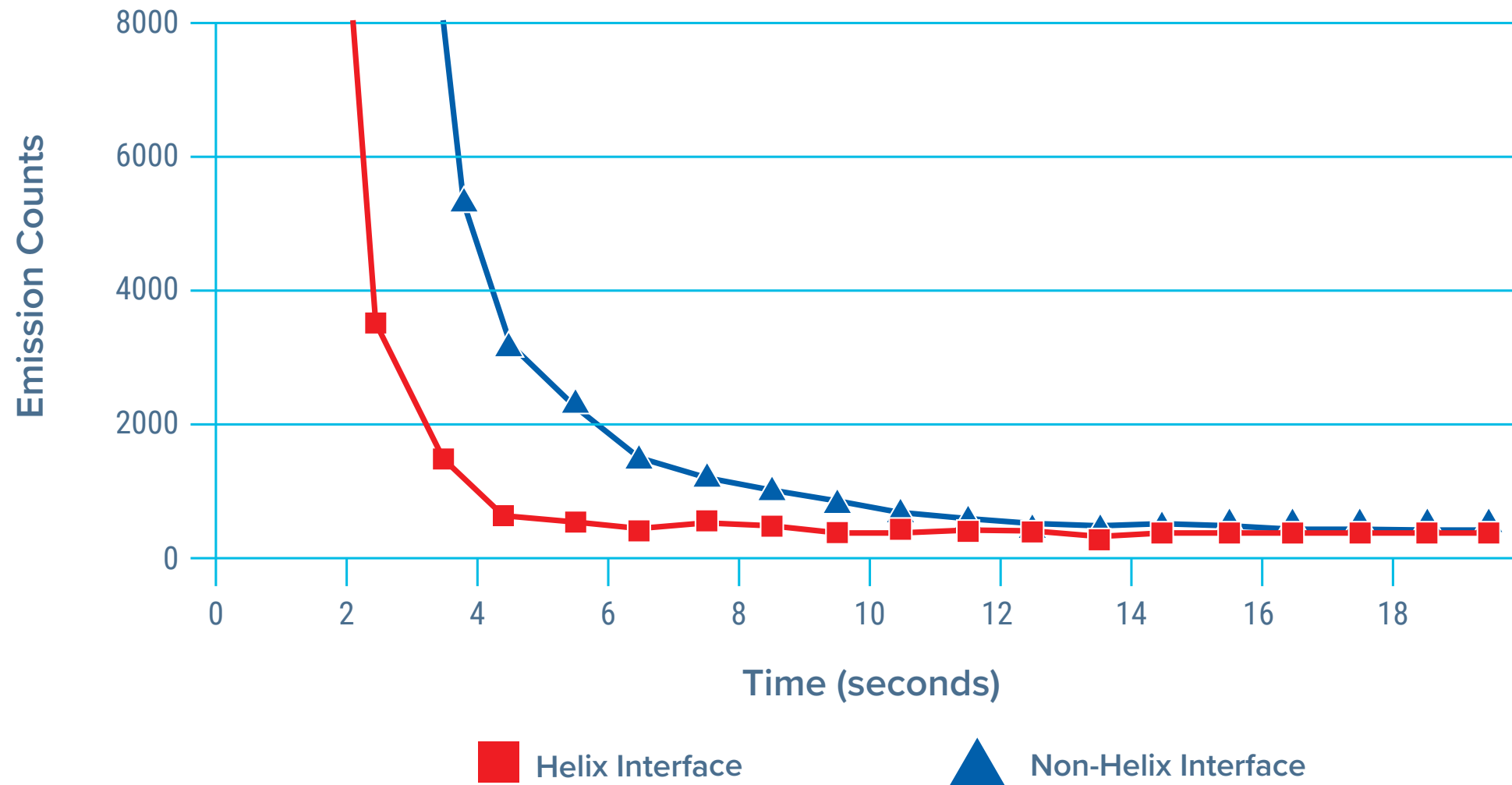
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Helix CT – Constant Torque



- Constant Torque control
- Provides unparalleled, reproducible day-to-day ICP performance.

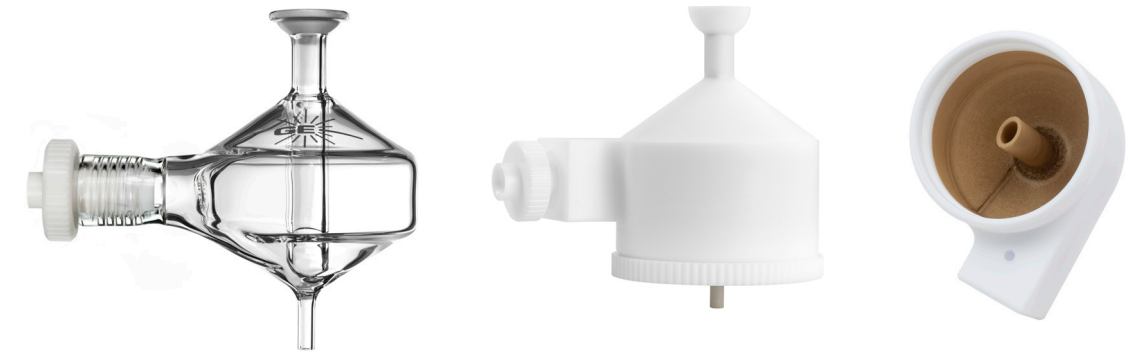
Helix CT – Washout Comparison



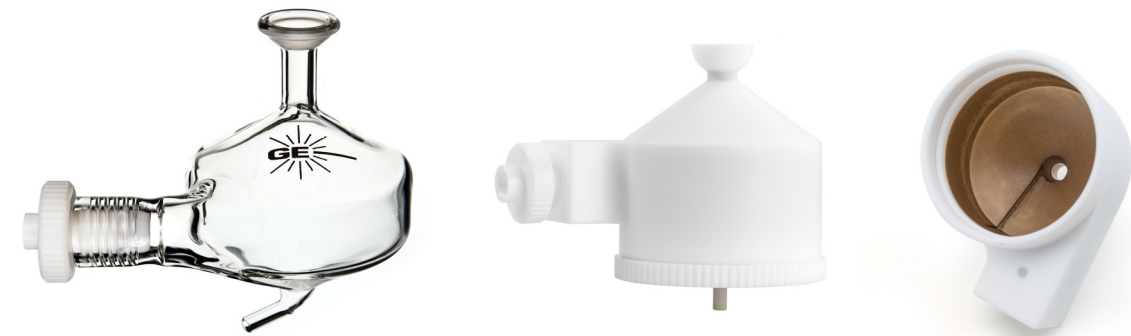
Non-Helix Interface

Twister vs Tracey

- 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

Twinnabar vs Cinnabar

- Low volume (20 mL) for application rate of 400 uL/min or less
- Provides fast washout for low flow applications
- Excellent sensitivity and precision
- Cinnabar provides approximately 15% increase in counts (on average)
- Twinnabar more suitable for higher matrix samples and improved short-term precision



Twinnabar



Cinnabar



Inert Spray Chambers



PFA – ICP-MS

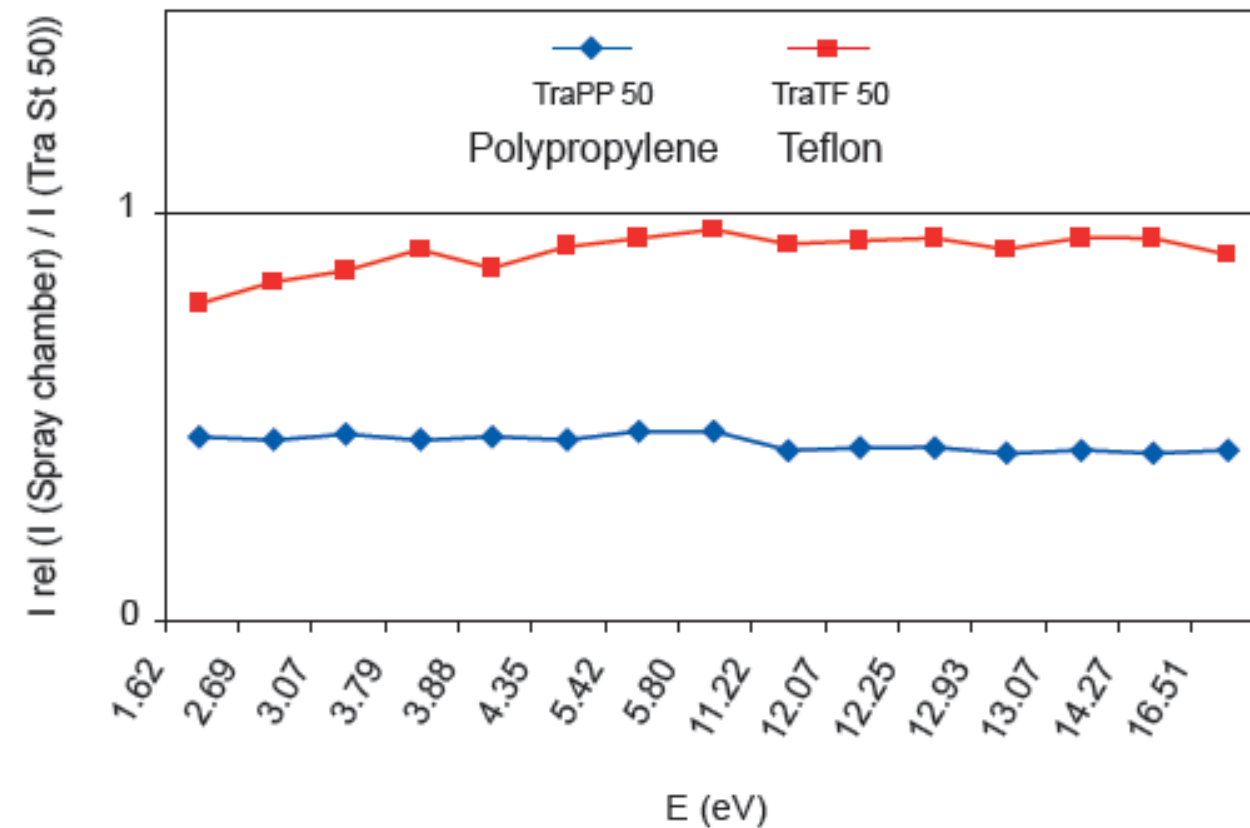
- PFA Material
 - » Inert
 - » Ultra high purity
 - » Stediflow surface treatment
- 44mL internal volume



PTFE – ICP-OES

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

Inert Spray Chambers - Stediflow



- Improves wettability of spray chamber surface
- Ensures efficient drainage
- Improves sensitivity and precision
- Treatment can be regenerated

StediFlow Surface Treatment



PTFE – ICP-OES



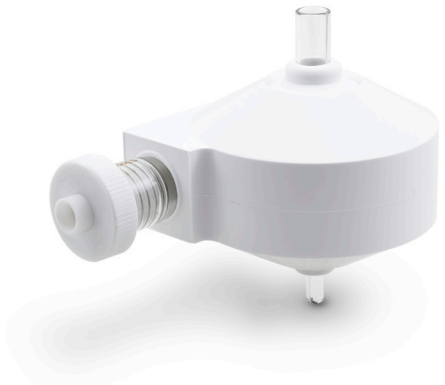
PFA – ICP-MS

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 and PCC



Glass



Quartz

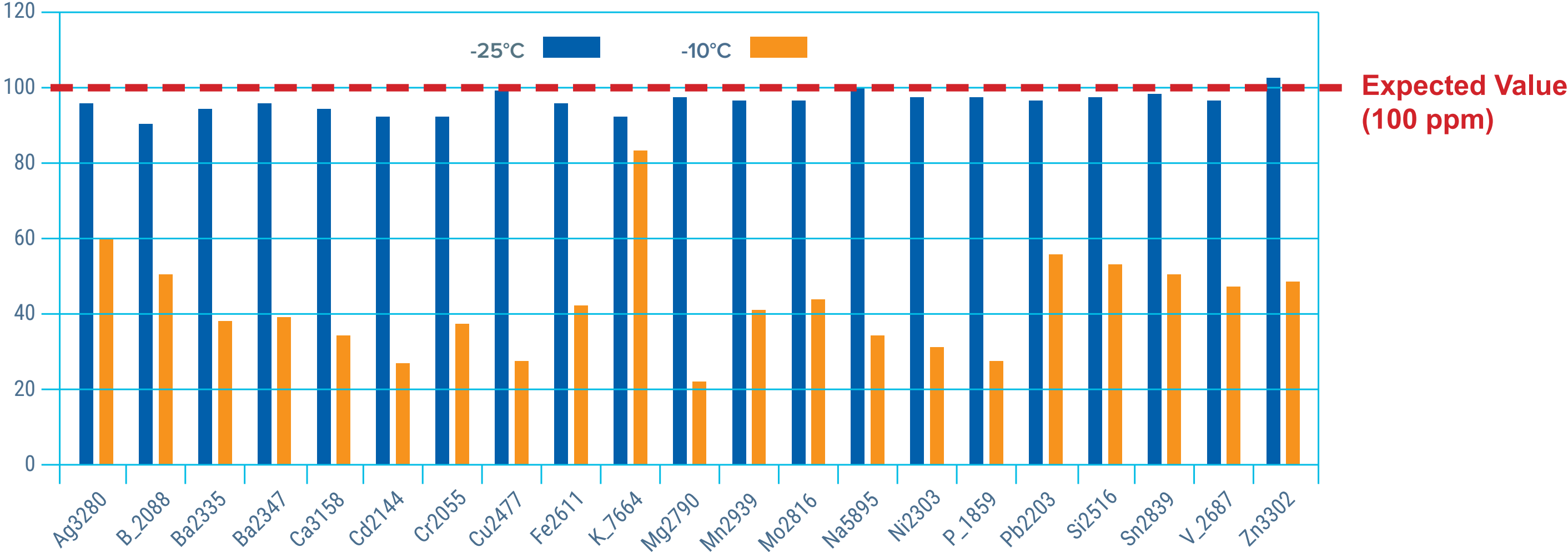


PFA



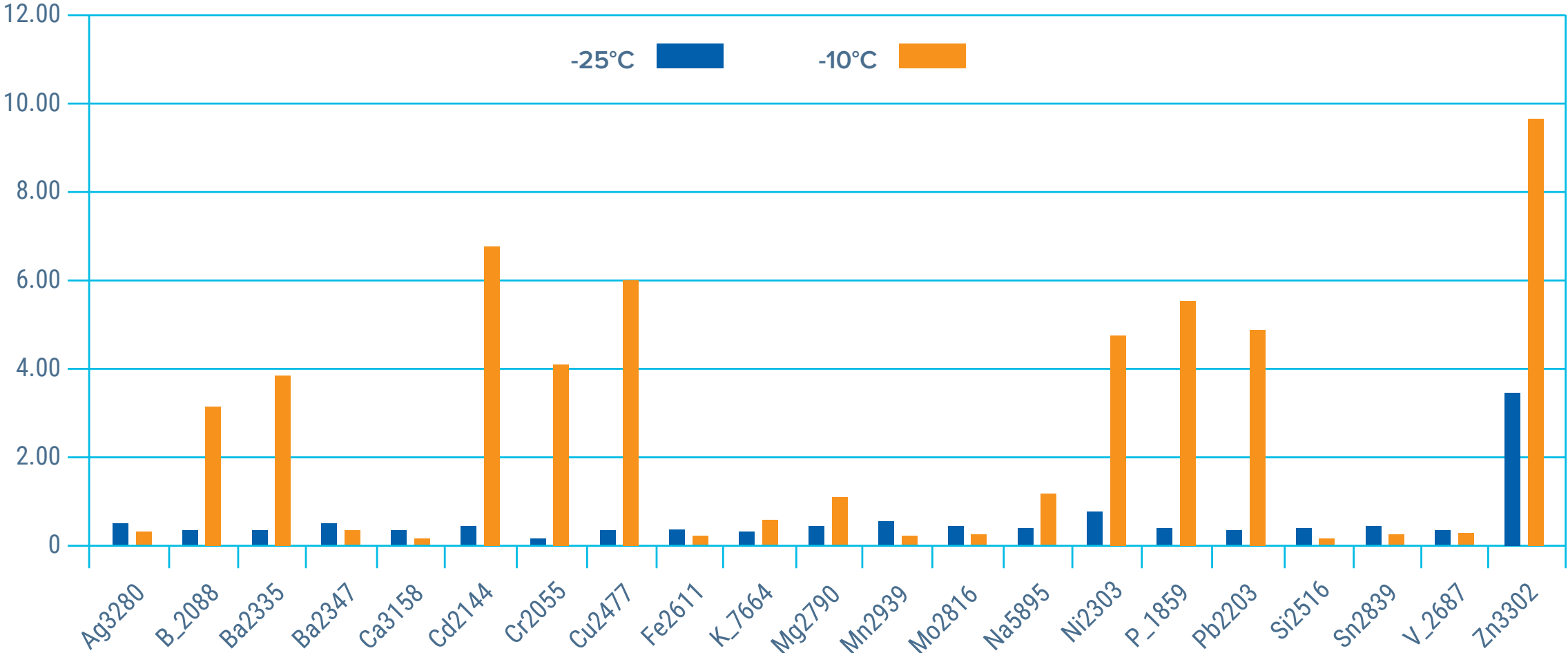
IsoMist XR

Effect of Spray Chamber Temperature on Accuracy (100 ppm Standard)

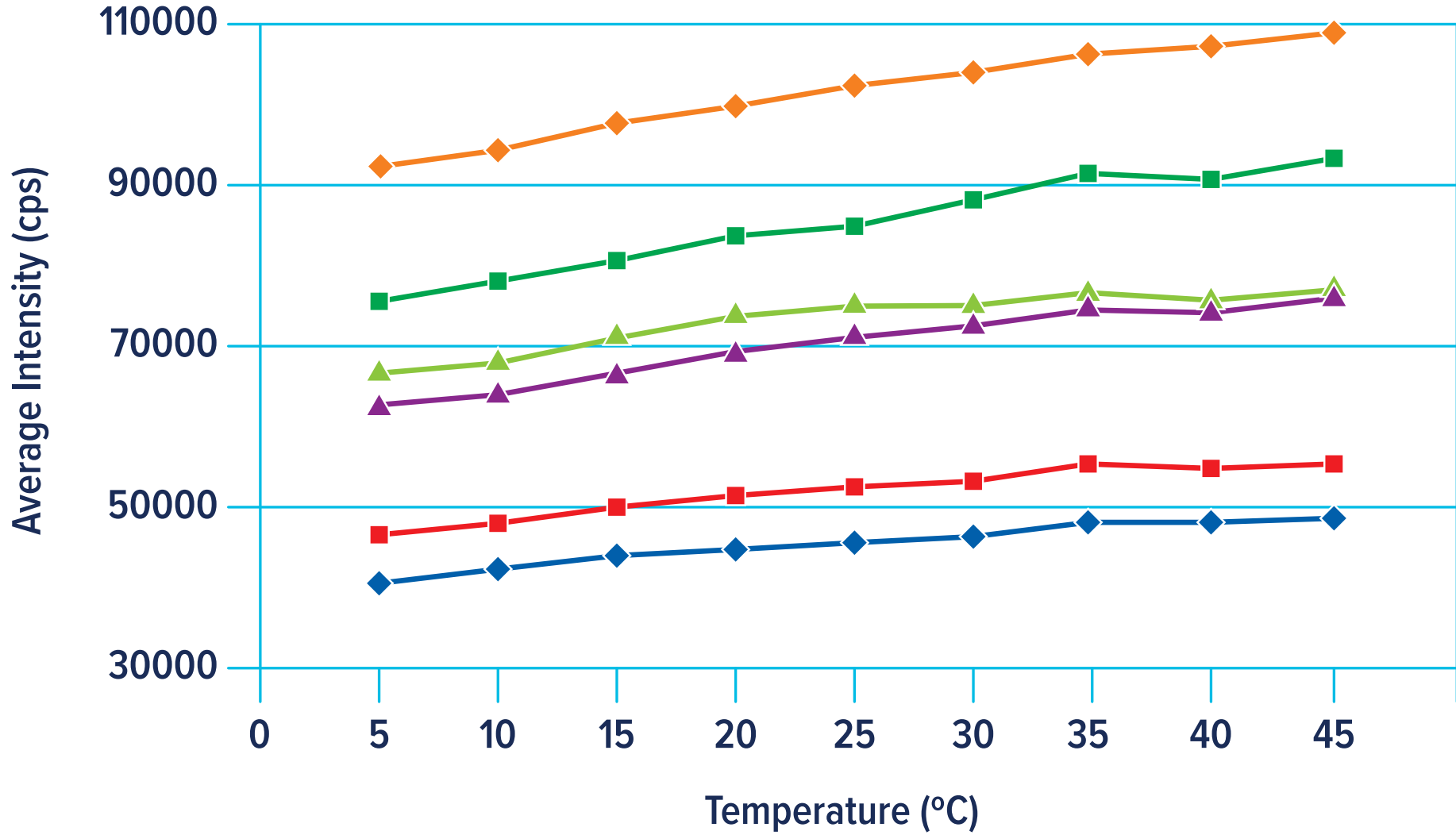


IsoMist XR

Effect of Spray Chamber Temperature on Precision



IsoMist XR



- Pt 214
- Ir 212
- Rh 343
- Ru 240
- Au 242
- Pd 340

IsoMist XR

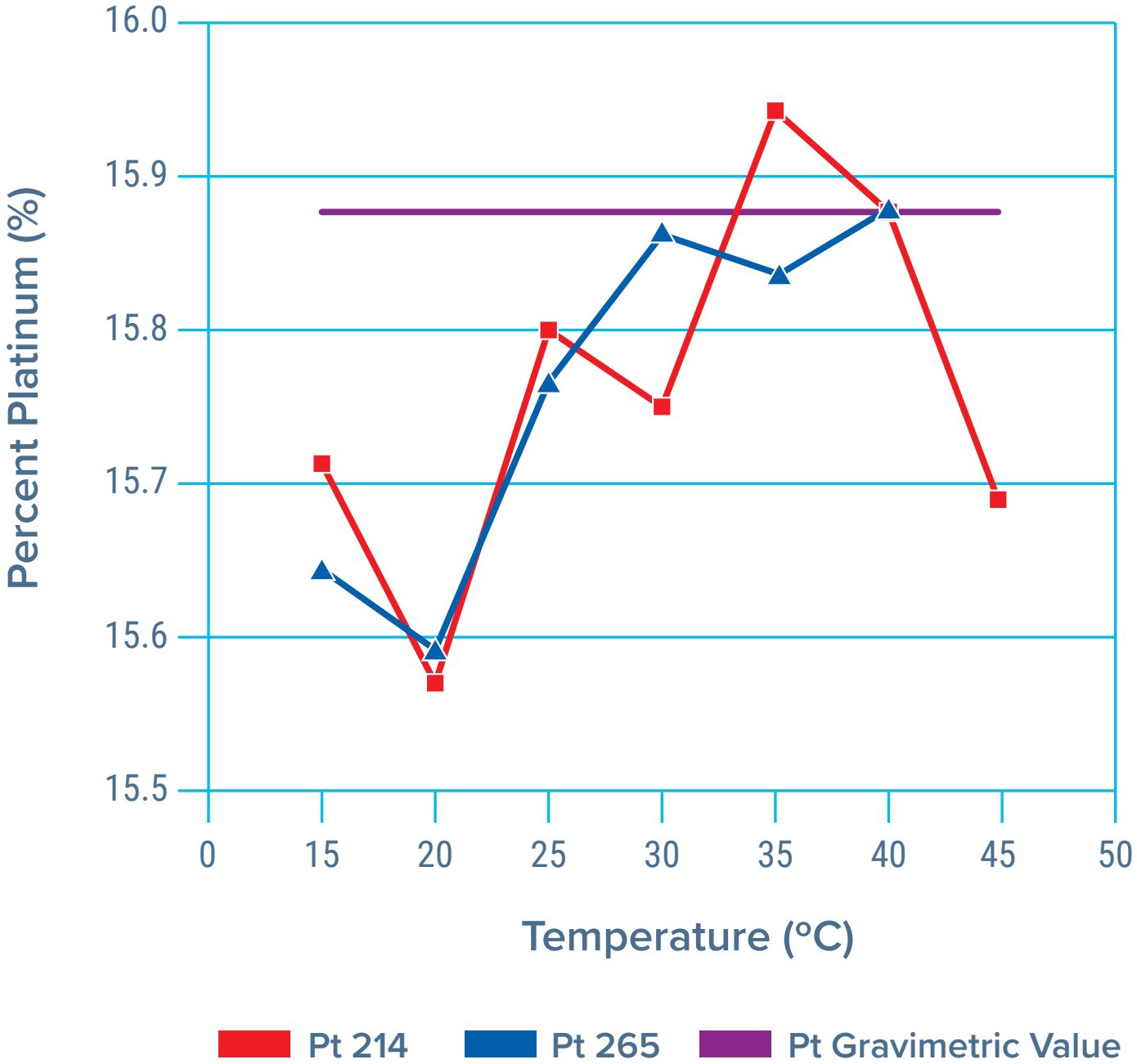


Table 1. Comparison of Instrument Detection Limits with and without the IsoMist XR

Element	IDL without IsoMist (ppb)	IDL with IsoMist at 5 °C (ppb)
Ag	1.00	0.50
Al	1.00	0.50
As	3.00	1.00
Ba	0.90	0.40
Be	0.10	0.09
Cd	1.00	0.50
Co	1.00	0.70
Cr	1.00	0.40
Cu	2.00	0.70
Fe	2.00	0.90
Mg	1.00	0.50
Mn	0.90	0.30
Mo	1.00	0.50
Ni	2.00	0.90
Pb	3.00	1.00
Sb	3.00	1.00
Se	5.00	2.00
Tl	2.00	1.00
Zn	1.00	0.50

Improved Detection Limits

An investigation was recently carried out using the IsoMist XR connected to a Spectro™ Arcos II MV ICP-OES at a NY water treatment facility. After optimizing the nebulizer and ICP operating conditions, the IsoMist XR was used to finely tune the conditions for optimal signal intensity and reduced background. Replacing the standard cyclonic spray chamber with the IsoMist and optimizing the sample introduction environment at 5°C provided a significant improvement in instrument detection limits (Table 1).

In contrast to the precious metal study, a lower temperature with the water samples improved detection limits by reducing background and yielding a more robust and higher temperature plasma.

PCC Kit



Scott style Spray Chamber

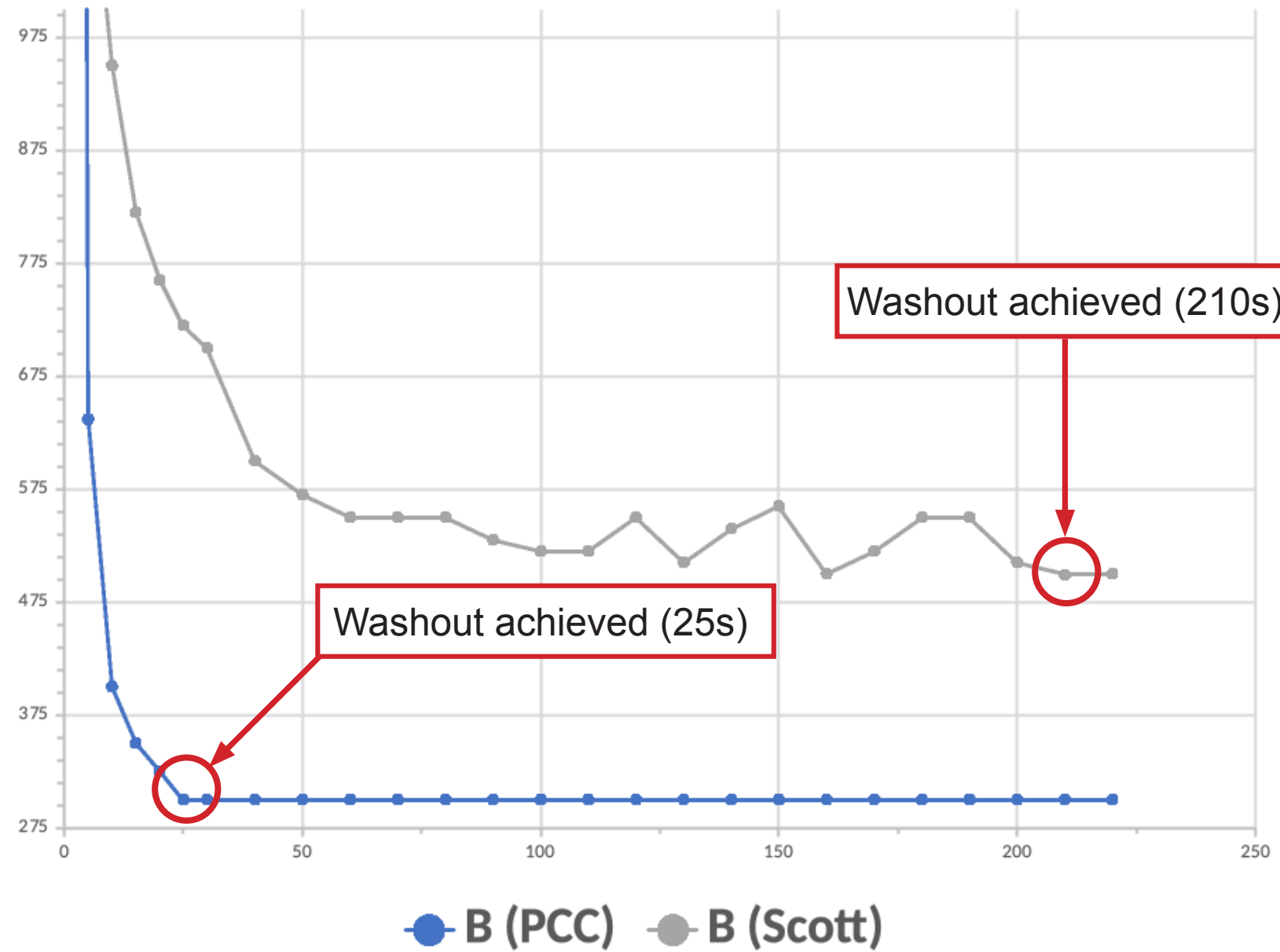


Tracey Spray Chamber

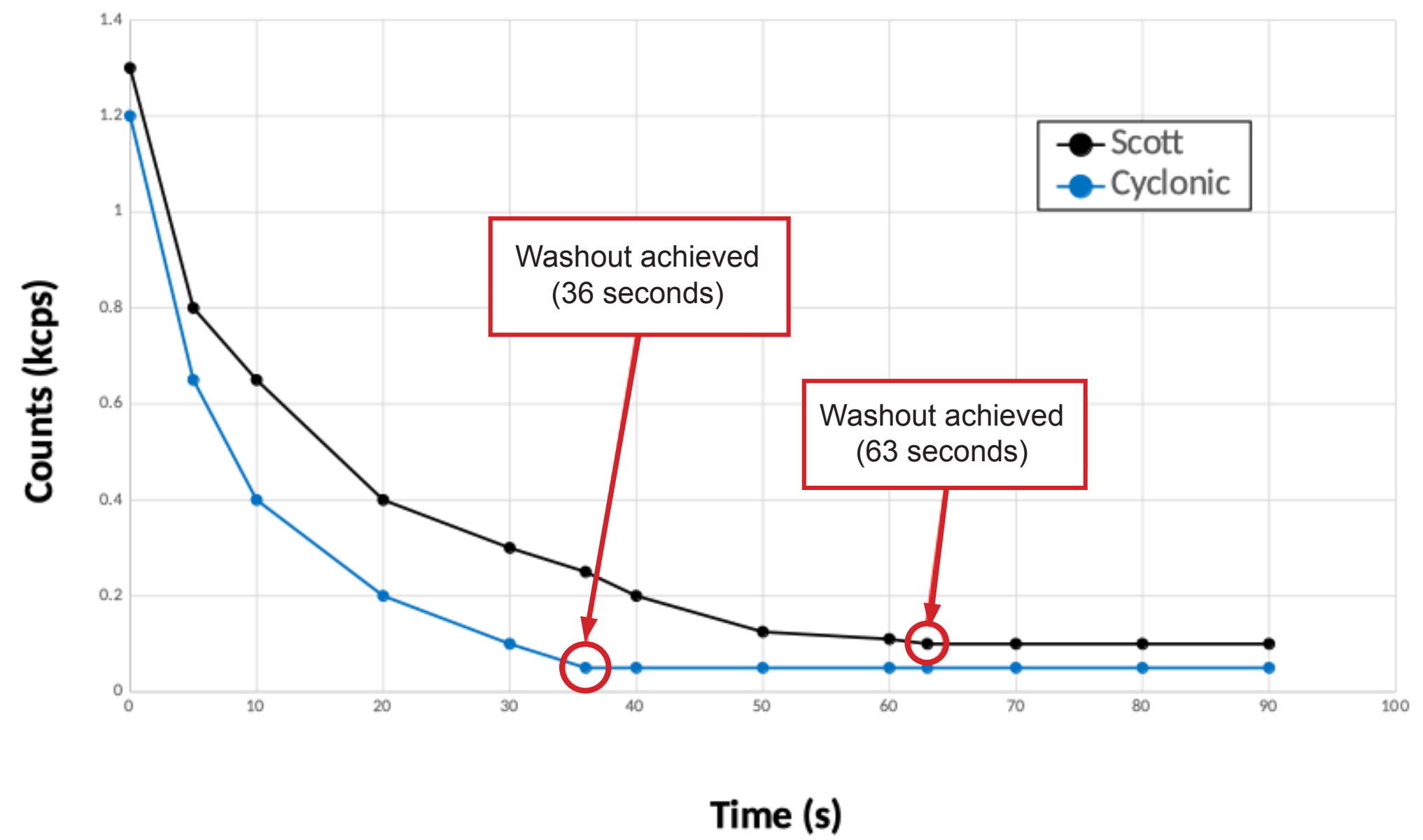


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Washout Comparison (200 ppb Boron)



Washout Comparison (100 ppb Mercury)



Torches



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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 like quartz
- Economical price as you only replace the outer tube



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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.



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Improved Signal Intensity



Analyte	Ceramic Outer Tube	Quartz Outer Tube	% Increase
As	134	117	15
As	173	148	17
Be	214773	180840	19
Cd	4259	3367	26
Co	1050	855	23
Cr	5490	4435	24
Cu	5258	4558	15
Fe	3408	2767	23
Mn	49529	40237	23
Mo	954	778	23
Ni	721	584	24
Pb	285	226	26
Sb	326	278	17
Se	102	90	13
Ti	12964	10820	20
Tl	185	146	27
V	4677	3815	23
Zn	4801	4113	17

*Spectroscopy 35 (2) February 2020

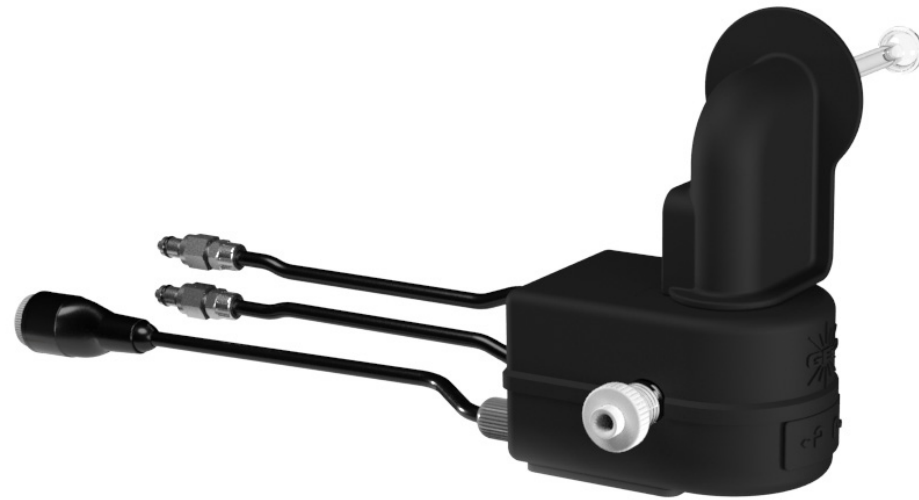
Improved Detection Limits



Element (λ)	Detection Limit (ug/L)	
	Radial Quartz Torch	Radial Ceramic D-Torch
Al 167	1.1	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

*Thermo™ Application Note 43053

New Products



IsoMist-MS



**Jet Vortex Interface
(JVI™)**



**Guardian Autosampler
Probe**



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Guardian™

Drip-Resistant Autosampler Probe

- Robust tip design.
- Drip-resistant.
- Unique inbuilt particle filtering prevents blockages in your nebulizer and capillary tubing.
- All PEEK and PTFE construction.
- Resistance to strong acids and solvents.
- Interchangeable UniFit sample lines (3000mm in length) to accommodate various IDs (e.g. 0.3, 0.50, 0.75 & 1.0mm)
- Available for Cetac, Aim lab, Agilent SPS 4 and PerkinElmer S20 Series Autosamplers.



Guardian Autosampler Probe
Suited for Cetac and PerkinElmer S20 Series Autosamplers



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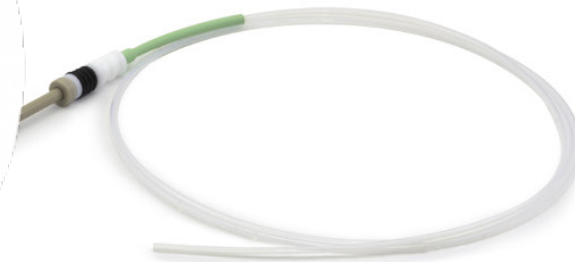
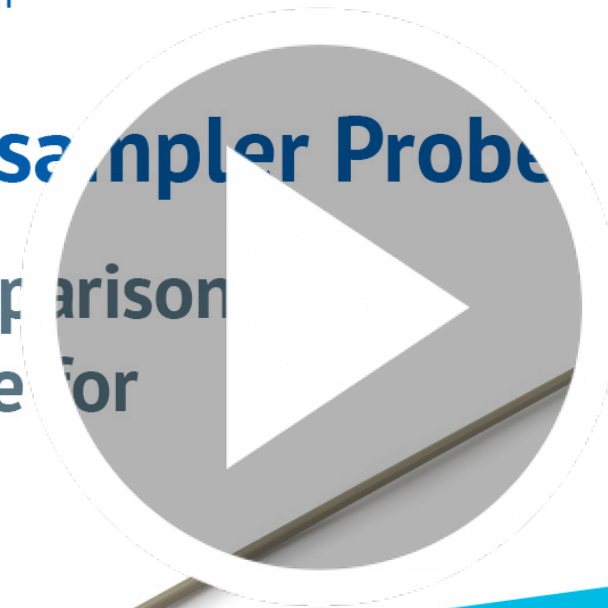
Guardian Probe Performance Comparison

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



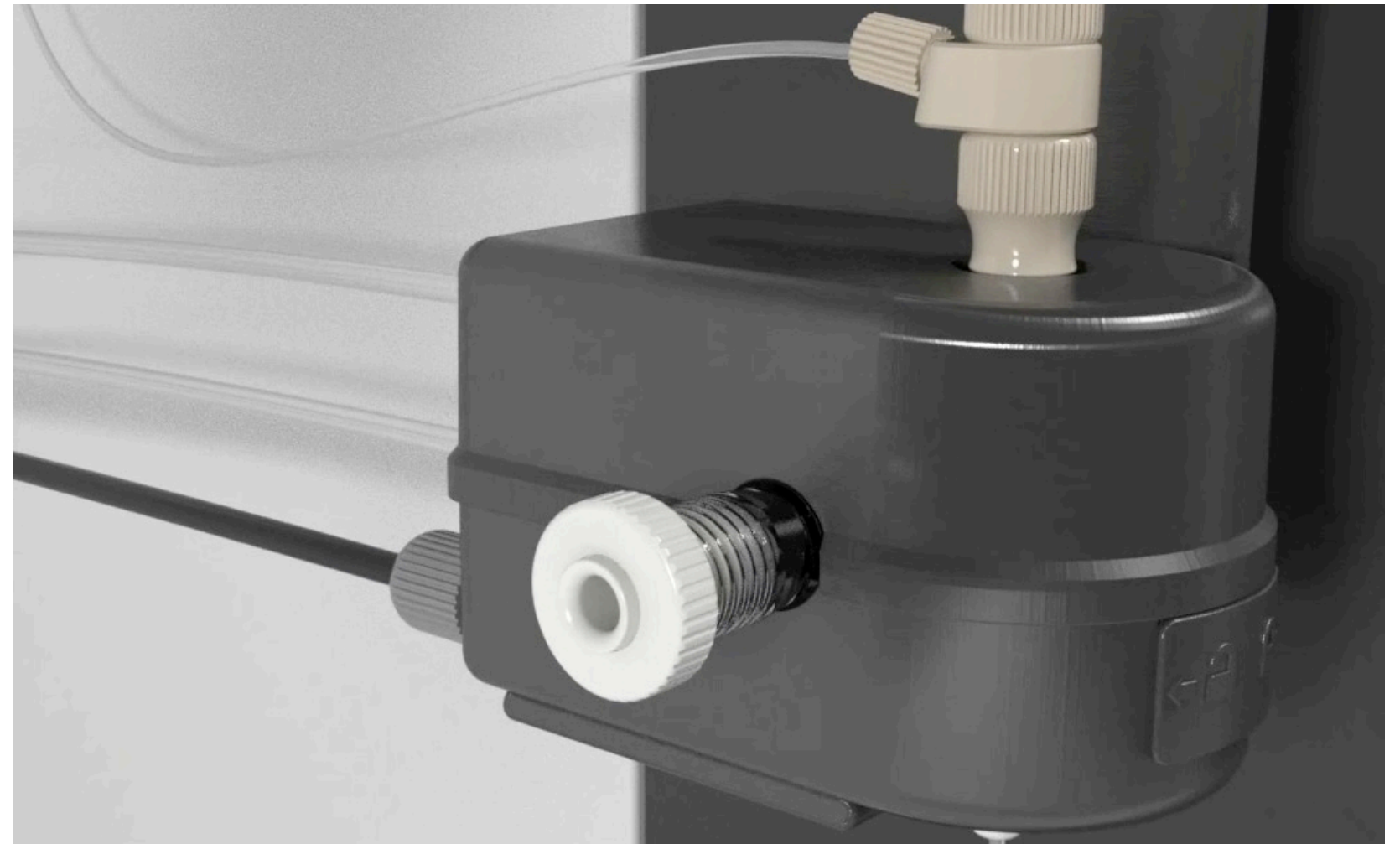
Guardian Autosampler Probe

Performance comparison
carbon fibre probe for
oil applications



IsoMist-MS

- Next Generation IsoMist-Compact.
- DC (Direct Connection) Spray chamber.
- Low volume (30mL) cyclonic spray chamber for faster washout with Helix CT technology.
- Interchangeable Tracey™ DC spray chambers (Glass, PEEK, PFA & Quartz).
- Compatible with UHMI or HMI conditions.
- Light weight design.
- Improved transport efficiency with reduced sample path length.
- Suitable for Agilent® ICP-MS 7700/7800/7850/7900/8800/8900 and Thermo® Q/RQ/TQ ICP-MS.



JVI™ – Jet Vortex Interface

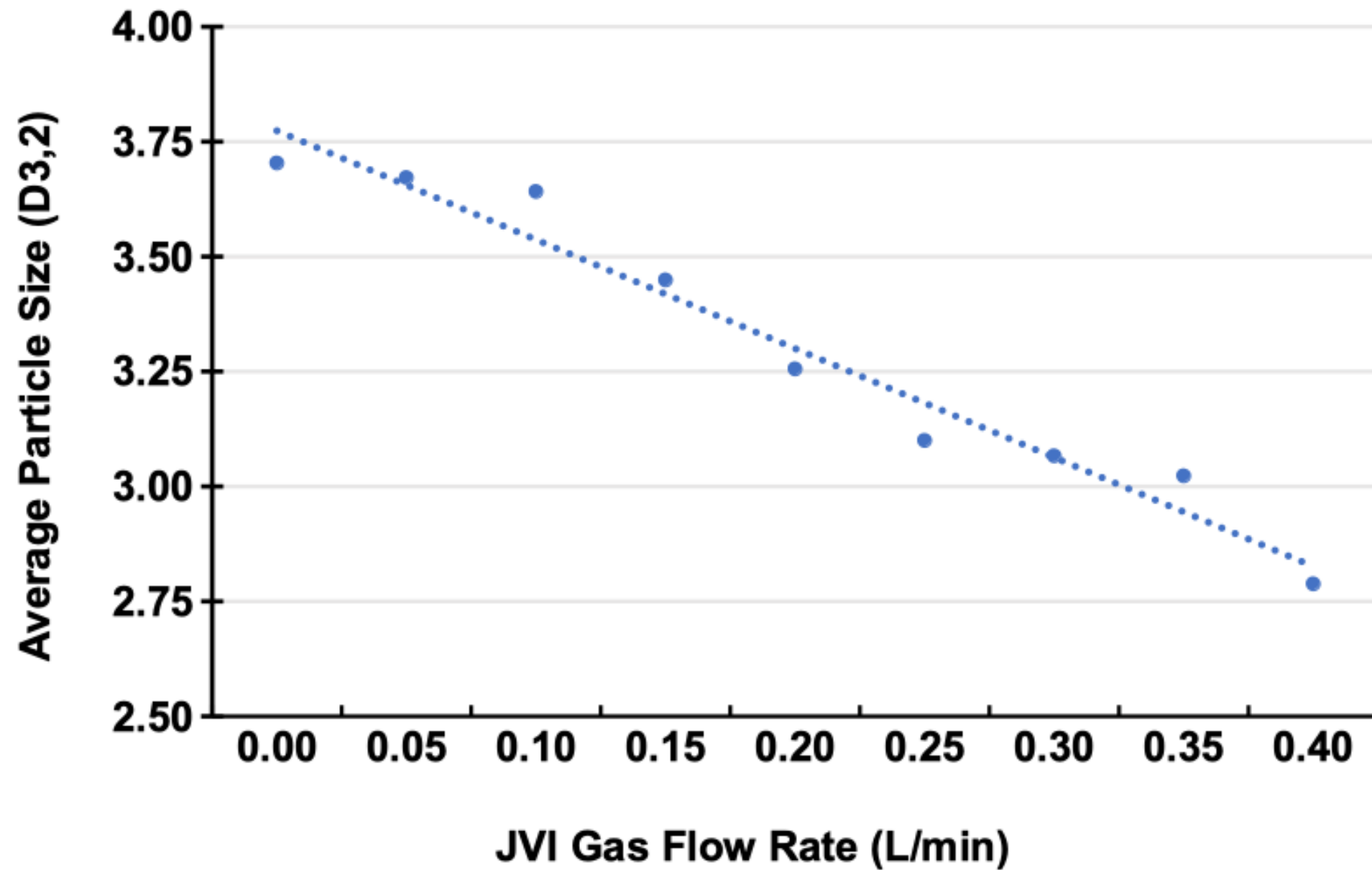
A novel design (Patent Pending), providing highly efficient Aerosol Filtration. Simple and straightforward installation, the JVI works in conjunction with the existing “Make-Up” or “Dilution/Auxiliary ” gas option of your ICP and Glass Expansion DC gas connector. Compatible with any Glass Expansion DC spray chamber. For use with ICP-OES and ICP-MS applications.

Benefits

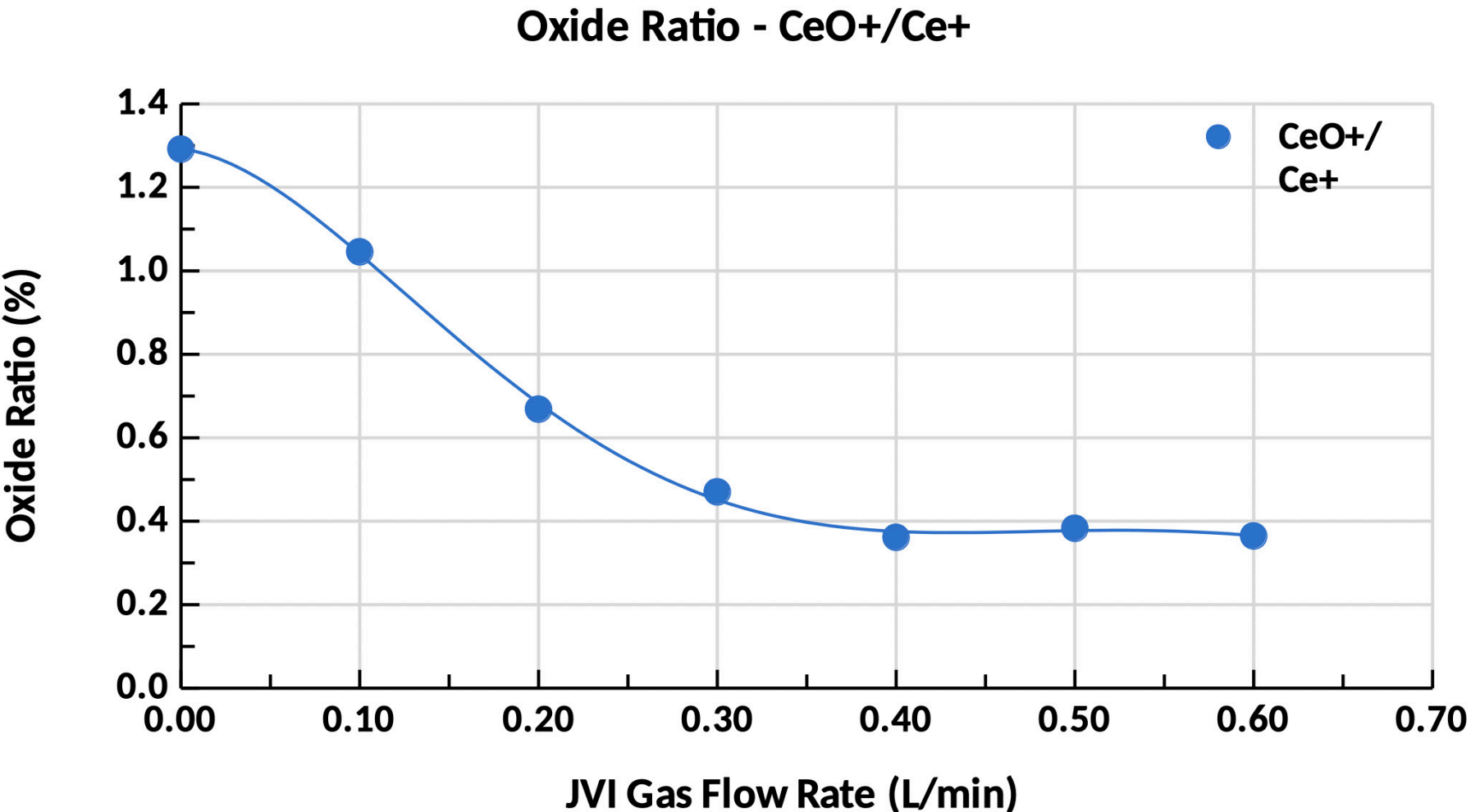
- Reduces average particle size by 3-4% for every 0.05 L/min flow of JVI.
- Chemically inert, made from PEEK.
- Secure connection to gas supply, torch & DC spray chamber.
- Improved life of torch & interface cones.
- Reduce build-up on injector & interface cones.
- More robust plasma conditions.



JVI Gas Flow Rate Effect on Particle Size



JVI: Aerosol Filtration



- The JVI can be utilized to fine tune the plasma conditions for higher matrix samples.
- Increasing the JVI gas flow reduces the Oxide ratio to well below 1%, creating a more robust plasma, ideal for higher matrix samples.
- With a more robust plasma you can achieve higher sensitivity, reduced matrix deposition on the interface, leading to improved stability and less frequent maintenance.

Thank You

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