



**GLASS EXPANSION**  
Quality By Design

# Better Solutions for Optimized ICP Analysis



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



# Introduction



Let's transform your ICP method from "standard" to **SUPERIOR**, focusing on the role of the nebulizer in achieving this goal.

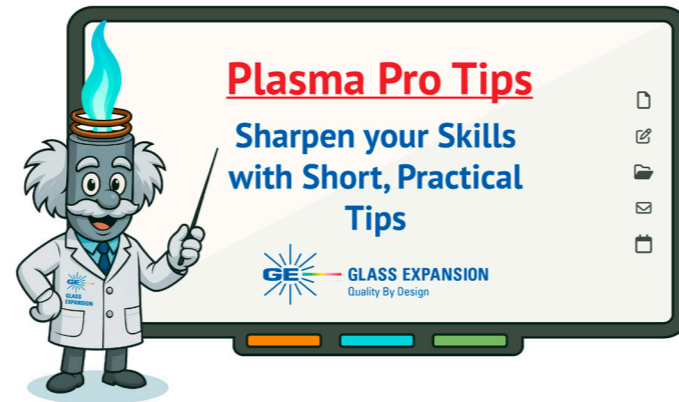
- Nebulizer selection, why choosing the best model matters
- Optimization of nebulizer operating conditions
- Aerosol quality and why it matters for your results
- Practical tips to reduce drift and streamline your daily workflow



# Support and Customer Service



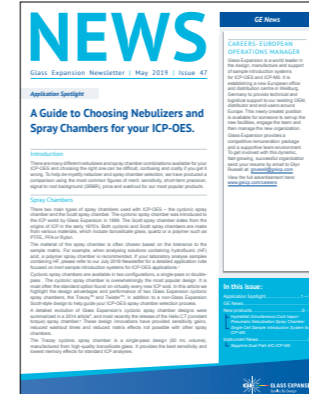
- Over 40 years of expertise
- Fully equipped R&D ICP Laboratory
- Technical team
- Application notes
- Industry News (**NEW**)
- Plasma Professor (**NEW**)
- Catalogs (**NEW**)
- Product flyers
- Website
- Product care advice
- Operating instructions
- Videos



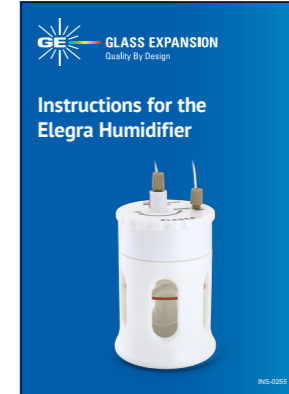
Plasma Professor



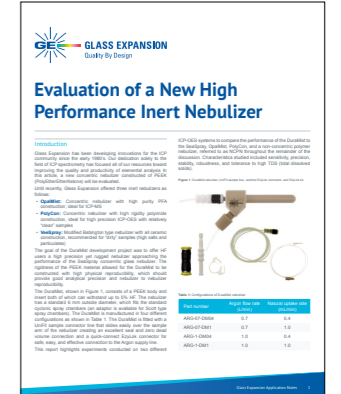
Flyers



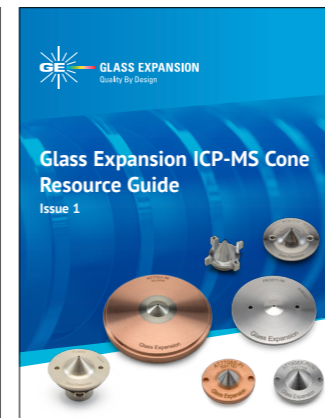
Newsletters



Instructions



Application Notes



Catalogs



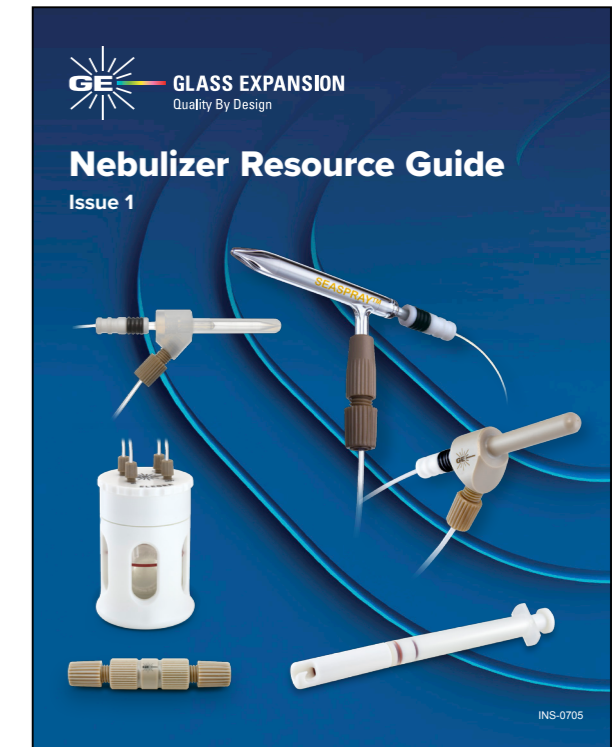
Website



# 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™ 	4	20	*200	No	High	Good	Glass
MicroMist™ 	1	15	*100	No	High	Good	Glass
Conikal™ 	5	5	210	No	High	Good	Glass
Slurry™ 	11	1	280	No	High	Good	Glass
Quartz SeaSpray™ 	5	20	210	No	High	Excellent	Quartz
OpalMist™ 	4	15	*200	Yes	High	Excellent	PFA
DuraMist™ 	4	30	*200	Yes	High	Good	PEEK
VeeSpray™ 	100	30	550	Yes	Moderate	Good	Ceramic



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\*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

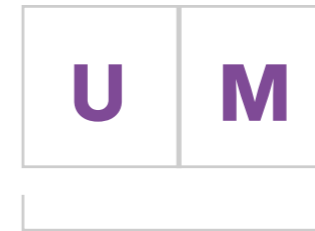
# Understanding Nebulizer Part Numbers



Prefix denoting the type of gas connector to suit ICP model  
e.g. A13 = Agilent®

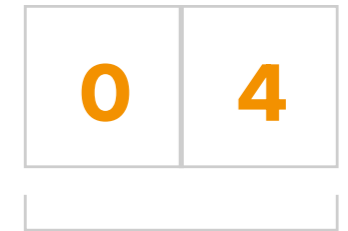


Argon flow in L/min  
e.g. 1 = 1 L/min



**Nebulizer model type:**

- UM = MicroMist
- UC = Conikal
- US = Slurry
- UM = MicroMist
- CV = Ceramic Veerspray
- DM = DuraMist
- USS = SeaSpray
- PFA = OpalMist



Aspirated uptake at nominal argon flow, in mL/min  
e.g. 04 = 0.4mL/min

**Example:** MicroMist DC Nebulizer 0.4mL/min



# Understanding Nebulizer Operating Conditions

## Sample delivery by self-aspiration

MicroMist Nebulizer (P/N A13-1-UM04) operated at 1.0 L/min Argon (40 psi)

Tubing ID (mm)	Uptake Reading ( $\mu\text{L}/\text{min}$ - DI Water)	Decrease from Nominal
0.50	419	
0.25	123	-71%
0.18	84	-80%

Glass Expansion nebulizers are designed to operate at **40 psi (275 kPa)** when set to their specified gas flow

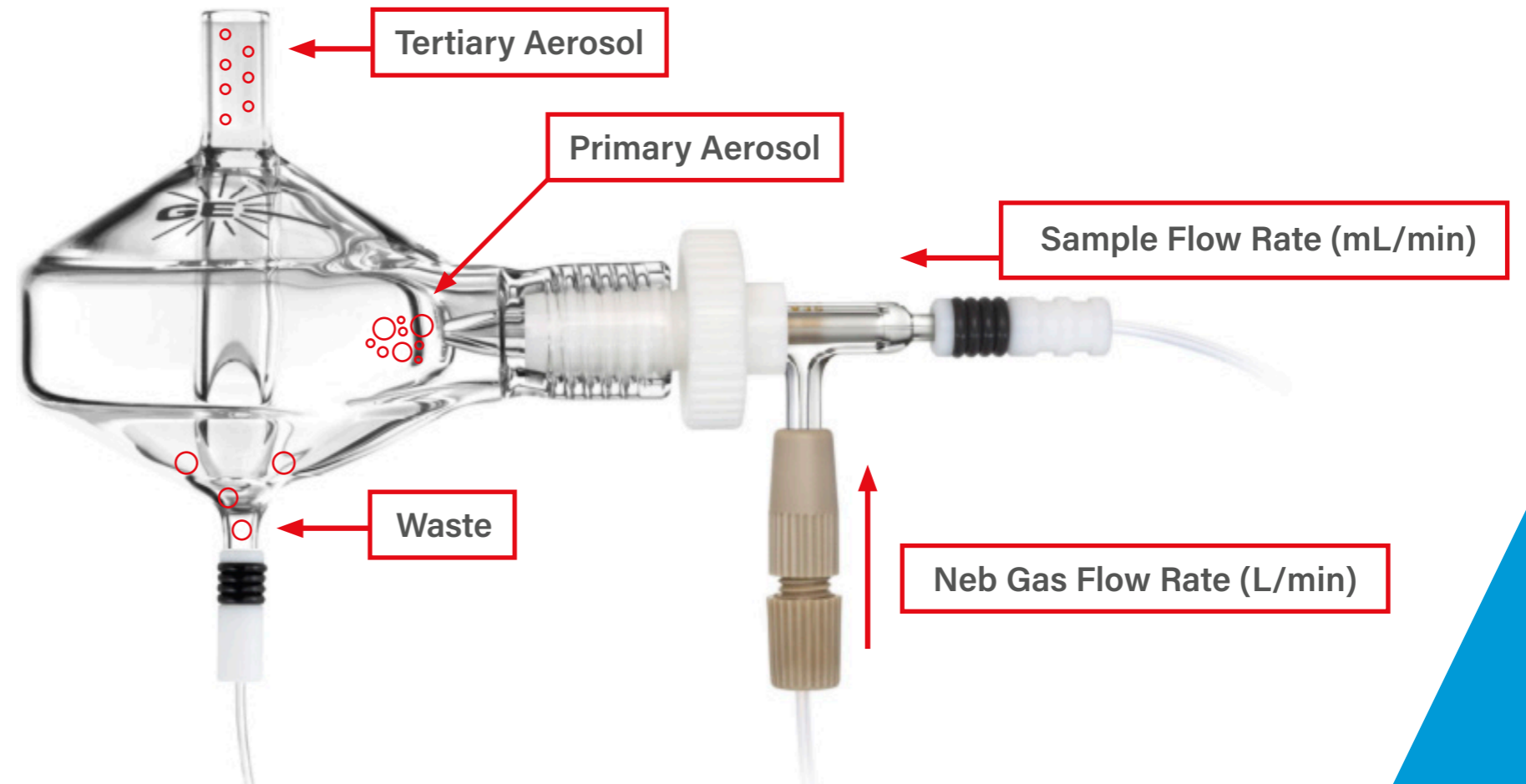
## Sample delivery by peristaltic pump or syringe drive

Nebulizer Model	Recommended Sample Flow Range
A13-07-USS2	0.4 to 3mL/min
A13-07-DM1	0.4 to 2mL/min
A13-1-UM04	0.05 to 1mL/min

# Basics of Aerosol Generation

- Primary Aerosol produced by Nebulizer.
- Tertiary Aerosol “filtered” by Spray Chamber,  $<10\ \mu\text{m}$ .
- Smaller and more uniform droplet size requires less Energy from the plasma.
- For highest transport efficiency you want a higher concentration of droplets with a diameter  $<10\ \mu\text{m}$ .

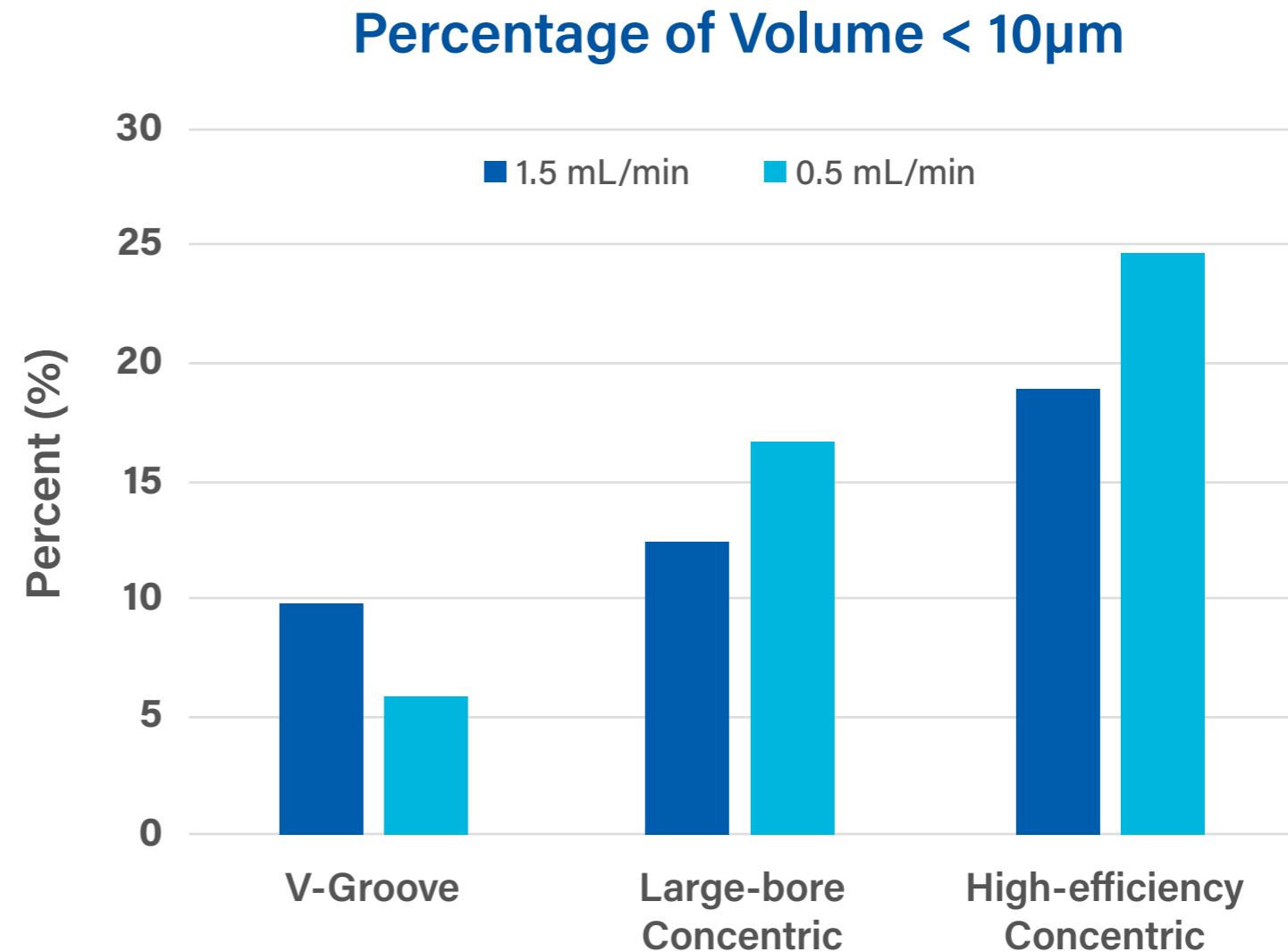
Quality of Aerosol  $\propto$  Quality of Results



# Aerosol Diagnostics

## Effect of nebulizer design and sample flow rate

- Nebulizer gas flow constant at 0.7 L/min Argon
- V-Groove has the lowest percent of droplet sizes less than 10  $\mu\text{m}$
- Lowering sample flow rate for concentric design increases the percent of droplet sizes less than 10  $\mu\text{m}$

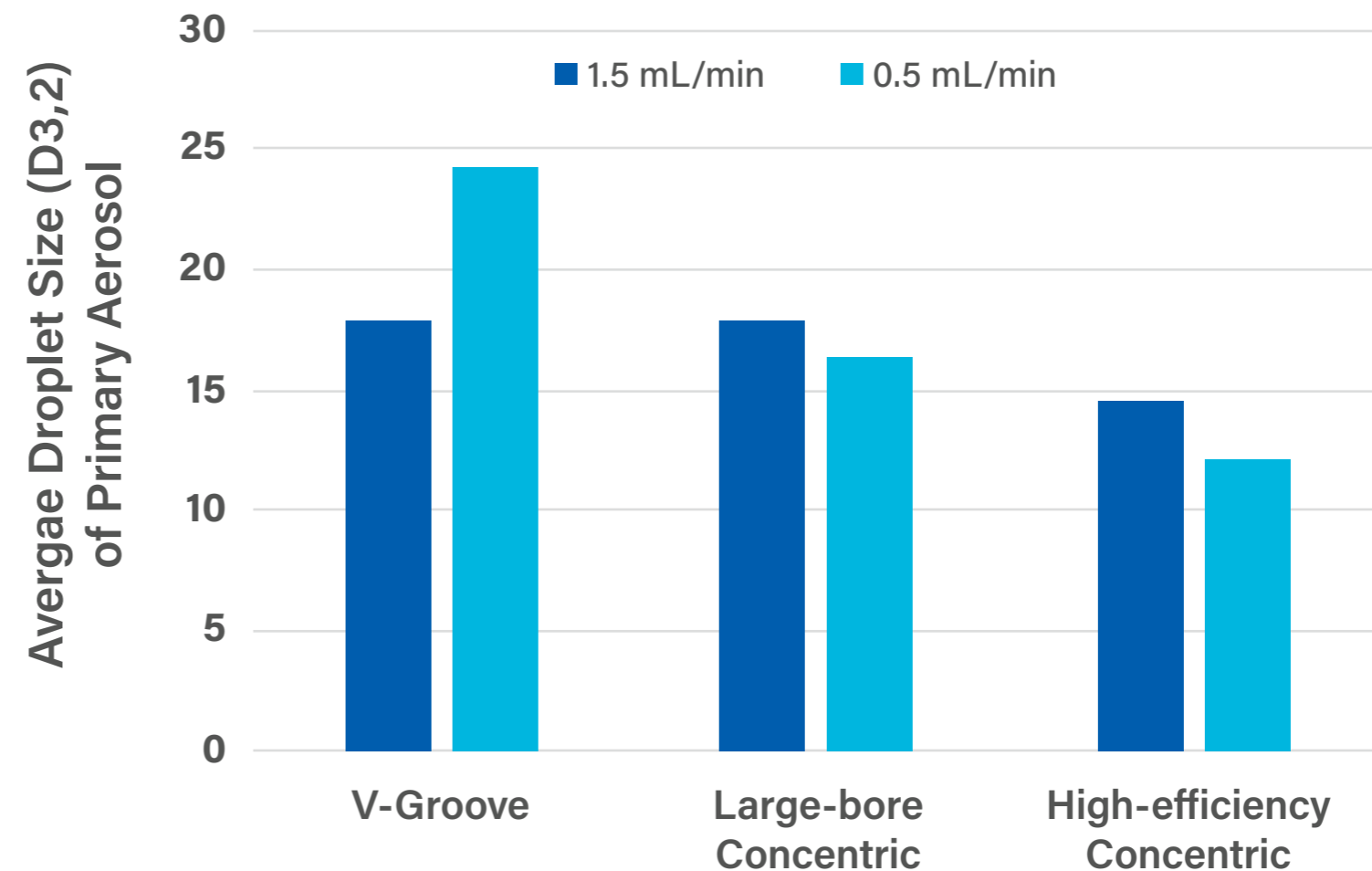


# Aerosol Diagnostics

## Effect of nebulizer design and sample flow rate

- Nebulizer gas flow constant at 0.7 L/min Argon
- V-Groove has the largest average droplet size
- Lowering sample flow rate for concentric design decreases the average droplet size

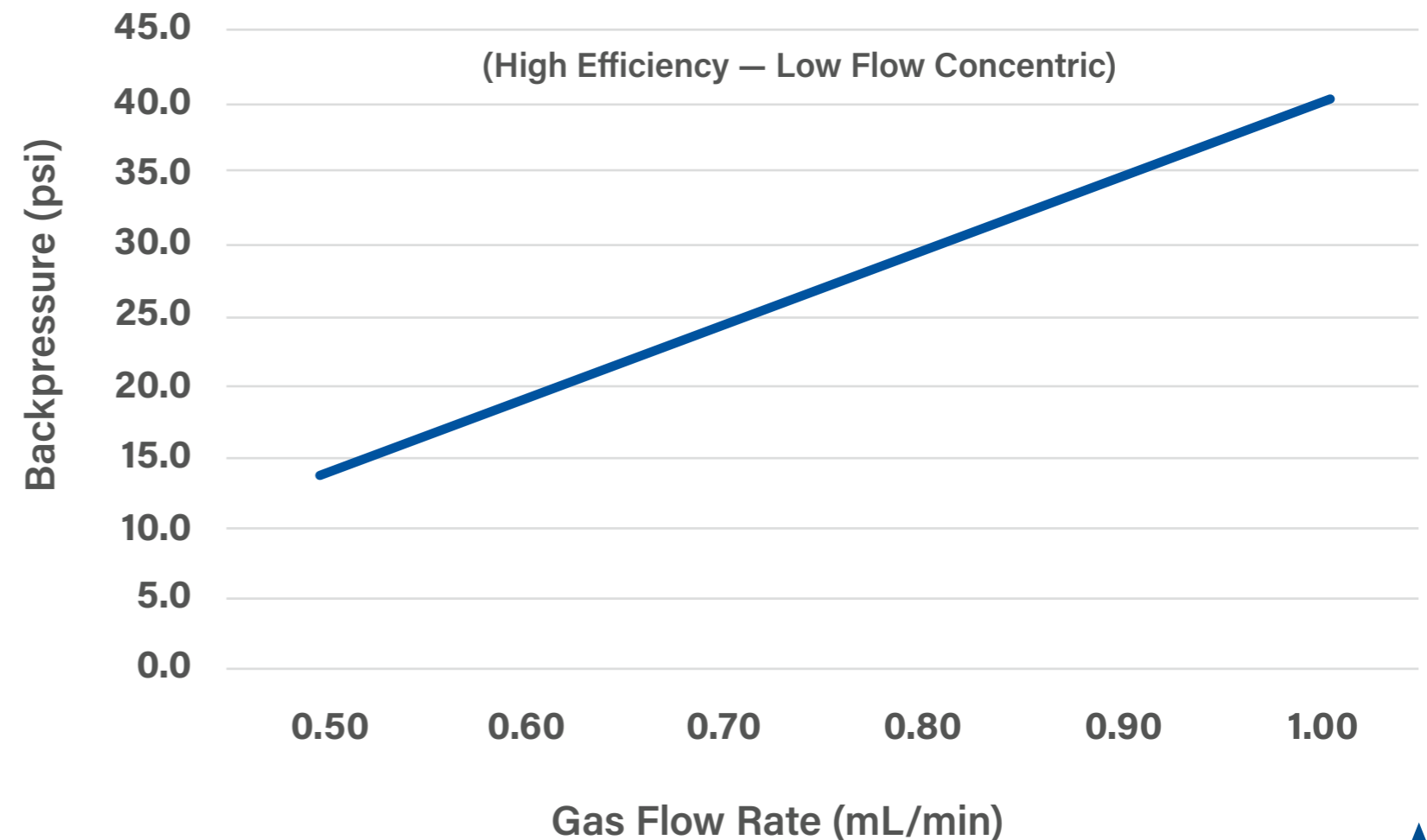
## Sauter Mean Diameter – Average Droplet Size



# Relationship of Backpressure and Gas Flow rate

- **1.0 L/min** Nebulizer model (A13-1-USS04)
- Gas flow rate varied from 0.5 to 1.0 L/min
- Optimum 40 PSI

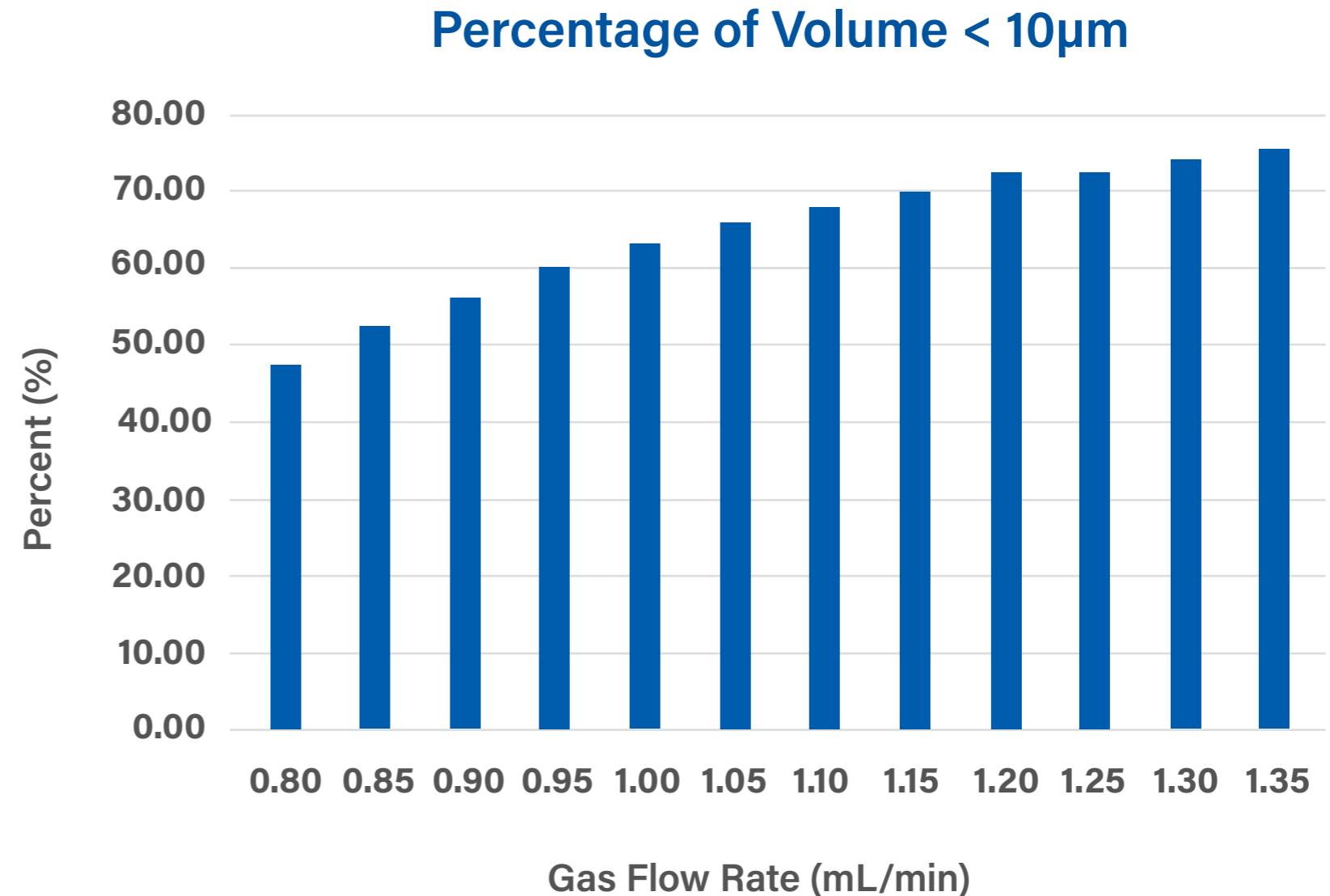
## Relationship of Backpressure and Gas Flow Rate



# Aerosol Diagnostics

## Effect of nebulizer gas flow rate

- Effect of nebulizer gas flow rate –high efficiency concentric (ICP-MS)
- A13-1-USS04
- Nebulizer sample flow constant at 0.4 mL/min
- The percent of droplet sizes less than 10  $\mu\text{m}$  increases as the nebulizer gas flow rate is increased.

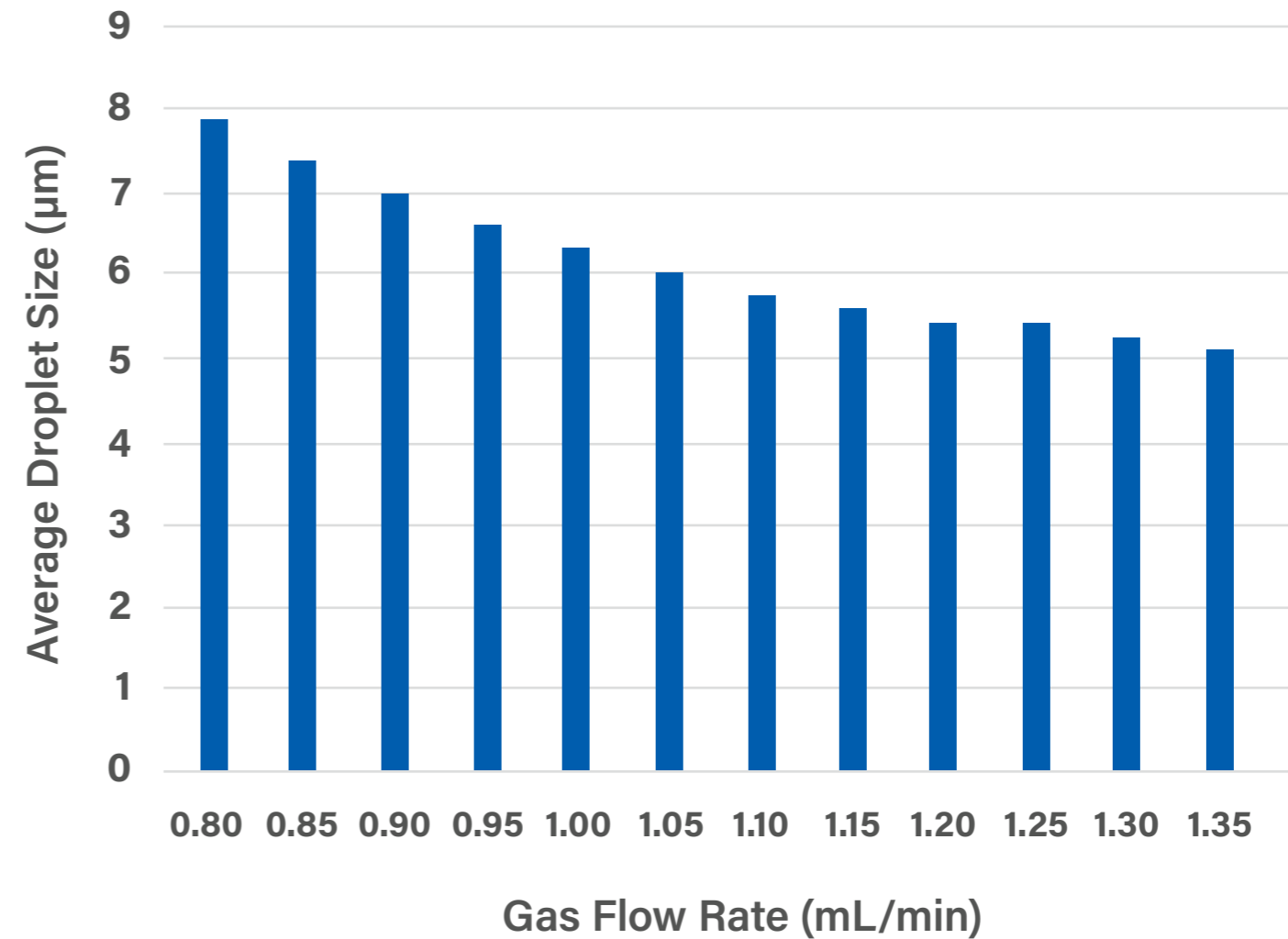


# Aerosol Diagnostics

## Effect of nebulizer gas flow rate

- Effect of nebulizer gas flow rate – high efficiency concentric (ICP-MS)
- A13-1-USS04
- Nebulizer sample flow constant at 0.4 mL/min
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## Sauter Mean Diameter – Average Droplet Size



# Reduce Drift and Streamline Workflows

## 1. Eluo Nebulizer Cleaner

### Why use it?

- **How it helps:** Safe, controlled cleaning using a controlled stream of liquid
- Extends nebulizer life and **maintains consistent performance**
- Use mildly acidic solution or dilute RBS-25 for initial flush, can soak over night and back flush with DI water
- **DI Water and methanol alone are not sufficient cleaning solutions**



Eluo Nebulizer Cleaner

## 2. Eluo Nebulizer Cleaner

### Why use it?

- **How it helps:** Improved signal stability for challenging sample matrices.
- Reduced frequency of maintenance intervals
- Compact design and simple to install, bypass switch to turn on and off.
- Completely inert, no heating or electric power required, and non-pressurized vessel.



Elegra



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# Want a FREE review of your Sample Introduction System?

Please contact us by email ([geusa@geicp.com](mailto:geusa@geicp.com)) to:

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



# Thank You

## Asia Pacific

6 Central Boulevard  
Port Melbourne VIC 3207  
Australia

Phone: +61 3 9320 1111  
Email: [enquiries@geicp.com](mailto:enquiries@geicp.com)

## Americas

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

Phone: 508 563 1800  
Email: [geusa@geicp.com](mailto:geusa@geicp.com)

## Europe

Friedenbachstrasse 9,  
35781 Weilburg,  
Germany

Phone: +49 6471 3778517  
Email: [gegmbh@geicp.com](mailto:gegmbh@geicp.com)



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

