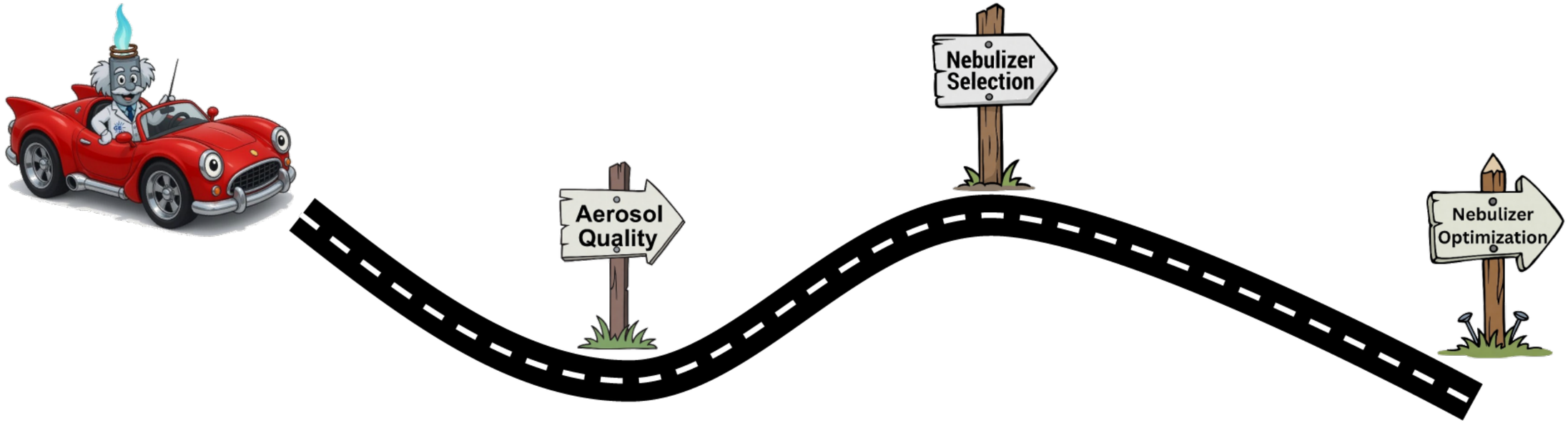
Plasma Pro Tips

Recommended Nebulizer Operating Parameters

GLASS EXPANSION
Quality By Design

Introduction

Let’s transform your ICP method from “standard” to SUPERIOR, focusing on the role of the nebulizer in achieving this goal.

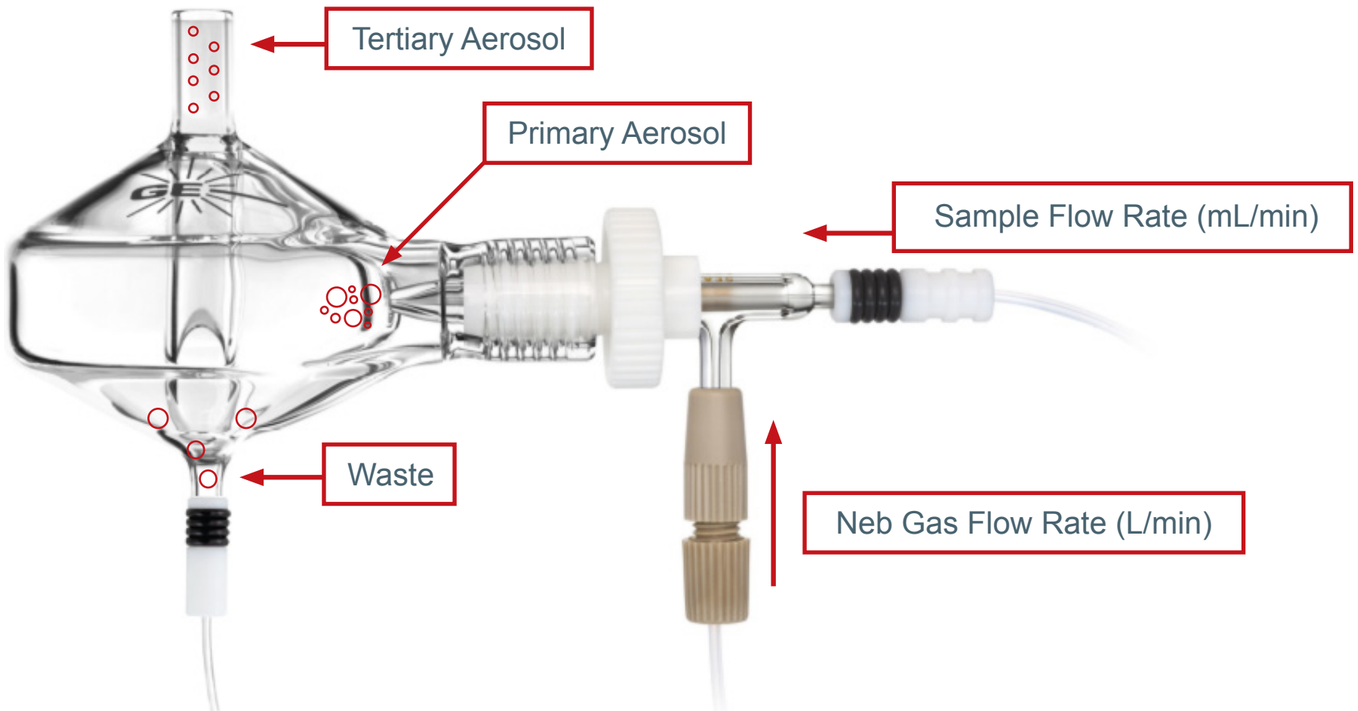


GLASS EXPANSION
Quality By Design

Basics of Aerosol Generation

Quality of Aerosol ∝ Quality of Results

- Primary Aerosol produced by Nebulizer
- Tertiary Aerosol “filtered” by Spray Chamber, <10 µm
- 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 µm



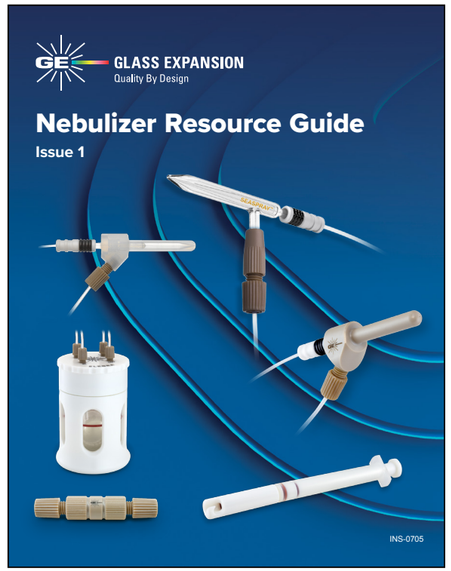
GLASS EXPANSION
Quality By Design

Nebulizer Selection

Selecting the right nebulizer requires careful consideration of various factors:

Nebulizer	Dead Volume V_0 (µL)	TDS (%)	Particulates (µm)	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

***Particle Size Tolerance (µm): 200 =** USS1, USS2, DM2, PFA2; **140 =** PFA1, DM1; **100 =** USS04, PFA04, DM04; **90 =** UM02, UM01, UM005; **70 =** PFA005, PFA01, PFA02



Scan to Download

GLASS EXPANSION
Quality By Design

Understanding Nebulizer Part Numbers

Example: MicroMist DC Nebulizer 0.4mL/min

A	1	3	1	U	M	0	4

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 Veespray
DM = DuraMist
USS = SeaSpray
PFA = OpalMist

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

GLASS EXPANSION
Quality By Design

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 (µL/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 (276 kPa)** when set to their specified gas flow

Sample delivery by peristaltic pump or syringe drive

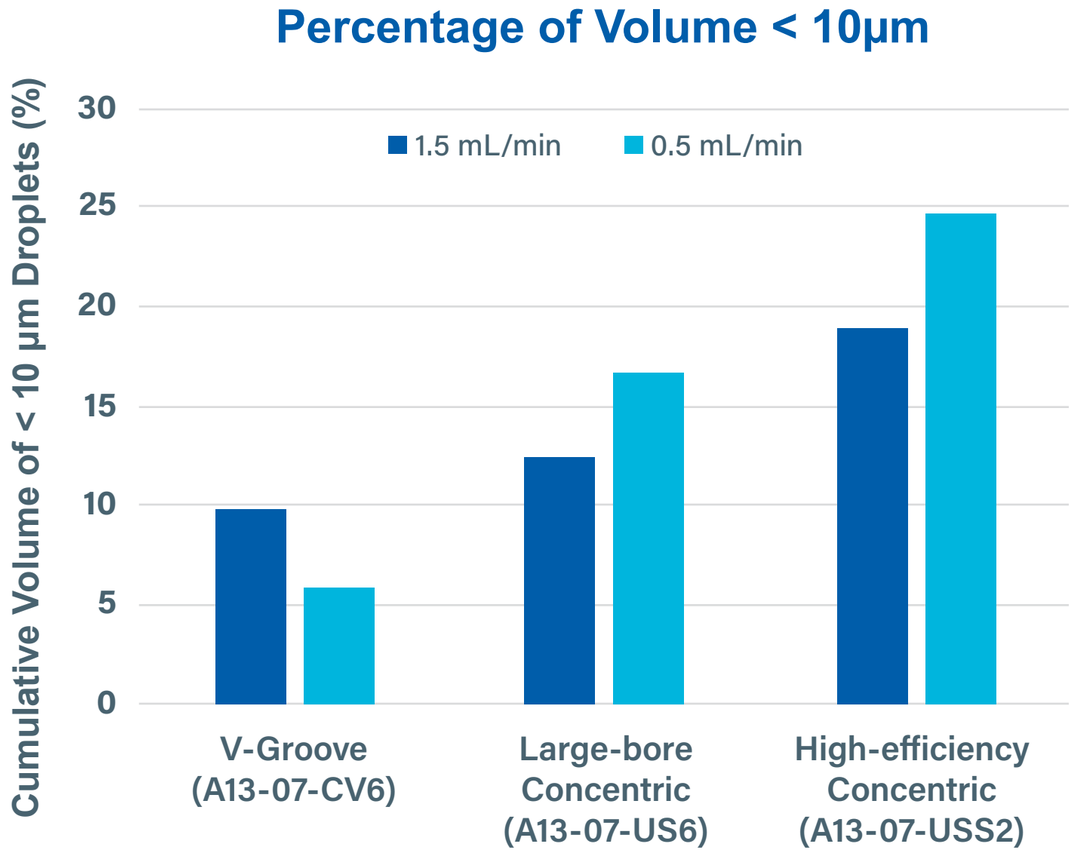
Nebulizer Model	Recommended Sample Flow Range
A13-07-USS2	0.4 to 3mL/min
A13-07-DM1	0.4 to 2mL/min
A13-1-UM04	0.05 to 1mL/min

GLASS EXPANSION
Quality By Design

Primary Aerosol Diagnostics

Effect of nebulizer design and sample flow rate

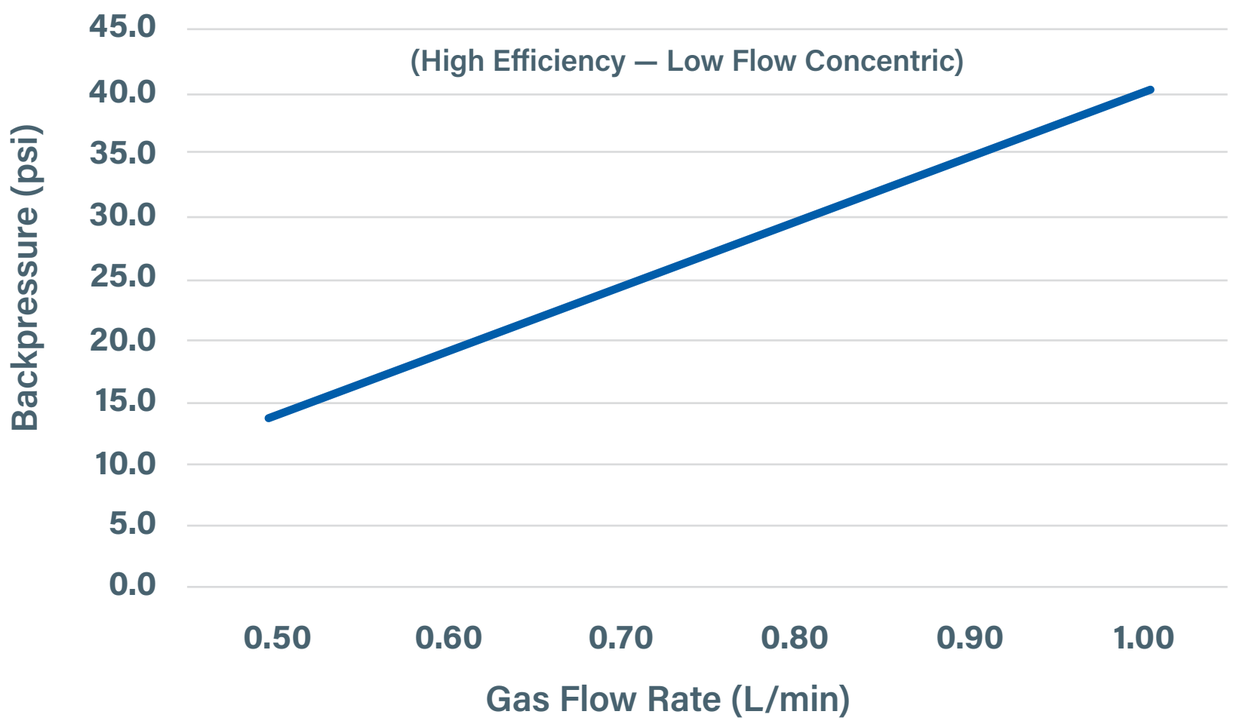
- Nebulizer gas flow constant at 0.7 L/min Argon
- V-Groove has the lowest percent of droplet sizes less than 10 µm
- Lowering sample flow rate for concentric design increases the percent of droplet sizes less than 10 µm



GLASS EXPANSION
Quality By Design

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 achieved at 1.0 L/min**

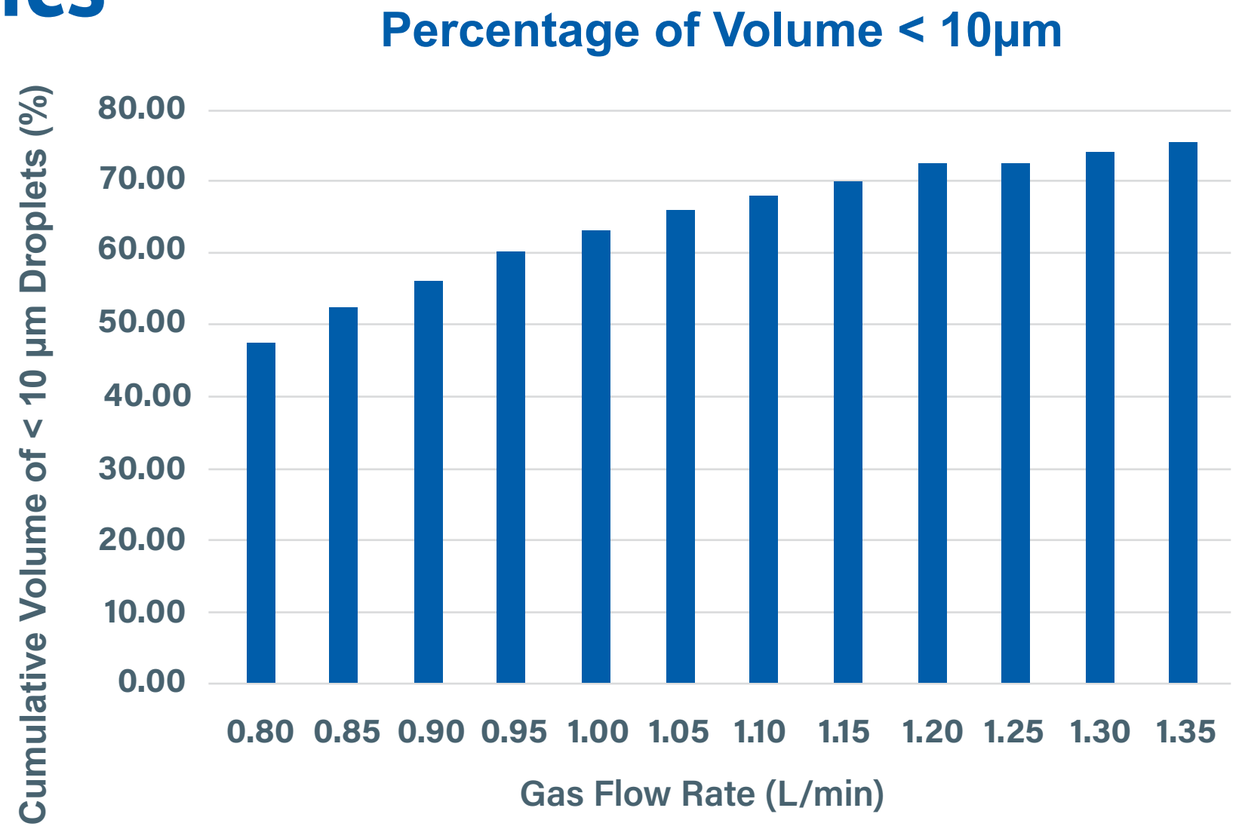


GLASS EXPANSION
Quality By Design

Primary Aerosol Diagnostics

Effect of nebulizer gas flow rate

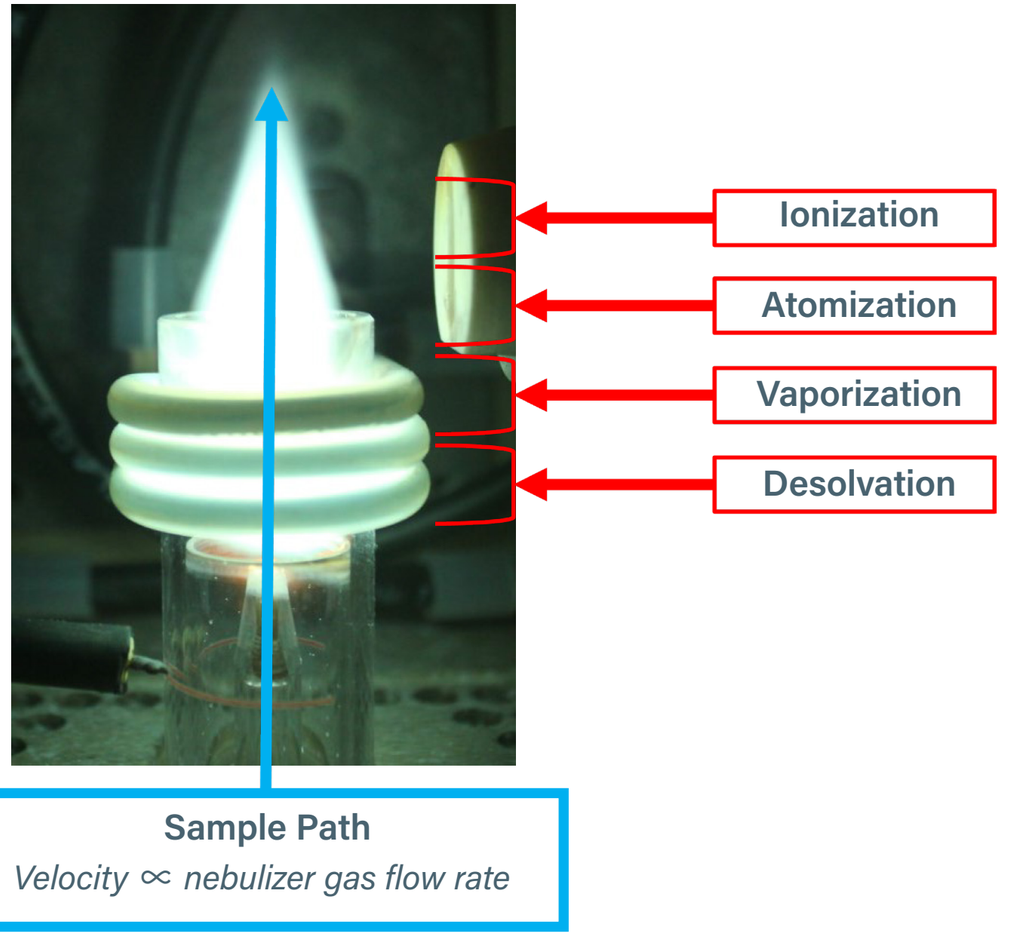
- Effect of nebulizer gas flow rate – high efficiency concentric (ICP-MS)
- A13-1-USS04
- Nebulizer sample flow constant at 0.4 mL/min
- The percent of droplet sizes less than 10 µm increases as the nebulizer gas flow rate is increased



GLASS EXPANSION
Quality By Design

What Does it Mean to Optimize

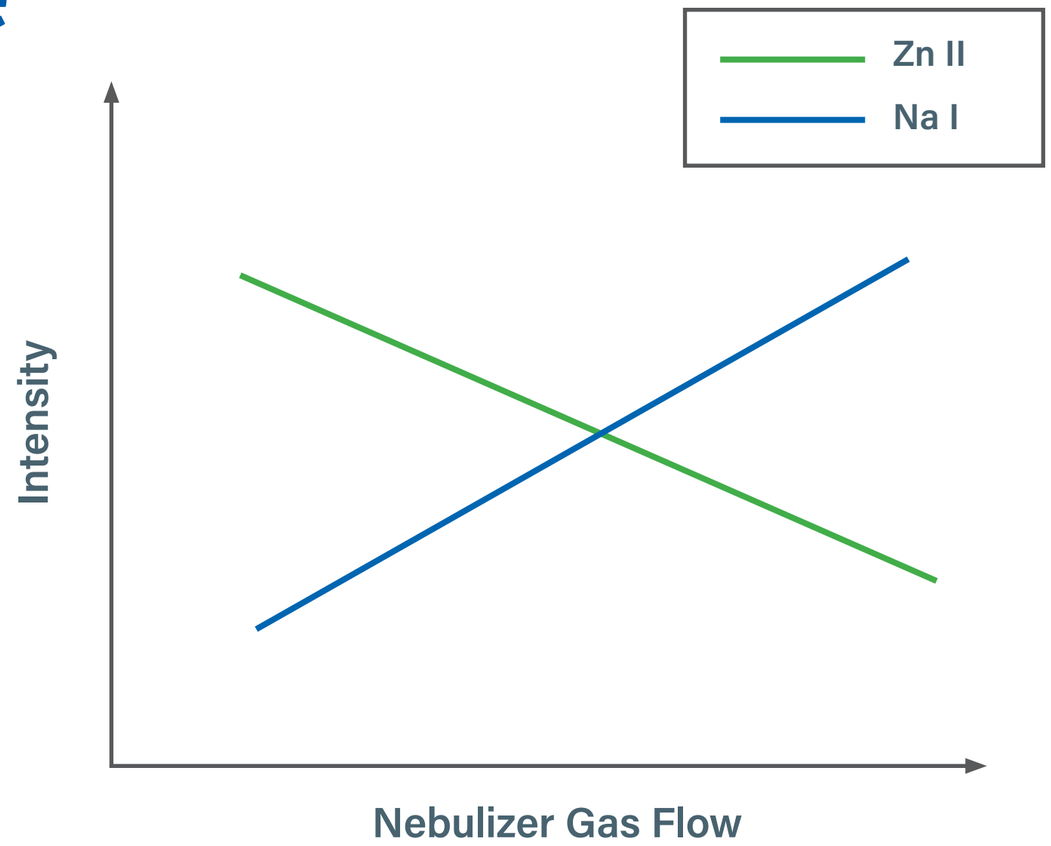
Line	Wavelength (nm)	Ionization Energy (eV)
Zn II	202.548	17.96
Cd II	214.439	16.91
Mg II	279.553	15.04
Mg I	285.213	7.65
Li I	670.784	5.39
Na I	589.595	5.14



GLASS EXPANSION
Quality By Design

What Does it Mean to Optimize

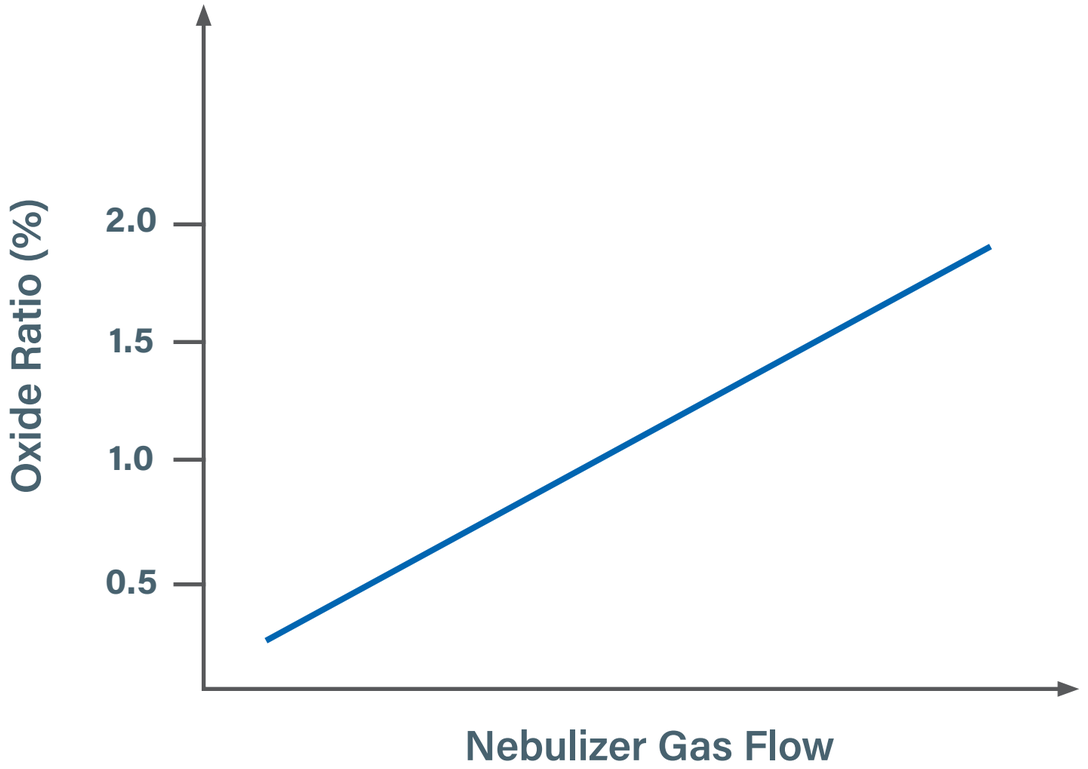
Line	Wavelength (nm)	Ionization Energy (eV)
Zn II	202.548	17.96
Cd II	214.439	16.91
Mg II	279.553	15.04
Mg I	285.213	7.65
Li I	670.784	5.39
Na I	589.595	5.14



GLASS EXPANSION
Quality By Design

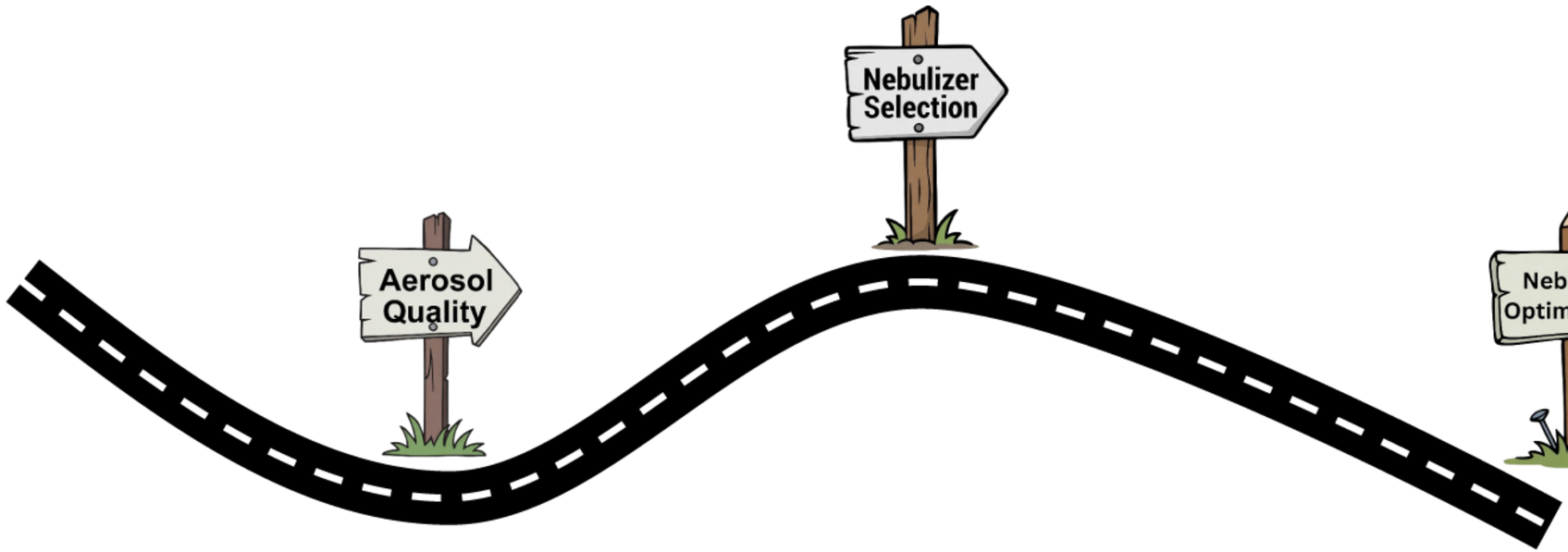
What Does it Mean to Optimize

Analyte	Purpose
^{7}Li	Low-mass sensitivity
^{24}Mg	Low-mass sensitivity
^{59}Co	Mid-mass sensitivity
^{89}Y	Mid-mass sensitivity
^{140}Ce	(CeO^{+}/Ce^{+}) and (Ce^{++}/Ce)
^{208}Pb	High-mass sensitivity



GLASS EXPANSION
Quality By Design

Lets Recap Today's Session

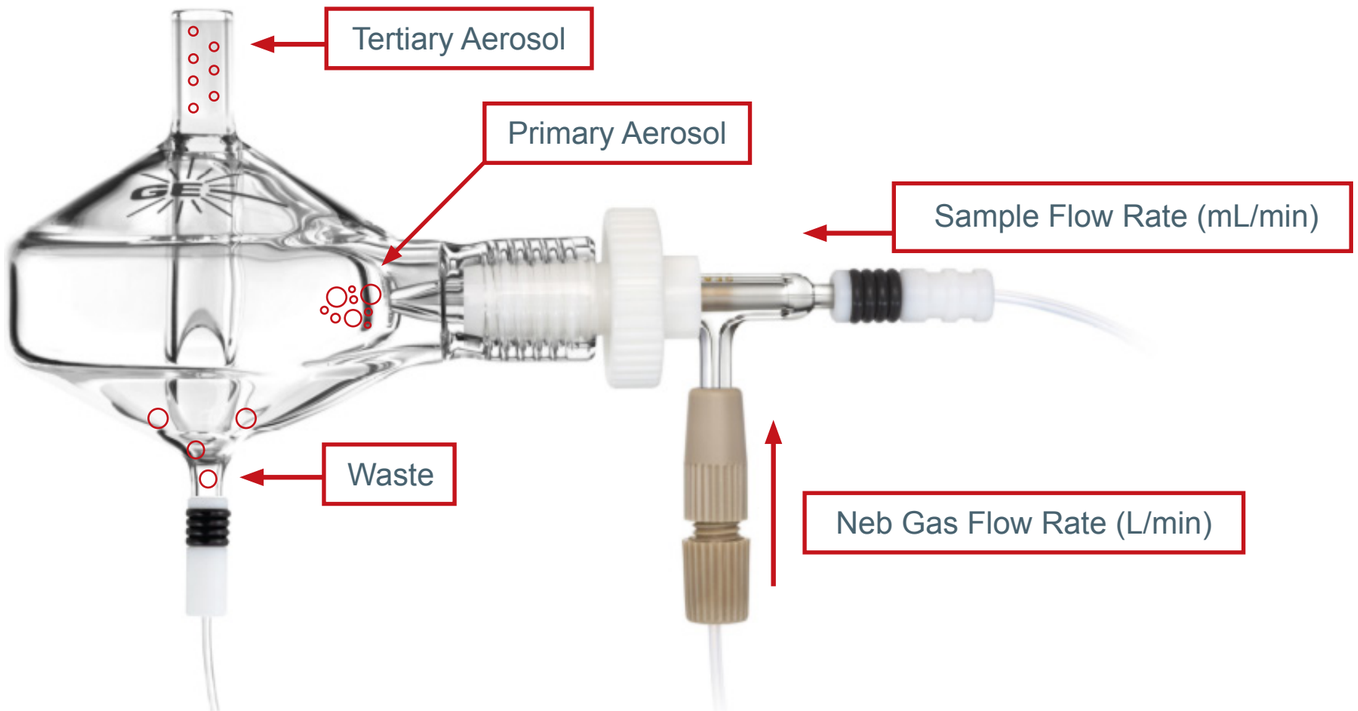


GLASS EXPANSION
Quality By Design

Basics of Aerosol Generation

Quality of Aerosol ∝ Quality of Results

- Primary Aerosol produced by Nebulizer
- Tertiary Aerosol “filtered” by Spray Chamber, <10 µm
- 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 µm



GLASS EXPANSION
Quality By Design

Understanding Nebulizer Part Numbers

Glass Expansion nebulizers are designed to operate at **40 psi (276 kPa)** when set to their specified gas flow

A	1	3	1	U	M	0	4

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:

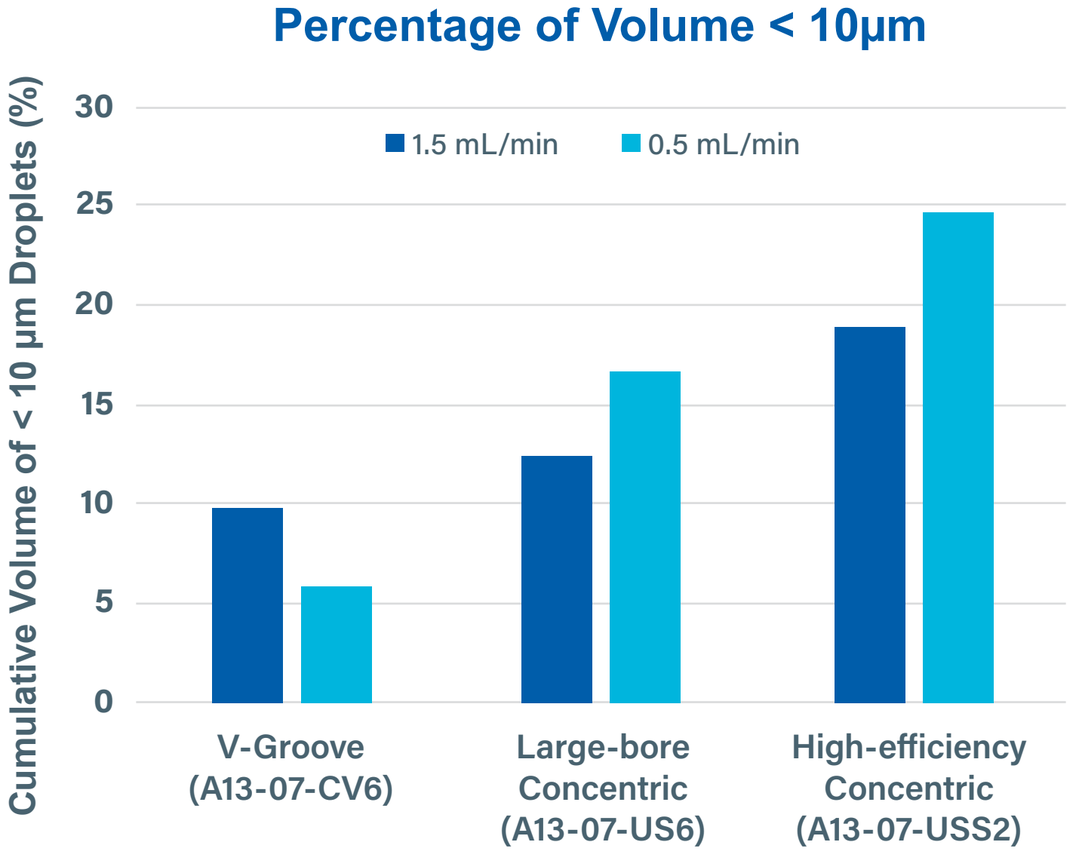
UM = MicroMist
UC = Conikal
US = Slurry
UM = MicroMist
CV = Ceramic Veespray
DM = DuraMist
USS = SeaSpray
PFA = OpalMist

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

GLASS EXPANSION
Quality By Design

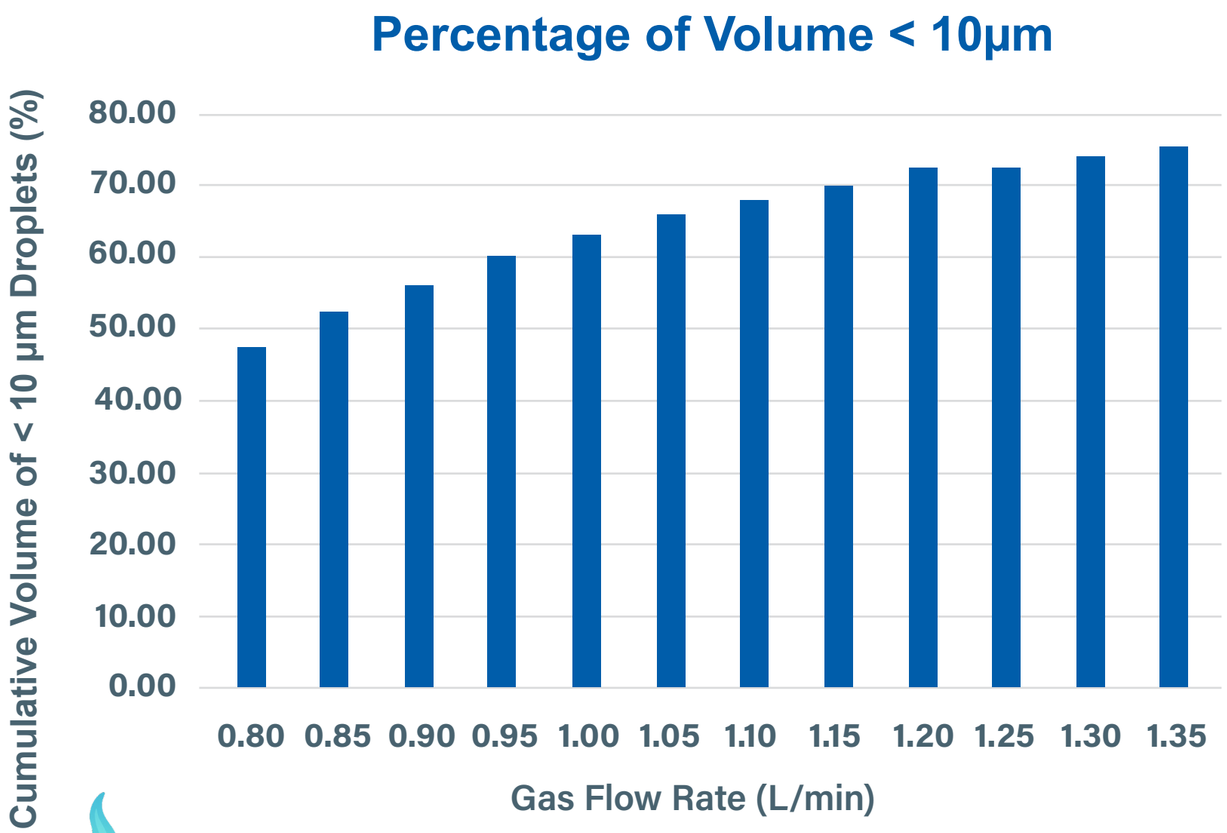
Primary Aerosol Diagnostics

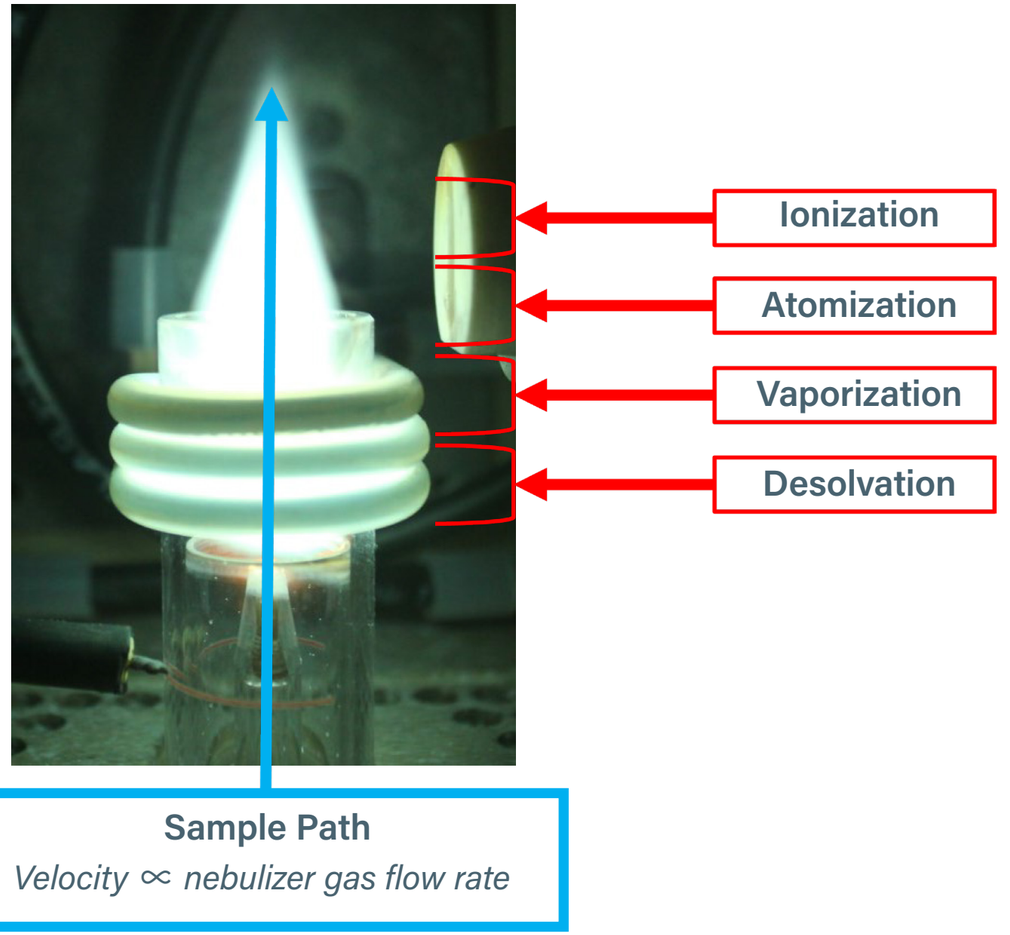
Effect of nebulizer design and sample flow rate



GLASS EXPANSION
Quality By Design

What Does it Mean to Optimize





GLASS EXPANSION
Quality By Design

See you next time!

www.geicp.com

Scan to submit
a question!