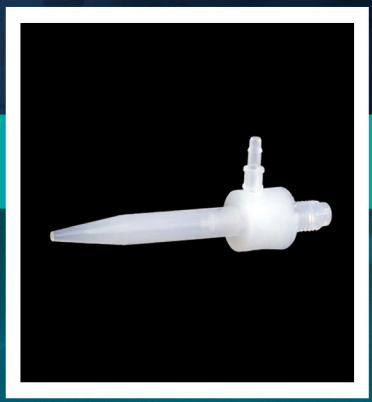
Advanced Automation and Sample Introduction Systems

for PerkinElmer Avio 200 & 500 ICP



Elemental Scientific

NEW PRODUCTS FEATURED

SampleSense *FAST* and prep*FAST*

Automatically detect and inject liquid samples with SampleSense technology. New inert injection valve with optical sensing of the sample for ultra-high throughput and reliability. Maximizes productivity, simplifies method development, monitors sample loading, minimizes sample consumption, and compensates for changes in the sample uptake pathway. (Pages 24-25)

prep3

Automated inline dilution system which uses peristaltic pumps to perform precise and accurate inline dilution of samples and standards. (Pages 32-35)

prep*FAST* e

Economical inline dilution system that provides low cost syringe dilution and laboratory automation. Capable of dilution factors ranging from 1 to 50. (Pages 14-15)

prep*FAST* M5

Autocalibration and autodilution system with syringe sample loading for small and viscous samples. (Pages 18-19)

ZipTorches and Injectors

Torch and injector design for Avio 200 and Avio 500 ICPs that can be used interchangeably between the two systems and installed in a matter of seconds. (Pages 59-63)

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CONSUMABLES

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ESI Autosamplers

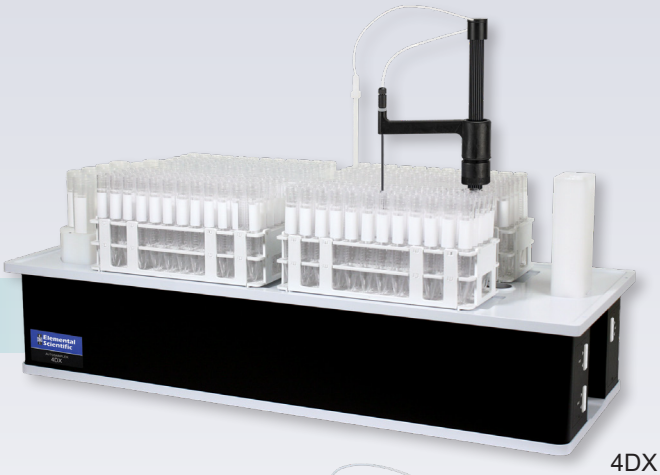
ESI autosamplers are durable, chemically inert, and feature dual flowing rinse stations to reduce carryover. Flexible rack configurations along with the ability to **upgrade to any** high-throughput *FAST* or autodiluting prep*FAST* system, make ESI autosamplers the perfect foundation for automation in any trace metal lab. Three autosampler models having five different rack capacities ranging from 2 micro racks up to 14 large racks, the largest on the market.

2DXe

DXe – Economical

DXe economical autosampler features:

- Durable dual rail system
- Dual flowing rinse stations
- Precision sampling
- Reset probe–prevents probe damage
- Flexible rack configurations
- Available rack capacities (Micro, 2, 4, 8 & 14)



4DX

DX – *FAST* Ready

DX autosampler features:

- DX autosamplers have all of the benefits of DXe autosamplers
- *FAST* Ready
  - Upgradeable to *FAST* (pg 8)
  - Upgradeable to prep*FAST* (pg 10)
- Available rack capacities (Micro, 2, 4, 8 & 14)

8DXCi

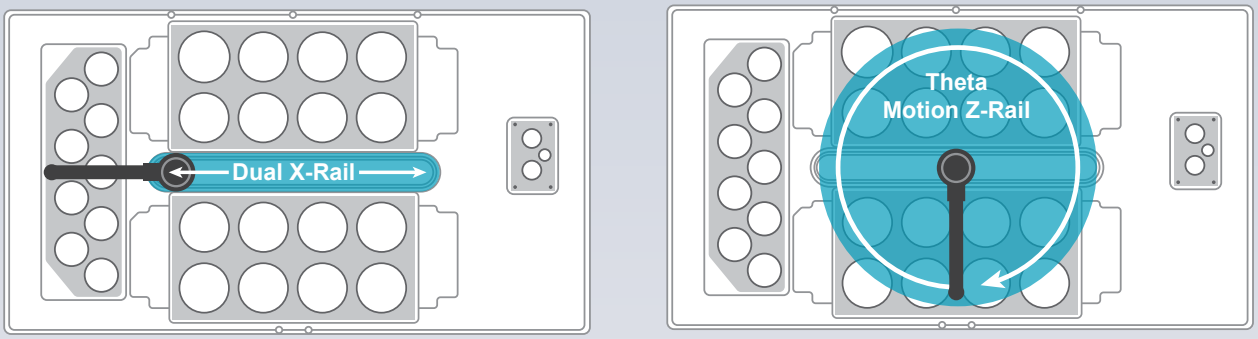
DXCi – Autocorrecting

DXCi autosampler features:

- DXCi autosamplers have all of the benefits of DX autosamplers
- Automatically monitors and corrects positions for all axes of motion
- Corrects for accidental obstructions
- SampleSense *FAST* Ready
  - Upgradeable to SampleSense *FAST* (pg 24)
  - Upgradeable to SampleSense prep*FAST* (pg 25)
  - Upgradeable to SampleSense ultra-high throughput (pg 26)
- Available rack capacities (Micro, 2, 4, 8 & 14)

ESI Autosamplers are Engineered to be Precise and Durable

All ESI autosamplers are designed for the trace metal lab. They utilize a Dual X-rail design combined with a large diameter Z-rail with theta angular motion for precise sampling. All DX components are constructed using chemically resistant materials for an exceptionally long lifetime.

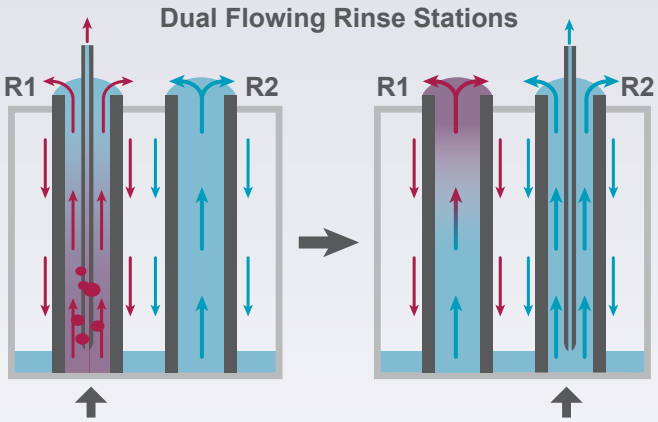


MicroDX autosampler shown

Dual Rinse Stations Reduce Carryover

Eliminating carryover is vital for accurate data and paramount to the production laboratory.

All ESI autosamplers have dual rinse stations to minimize sample-to-sample carryover. Rinse liquid is supplied by a common rinse pump split between two rinse station positions. With independent rinse pumps, each station can use a different rinse solution to effectively rinse wide-ranging sample types while minimizing rinse solution consumption.



1st Rinse
Remove residue from previous sample

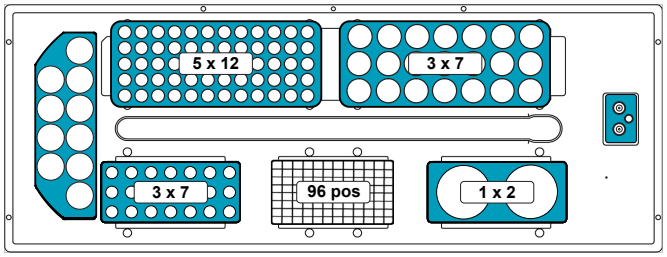
Then 2nd Rinse
Rinse system completely

ESI Autosamplers are Versatile and Upgradeable

ESI autosamplers are available in a range of sizes, with capacities from 2 micro racks (Micro DXe / DX / DXCi) to 14 large racks (14 DXe / DX / DXCi).

Flexible rack configurations permit almost any sample size, from micro vials up to 500 mL and larger bottles to be automatically analyzed.

All ESI autosamplers have the ability to upgrade to any *FAST* high-throughput or prep*FAST* autodilution system.



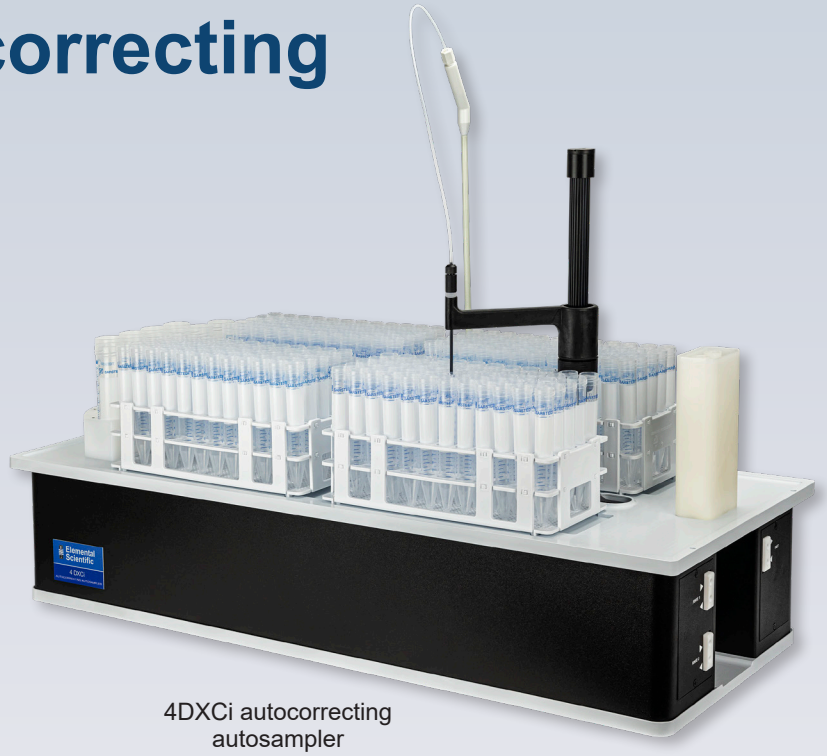
Versatile Rack Configurations

4DX shown with 5 x 12 and 3 x 7 large racks, 3 x 7 micro rack (MR), 96 well microplate, MR bottles - 2 x 250 mL

DXCi Autocorrecting Autosamplers

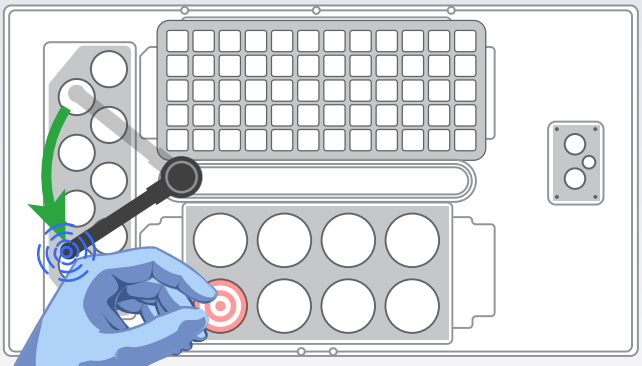
DXCi Autosampler Features:

- Automatically monitors and corrects positions for all axes of motion
- Corrects for accidental obstructions
- Optimal for small volume samples
- Optimal semiconductor sample configuration
- Upgrade to SampleSense *FAST* ultra-high throughput system
- Upgrade to SampleSense prep*FAST* autocalibration and autodilution system

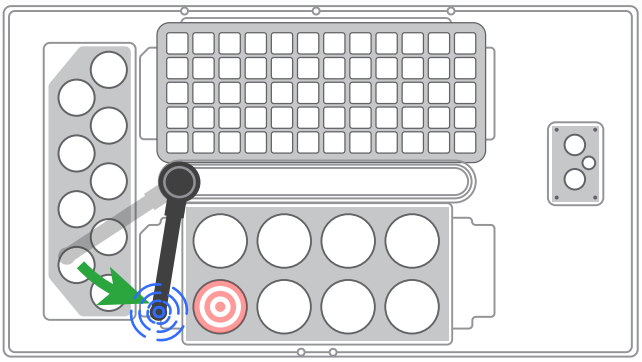


4DXCi autocorrecting autosampler

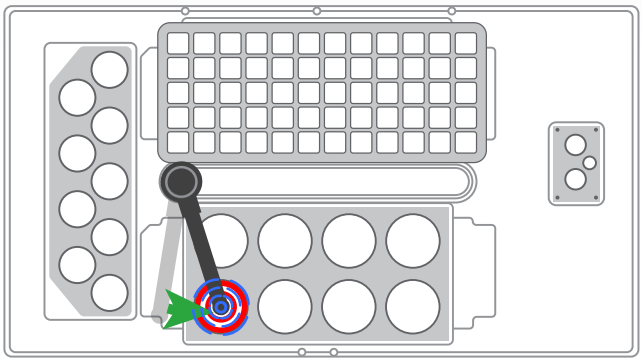
Probe arm begins movement towards designated vial location.



Obstruction detected, probe arm verifies missed x, y, z axis.



Obstruction cleared, probe arm continues to designated position.



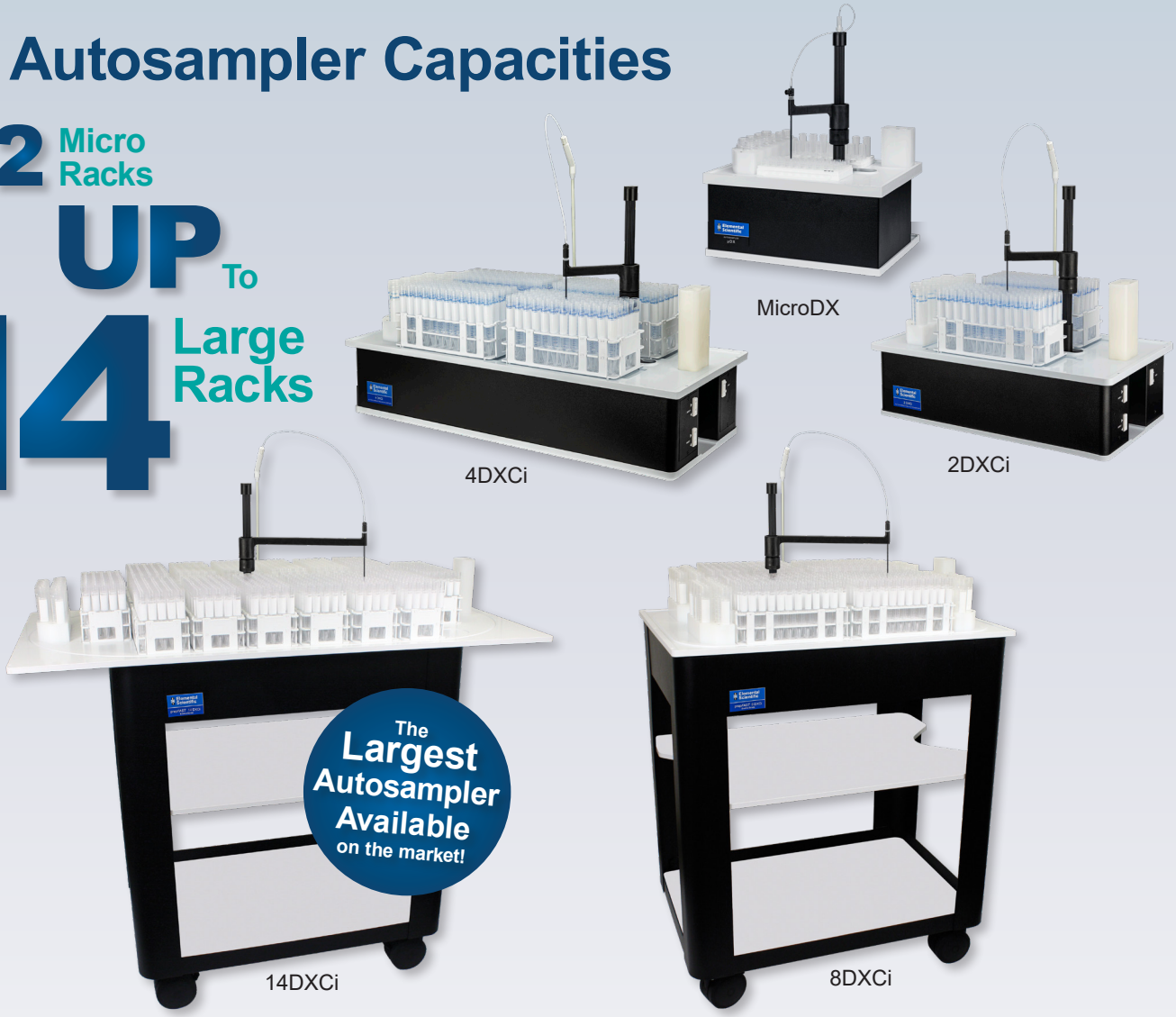
Probe arm accurately stops at vial position and collects sample.

ESI Autosampler Capacities

From **2** Micro Racks

UP To

14 Large Racks



Model	Part Number	Mobile Stand	Large Rack Capacity	Microplate/ Micro Rack Capacity	MAXIMUM SAMPLE CAPACITY			
					50 mL	15 mL	8 mL	MT-96
MicroDXe	m-DXe	N/A	-	2	20	42	80	192
MicroDX	m-DX							
MicroDXCi	m-DXCi							
2DXe	2DXe	SC-1210-DX	2	4	52	120	180	384
2DX	2DX							
2DXCi	2DXCi							
4DXe	4DXe	SC-1410-DX	4	6	94	240	360	576
4DX	4DX							
4DXCi	4DXCi							
8DXe Benchtop	8DXe-BT	N/A	8	-	208	480	720	-
8DX Benchtop	8DX-BT							
8DXCi Benchtop	8DXCi-BT							
8DXe	8DXe	Included						
8DX	8DX							
8DXCi	8DXCi							
14DXe	14DXe	Included	14	30*	304	840	1260	2880*
14DX	14DX							
14DXCi	14DXCi							

*Special version 14DX for microplates

FAST SYSTEM

for Avio 200/500 ICP

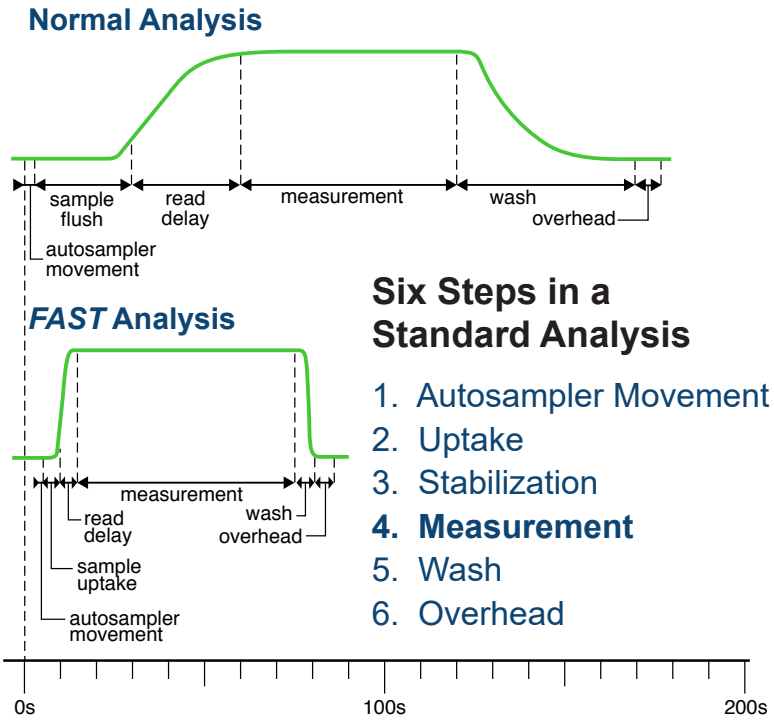
The *FAST* is a high-throughput, automated sample introduction system for the Avio 200/500 ICP. The *FAST* system uses valve injection with rapid vacuum sample loading to more than double the productivity of the Avio ICP, minimize instrument maintenance, and reduce operating costs.

FAST Benefits:

- High sample throughput
- *FAST* uptake, stabilization, and washout
- Specially-designed P-Series valve and loop combination has superb washout
- Options with and without segmented air bubbles ensures high precison for every application

Improved Efficiency

By presenting the sample for a short period of time during the measurement, ICP cone deposition is minimized, resulting in long stable analytical runs without maintenance. The SC-*FAST* reduces consumption of argon, power, and reagents.



Six Steps in a Standard Analysis

1. Autosampler Movement
2. Uptake
3. Stabilization
4. **Measurement**
5. Wash
6. Overhead

The SC-*FAST* system has the fastest signal stabilization and most complete rinse-out of any sample introduction system. This reduces uptake and wash times while increasing sample throughput.

Increased Sample Throughput

In addition to higher throughput gained by using an autosampler, the *FAST* system analyzes a sample 2-5 times faster than it takes a standard autosampler to perform the same task.

FAST also benefits labs with relatively few samples by reducing operating costs and shortening analytical runs.

STANDARD ANALYSIS
96 SAMPLES

FAST ANALYSIS
288 SAMPLES

2-5x HIGHER SAMPLE THROUGHPUT WITH *FAST* SYSTEM DEPENDING ON APPLICATION

Superior P-Series *FAST* Valve

- PFA rotors for long life and low maintenance
- Chemically resistant compression ring
  - Uniform pressure
  - Keyed for easy assembly
  - Prevents damage from overtightening
- All fluoropolymer flow path
- Internal components PTFE-coated to prevent corrosion
- In-valve mixing of internal standard (P7 valve)

FAST DXi:

- Integrated MP^2 peristaltic pump and *FAST* valve for the Avio 200/500 ICP
- High quality ceramic bearing peristaltic pump for long lifetime and high precision
- Upgradeable to prep*FAST*

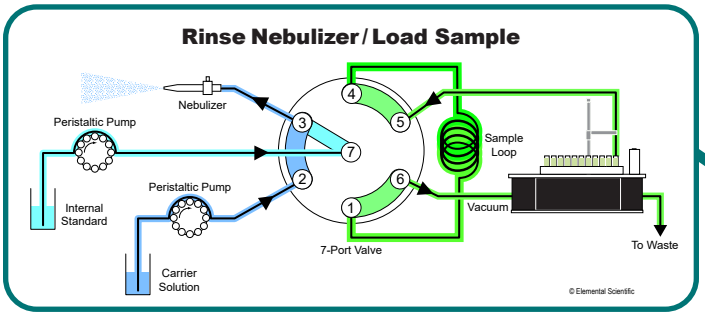
P7 *FAST* Valve

Avio 500 ICP

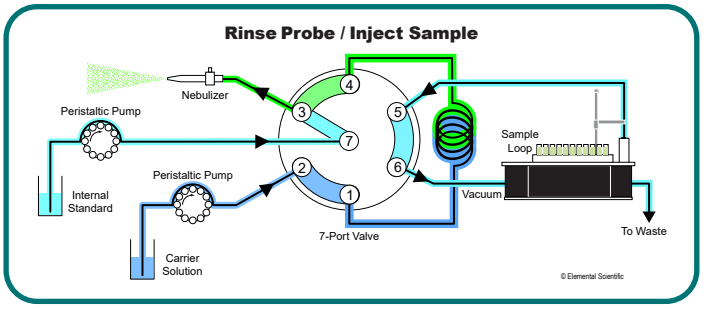
Single Valve *FAST* DXi for Avio 500 ICP

Single Valve *FAST* DXi for Avio 200 ICP

The *FAST* loads the sample loop as the nebulizer and tubing are cleaned.



The autosampler probe and tubing are rinsed while the sample is analyzed.



FAST SYSTEM PART NUMBERS FOR AVIO 200 & 500 ICP					
Description		2DX *FAST*	4DX *FAST*	8DX *FAST*	14DX *FAST*
FAST basic systems for high throughput and *FAST* washout (Includes DX autosampler)	Avio 200	2DXF-47A	4DXF-47A	8DXF-47A	14DXF-47A
	Avio 500	2DXF-37A	4DXF-37A	8DXF-37A	14DXF-37A

See page 4 for more information on SC DX autosamplers.

See page 24 for adding **SampleSense** to your *FAST* system

FAST with SampleSense Valve

prep*FAST*™ for Avio 200/500 ICP

Automated Sample Preparation with Inline Dilution

prep*FAST* is a line of automated inline dilution systems which eliminates manual dilution, reduces reagent usage, and improves laboratory productivity. These systems combine an ESI autosampler, high-throughput *FAST* technology and a syringe module to perform precise and accurate inline dilutions of standards and samples.

prep*FAST* Automates Daily Lab Functions

Autodilution

Samples are automatically inline syringe-diluted and prepared for analysis.

- Automatic inline dilution modes
  - Constant dilution (e.g. all samples diluted 10x)
  - Variable dilution (i.e. user-specified dilution factor sample-by-sample)
- Improve precision and accuracy
- Reduce vial and reagent usage
- Improve sample throughput and washout

2DXCi prep*FAST*

Autocalibration

Automate inline preparation of ICP calibration standards.

- Save time and improve laboratory efficiency
- Improve linearity
- Standards rack (9 x 125 mL) holds both calibration and QC compliance standards

Overrange Dilution

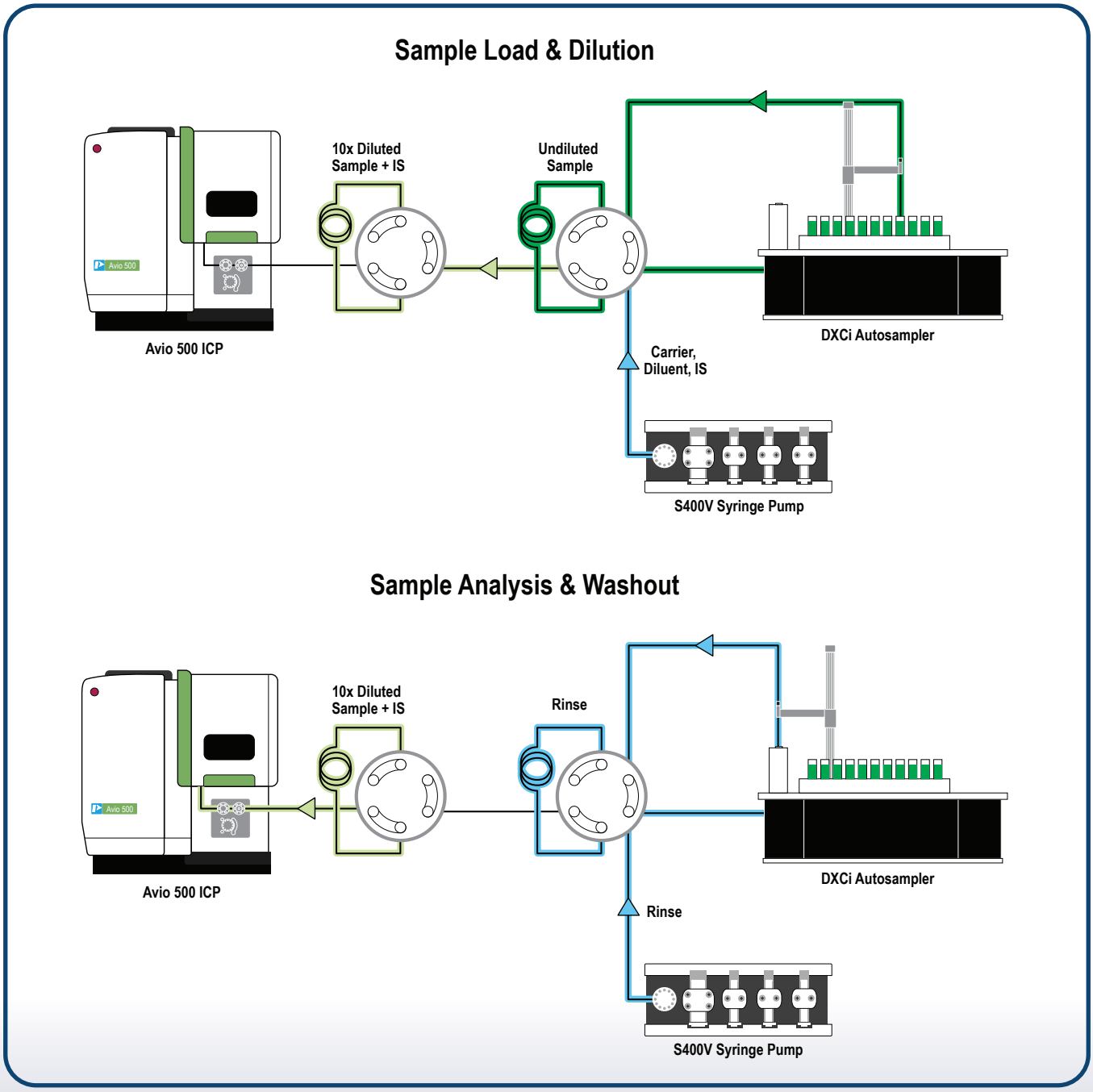
Automatically dilute and reanalyze samples having analyte concentrations above the calibration range.

- Autodilute overrange samples
- Automatic serial dilution brings even extremely high concentration samples into range
- Optimize laboratory throughput by generating reportable results from the initial sample run
- Automatically dilute high matrix samples that cause internal standards recoveries to fall out of acceptable ranges

Autodilution

prep*FAST*™ Rapid, Variable, In-valve Autodilution

Samples are quickly vacuum-loaded (prep*FAST* e, prep*FAST* and prep*FAST* M5) or precision syringe-loaded (prep*FAST* M5) into a loop. Sample is mixed with diluent and internal standard using a patented mixing valve at the dilution factor prescribed by Syngistix™ software. The diluted and mixed sample is then introduced into the ICP while the sample loop is syringe rinsed and readied for the next sample. This sampling and dilution process takes place in seconds.



prep*FAST* dilution diagram for Avio 500 ICP

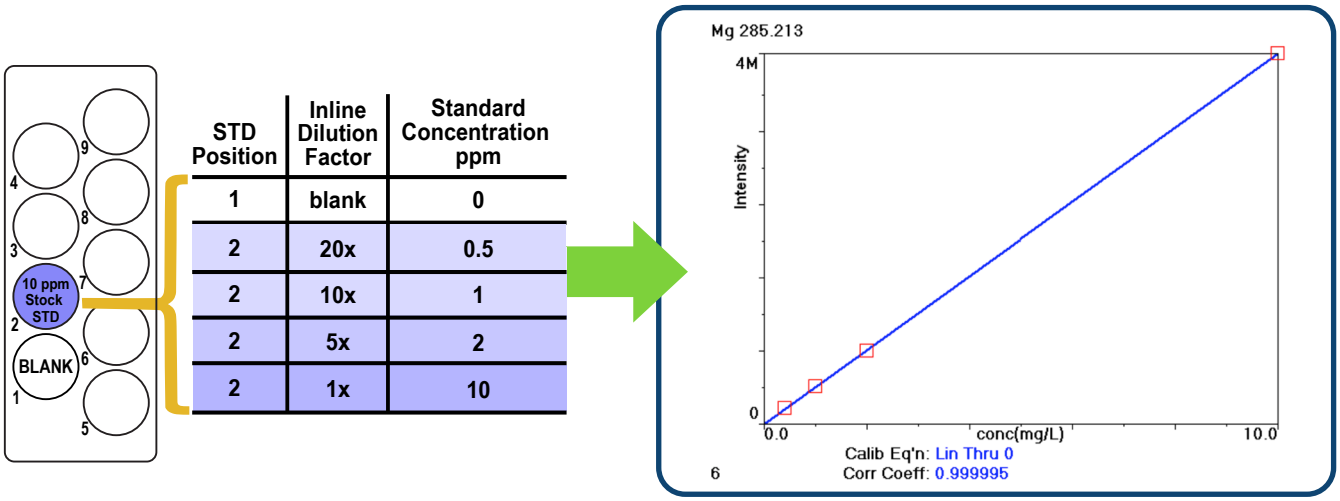
Autocalibration

prep*FAST*™ Autocalibration

Every prep*FAST* model can create multipoint calibration curves from a single bottle of stock standard. Each point of the calibration curve is prepared by autodilution of a single stock calibration standard placed on the autosampler deck. The prep*FAST* automatically generates highly linear and consistent ICPMS calibration curves. If necessary, multiple standards can be used for large concentration ranges or when standard matrices are incompatible.

prep*FAST* Autocalibration

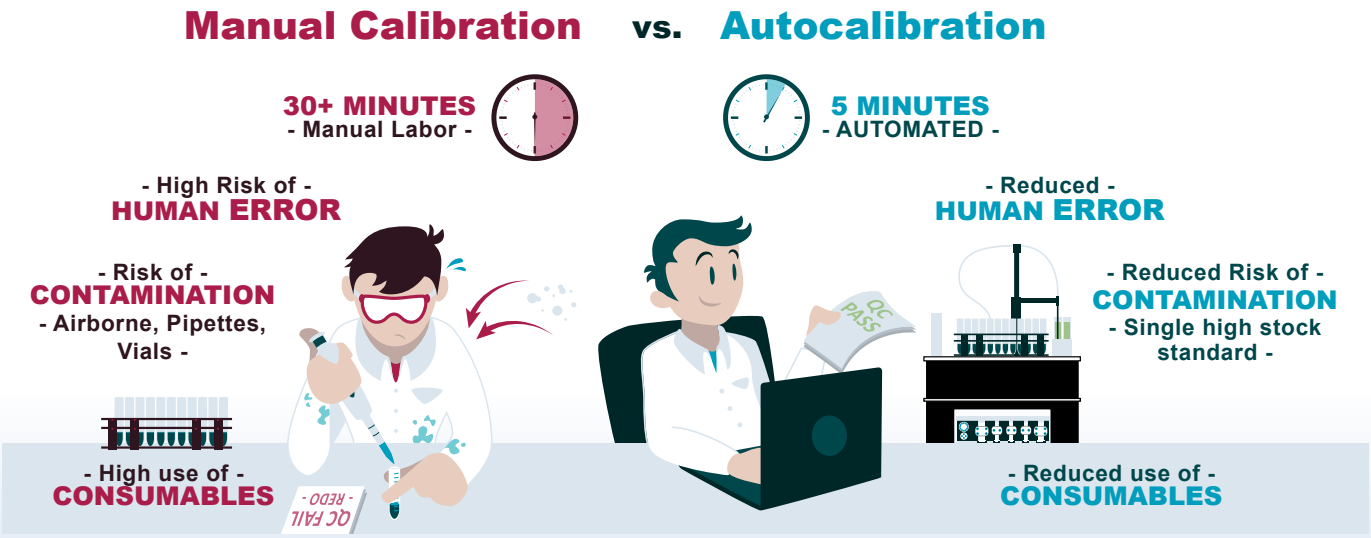
Inline Prep from 1 Blank + 1 Standard



STD Position	Inline Dilution Factor	Standard Concentration ppm
1	blank	0
2	20x	0.5
2	10x	1
2	5x	2
2	1x	10

Autocalibration of Mg from a 10 ppm stock standard

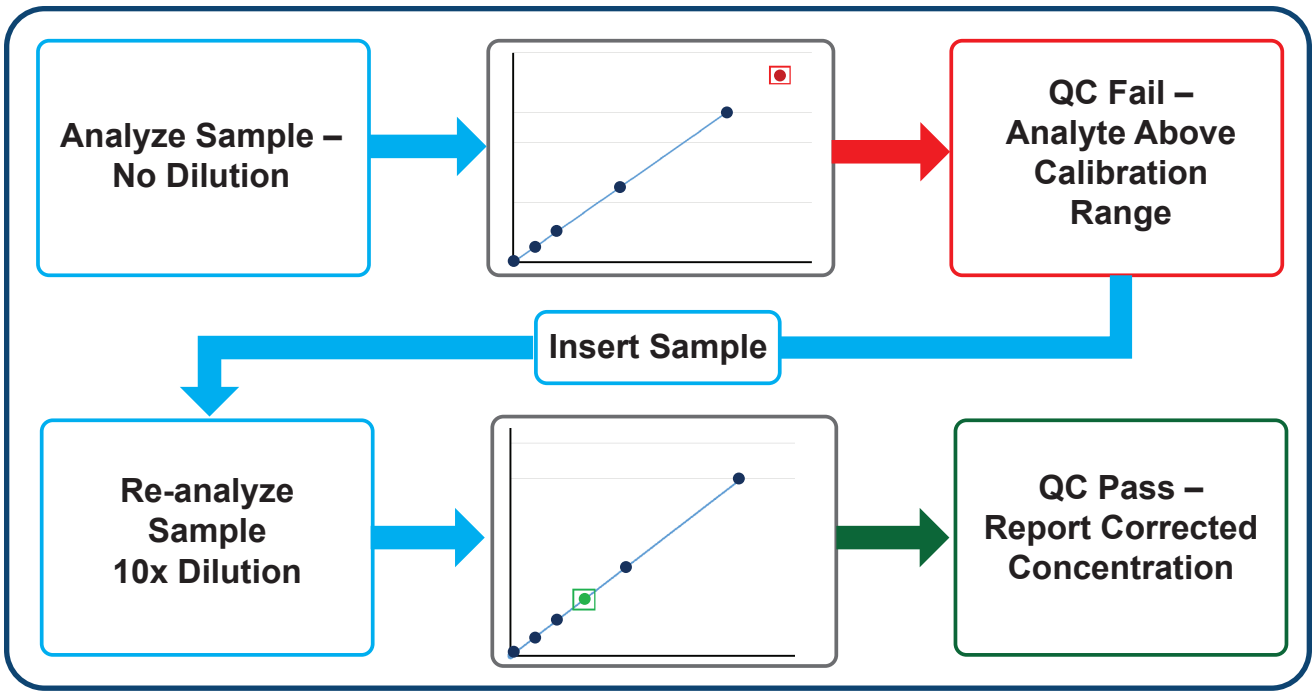
Autocalibration improves laboratory efficiency by eliminating the need for labor-intensive and error prone standard preparation. It reduces laboratory waste by reducing calibration vial, reagent, and standard waste. prep*FAST* autocalibration is particularly important for low concentration standards near the detection limit.



Overrange Dilution

prep*FAST*™ Overrange Analyte Autodilution

The prep*FAST* automatically dilutes samples when an analyte goes above method-specified quality control levels. The sample is automatically reinserted into the sample list and reanalyzed at a higher dilution factor until the determined concentration falls within the specified range.



Automated overrange sample dilution maximizes laboratory throughput. Without this feature high concentration samples have to be manually diluted and rerun later. Overrange autodilution automatically dilutes samples into the appropriate range without any user input or time lost waiting for a result.

Out-of-Range Internal Standard Autodilution

Internal standard out-of-range conditions occur when a high matrix present in a sample causes response changes in the ICP signal, which is identified by monitoring internal standard recoveries. Syngistix can be configured to automatically detect these limit failures, and instructs the prep*FAST* to automatically dilute the sample for reanalysis during the same analysis run.

Economical Inline Autodilution System

The prep*FAST* e economical inline dilution system provides low cost syringe dilution and laboratory automation. The prep*FAST* e is especially effective for applications having long analysis times or lower sample throughput requirements. Capable of dilution factors ranging from 1 to 50, the prep*FAST* e is recommended for use with sample volumes greater than 2-3 mL. The prep*FAST* e supports final analysis volumes between 0.5 and 6.0 mL.

Features

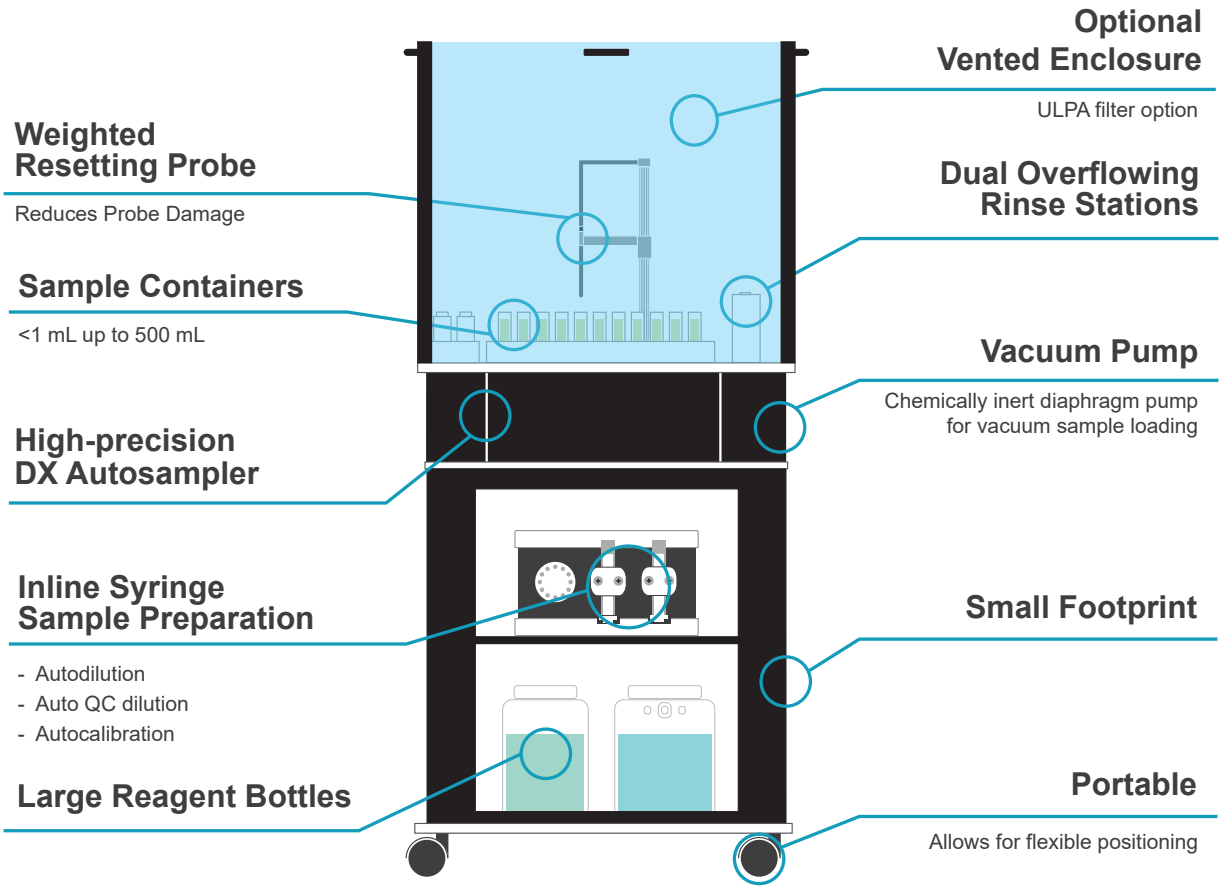
- Autocalibration
- Autodilution – 1 to 50x
- Automatic overrange dilution
- Peristaltic-pumped internal standard addition
- Fast vacuum sample loading

Benefits

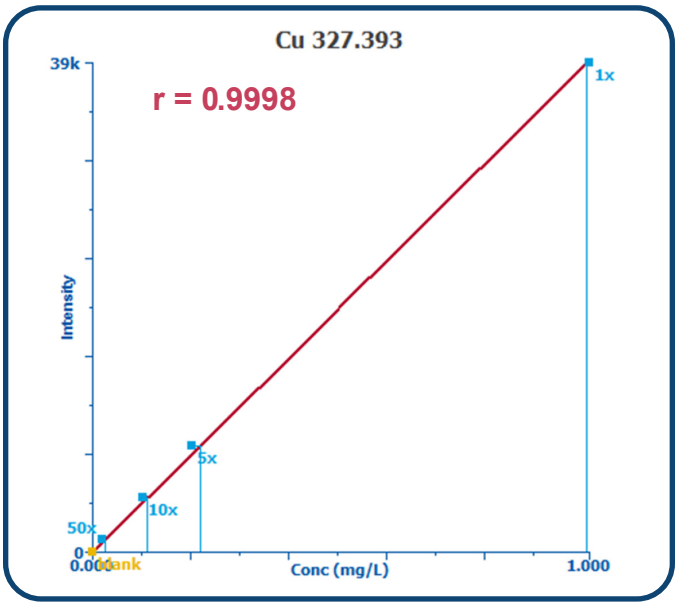
- Automate sample dilution
- Reduce laboratory waste
- Available in 2DX, 4DX, 8DX, and 14DX models

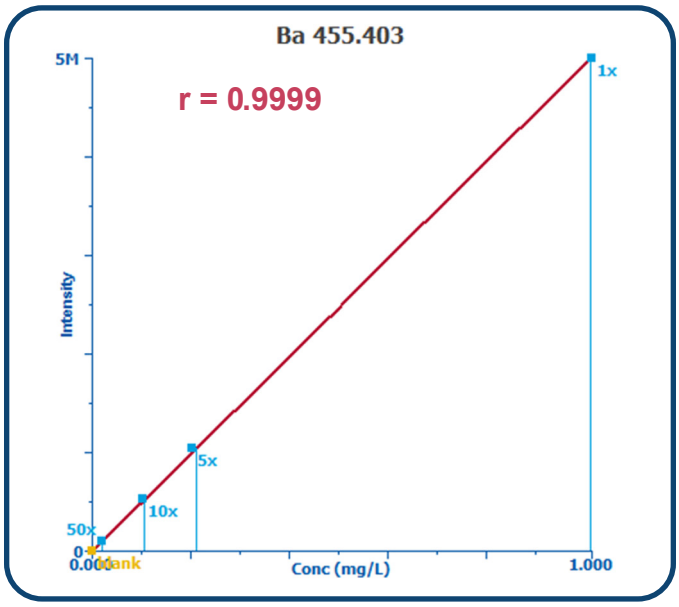
2DX
prep*FAST* e

prep*FAST* e Features Diagram



prep*FAST* e Automated Calibrations





Autocalibrations on Avio 500 with prep*FAST* e. Standard concentrations prepared at 20, 100, 200, and 1000 µg/L.

prep*FAST*™ for Avio 200/500 ICP

Fully Automated Inline Dilution System

The prep*FAST* inline dilution system fully automates laboratory dilutions while providing high sample throughput. The prep*FAST* delivers high precision autodilution, syringe-driven internal standard addition, and high speed washout. Capable of dilution factors from 1 to 400, the prep*FAST* is suggested for labs requiring the highest sample throughput and where the available sample volume is about 2-3 mL or more.

Features

- Autocalibration
- Autodilution – 1 to 400x
- Auto QC dilution
- Syringe-driven internal standard
- High speed rinse
- *FAST* vacuum sample loading

Benefits

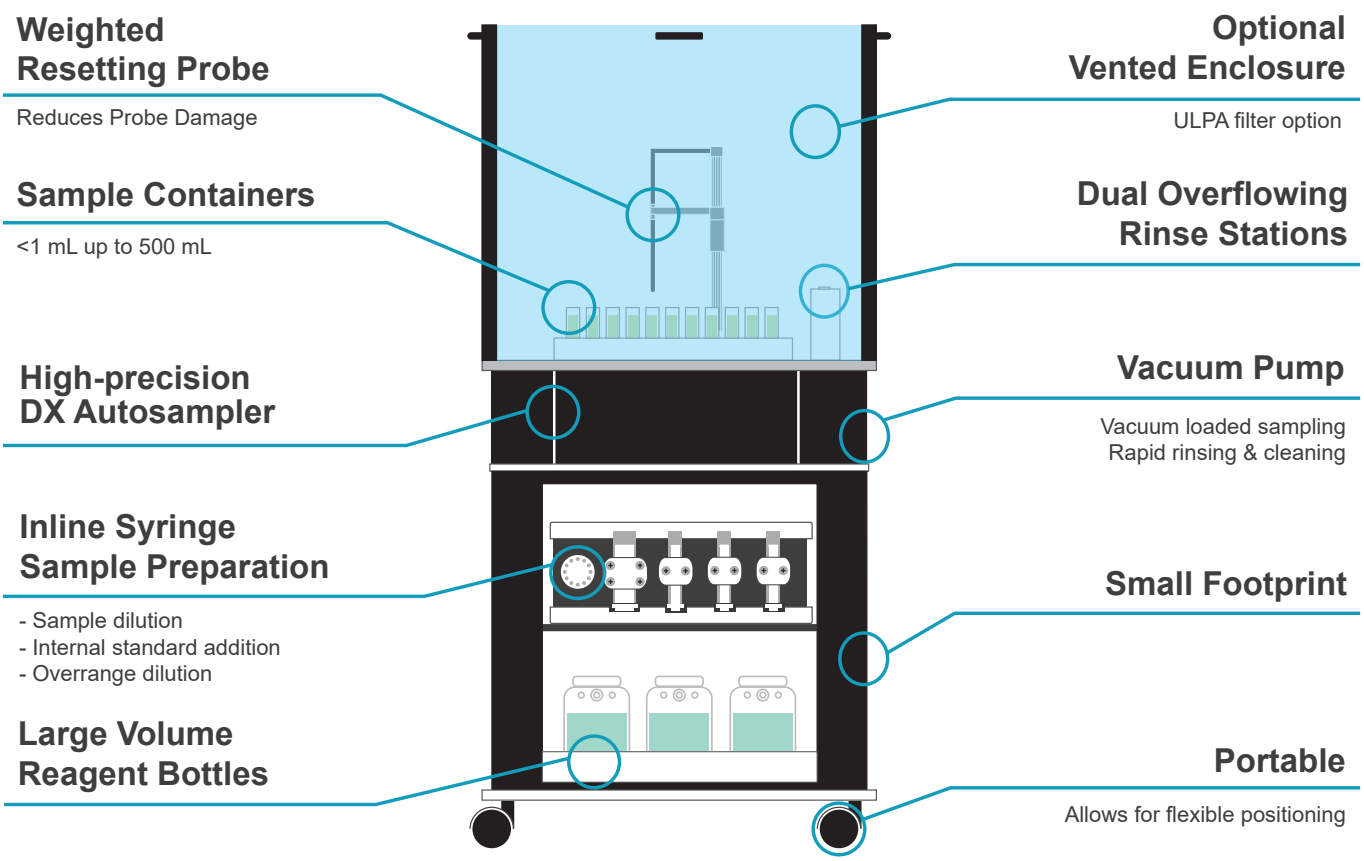
- Automate sample dilution
- Improve sample throughput
- Reduce laboratory waste
- Available in 2DXCi, 4DXCi, 8DXCi, and 14DXCi models

4DXCi prep*FAST*

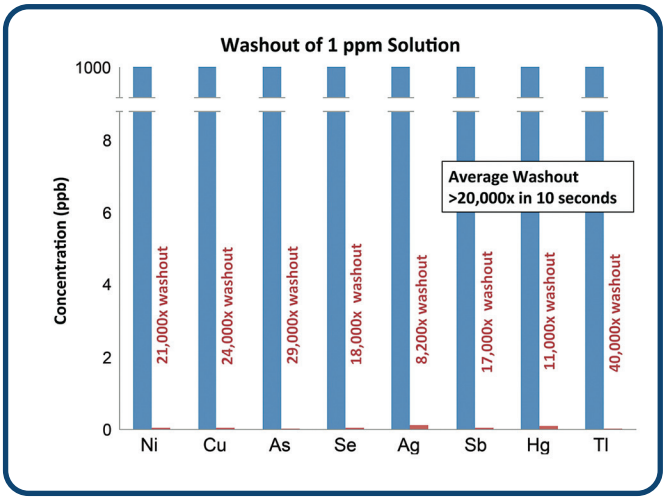
prep*FAST* with SampleSense Valve

See page 25 for adding SampleSense to your prep*FAST* system

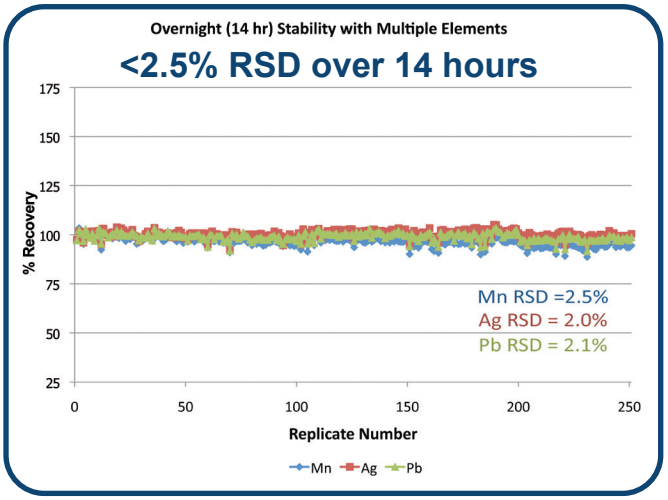
prep*FAST* Features Diagram



prep*FAST* Performance



FAST washout even for memory-prone elements



Long-term stability

Syringe Sample Loading + Syringe-driven Inline Dilution System

The prep*FAST* M5 inline dilution system delivers maximum laboratory automation. The prep*FAST* M5 provides precision syringe loading of samples or high-throughput vacuum loading. Syringe loading is recommended when sample volumes are limited – 2-3 mL – or when sample viscosity becomes an issue, such as organic solvents, viscous brines or biological samples. *FAST* vacuum loading can be used when sample volumes are large – above 2-3 mL – or when sample viscosity is not an issue. The prep*FAST* M5 delivers high precision autodilution, syringe-driven internal standard addition, flexible sample loading and ultimate sample washout. Capable of dilution factors from 1 to 400, the prep*FAST* M5 is perfect for labs requiring high sample throughput and where available sample volumes are **as low as 0.1 mL**.

S500V2 Dilution Module

Features

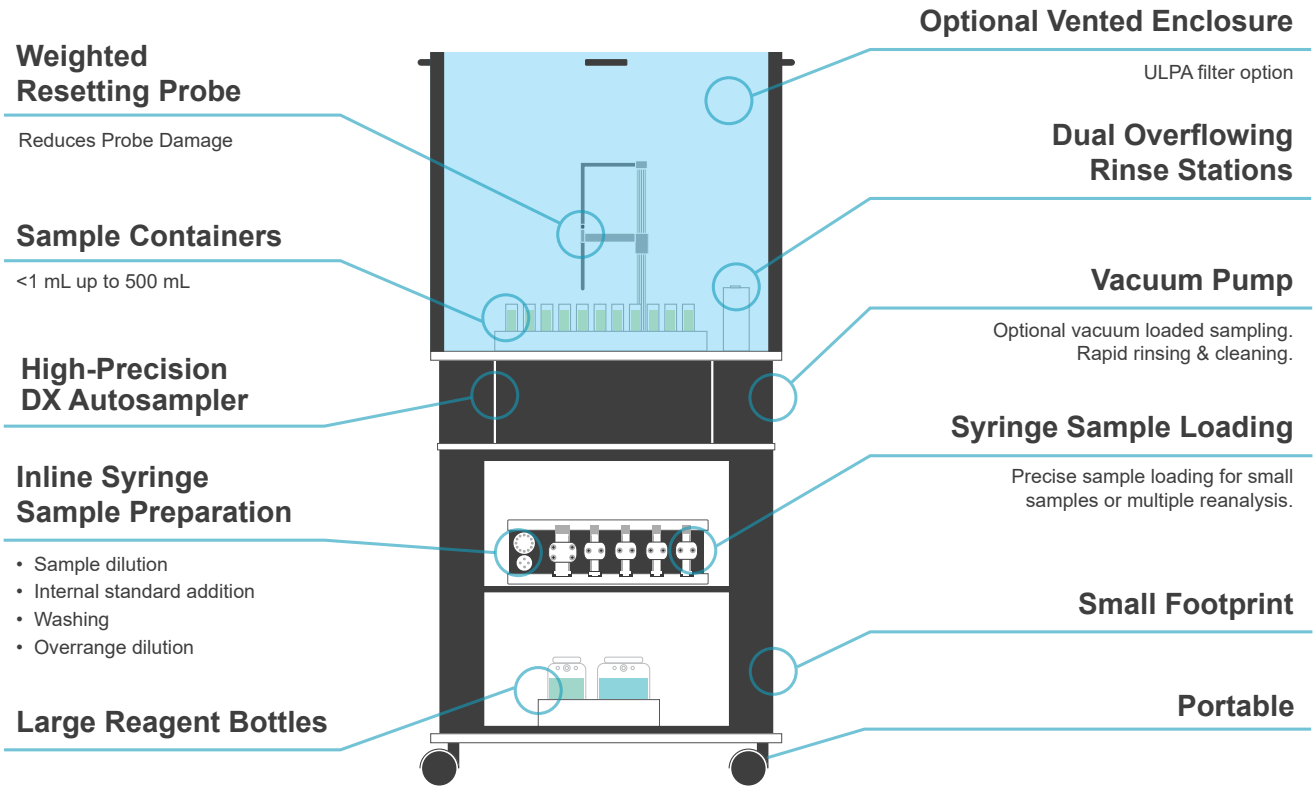
- **Precision syringe loading or high-speed vacuum loading**
- Autocalibration
- Autodilution – 1 to 400x
- Auto QC dilution
- Syringe-driven internal standard addition
- High speed rinse
- Ultimate washout
- High pressure syringe-driven probe rinsing

Benefits

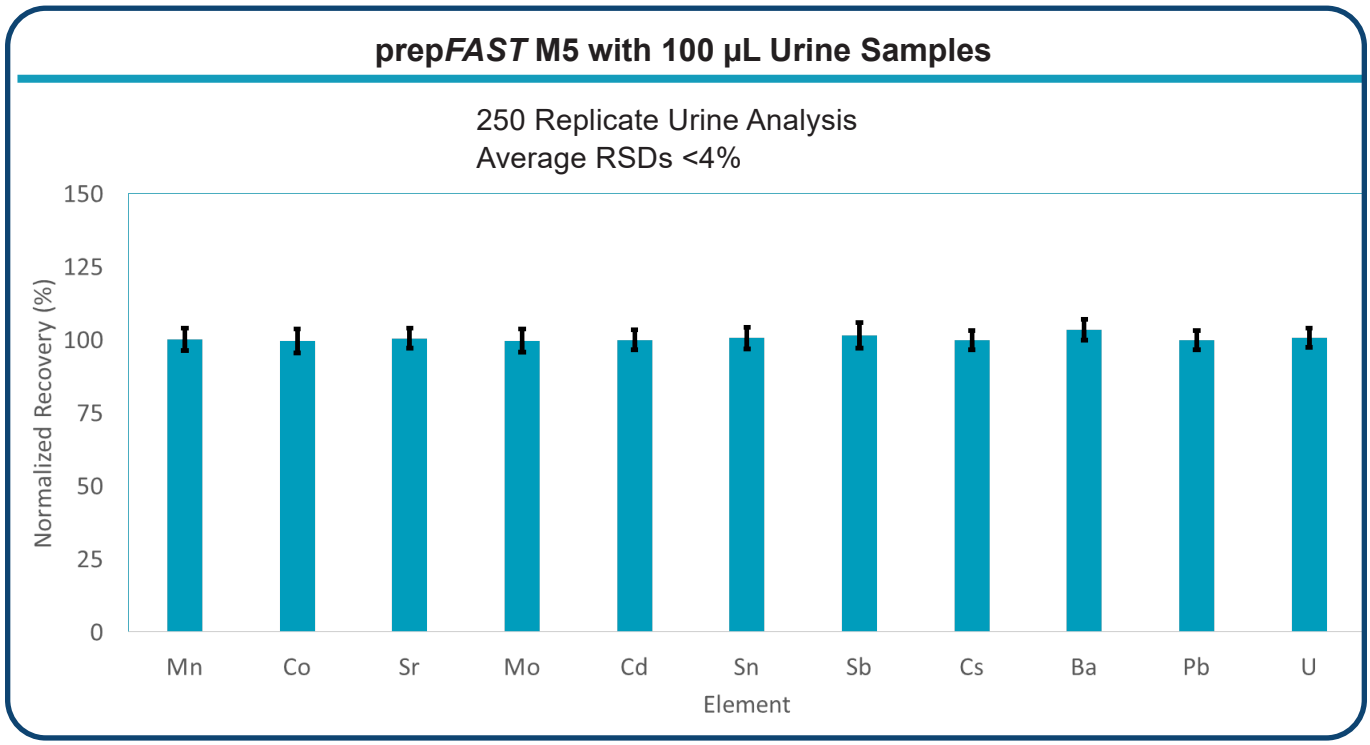
- Automate sample dilution
- High sample throughput
- Minimize sample use
- Reduce laboratory waste
- Best rinse-out performance
- Available in 2DXCi, 4DXCi, 8DXCi, and 14DXCi models

4DXCi
prep*FAST* M5

prep*FAST* M5 Features Diagram



Automated micro sample analysis in a difficult matrix



prep*FAST* Systems Comparison

prep*FAST* inline dilution systems automatically perform precise and accurate dilutions for samples and standards, improving laboratory workflow, productivity, and data quality.

4DXCi Autosampler with Mobile Station

prep*FAST* e

prep*FAST*

prep*FAST* M5

prep*FAST* e Provides:

- Autocalibration
- Autodilution
- Auto overrange dilution
- Peristaltic pump driven internal standard addition
- Dilution range: 1-50x

prep*FAST* Provides:

- Autocalibration
- Autodilution
- Auto overrange dilution
- Improved washout and higher throughput
- Syringe-driven internal standard addition
- Dilution range: 1-400x

prep*FAST* M5 Provides:

- Autocalibration
- Autodilution
- Auto overrange dilution
- Precision syringe sample loading for micro or viscous samples
- Best washout performance of any sample introduction system
- Syringe-driven internal standard addition
- Dilution range: 1-400x

prep*FAST* Systems Comparison

ESI offers three versions of prep*FAST*: prep*FAST* e, prep*FAST*, and the prep*FAST* M5. Compare each system's features below to determine which prep*FAST* system is right for your lab.

Description	Autocalibration	Autodilution	Auto Overrange Dilution	Syringe-Driven Internal Standard	High Pressure Rinse Ultimate Washout	Micro Volume Sample Analysis	Volatile Organic Solvent Analysis	Dilution Range
prep*FAST* e	✓	✓	✓					1 - 50x
prep*FAST*	✓	✓	✓	✓				1 - 400x
prep*FAST* M5	☑	☑	☑	☑	☑	☑	☑	1 - 400x

Avio 200

prep*FAST* e

	Part Number
2DX	2PFe-47
4DX	4PFe-47
8DX	8PFe-47
14DX	14PFe-47

prep*FAST*

	Part Number
2DX	2ADFi-47A
4DX	4ADFi-47A
8DX	8ADFi-47A
14DX	14ADFi-47A

prep*FAST* M5

	Part Number
2DX	2PF-M5-47A
4DX	4PF-M5-47A
8DX	8PF-M5-47A
14DX	14PF-M5-47A

Avio 500

prep*FAST* e

	Part Number
2DX	2PFe-37
4DX	4PFe-37
8DX	8PFe-37
14DX	14PFe-37

prep*FAST*

	Part Number
2DX	2ADFi-37A
4DX	4ADFi-37A
8DX	8ADFi-37A
14DX	14ADFi-37A

prep*FAST* M5

	Part Number
2DX	2PF-M5-37A
4DX	4PF-M5-37A
8DX	8PF-M5-37A
14DX	14PF-M5-37A

Revolutionary New Valve for *FAST* & prep*FAST*

SampleSense

SampleSense is a revolutionary valve for *FAST* and prep*FAST* systems that optimizes introduction of samples into Avio 200/500 ICP instruments. SampleSense utilizes optical sensors to verify a sample loop has been filled.

Enhance Workflow

- Eliminates method timing parameters
  - Optimizes loading conditions for each sample matrix
  - Automatically loads loop with samples of varying viscosities
- Reduces sample consumption
- Actively detects and reports sample loading issues
- Automatically compensates for drift caused by kinked lines or partial blockages
- SampleSense triggers the ICP at exactly the right time

How it Works

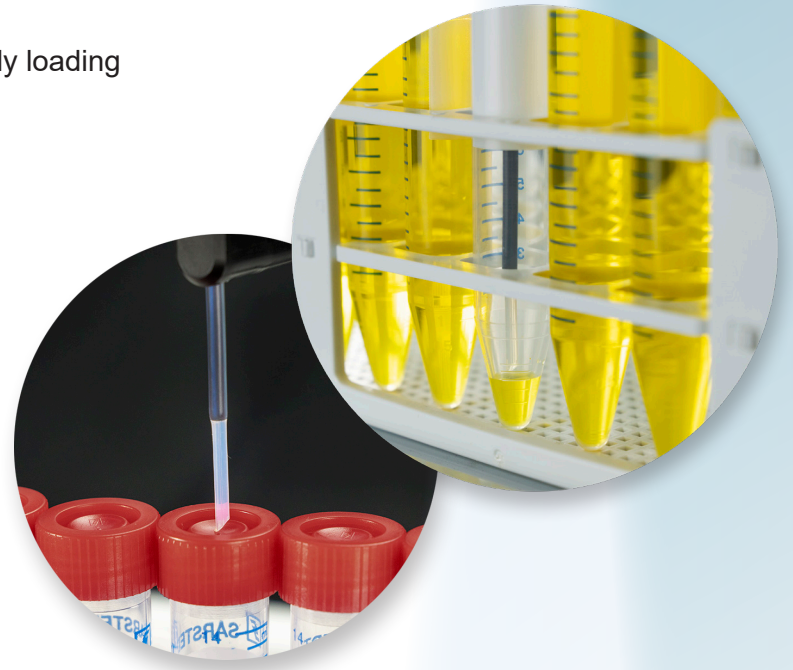
SampleSense simplifies method development by:

- Eliminates read delays, sample uptake and injection timers
- Allows sample loop sizes and sample types to be changed without adjusting method settings
- Minimizes sample consumption by automatically loading samples of varying viscosities

Detect Loading Issues

SampleSense monitors and logs sample loading issues caused by:

- Empty tubes or positions
- Vials inadvertently left capped
- Empty standard or QC
- Bubbles caused by incomplete loading



SampleSense Advantages

Innovative Sample Loading

SampleSense accounts for viscosity and automatically adjusts timing. One valve, one loop and one method for multiple sample types.

Time Savings

Operator time for sample introduction method development is eliminated. Just run samples.

Sample Savings

The sample is injected at precisely the right time. Every time. Even for small samples.

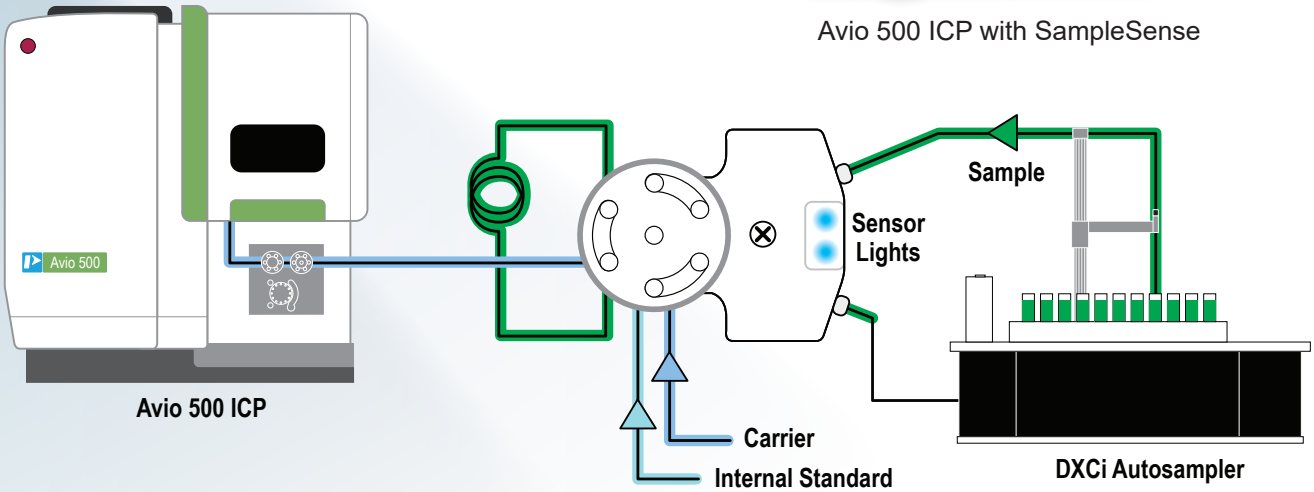
Error Notification

Incomplete sample loading or bubbles in the sample are detected and logged.

Maximize Productivity

FAST high-throughput automated sample introduction technology combined with SampleSense maximizes productivity for any lab. It optimizes sample throughput and conserves valuable sample, argon, power, and reagents by drastically shortening analytical runs.

Avio 500 ICP with SampleSense



Avio 500 ICP with SampleSense – Sample Load Complete / Rinse Nebulizer

SampleSense *FAST*

***FAST* has been trusted for over a decade in thousands of ICP laboratories worldwide.**

FAST is a valve injection automation system with rapid vacuum sample loading that more than doubles sample throughput, saves time, reagents and utilities.

Combining *FAST* with SampleSense provides an even higher level of automation, ease-of-use and sample throughput. Liquid samples are instantly detected, injected and the analysis is triggered automatically.

Avio 500
SampleSense
FAST

SampleSense *FAST* System

Incorporates an automated, high throughput valve injection system with optically-sensed sample loading and triggered analysis. Includes DXCi autosampler, SampleSense SS7 valve, PFA-ICN nebulizer, and *FAST* installation kit. Upgrade kits provide choice of SampleSense valve SS6 or SS7 (with in-valve internal standard addition).

SampleSense *FAST* Systems for Avio 200 & 500 ICP		
SampleSense *FAST* Autosampler	**Avio 200 Part Number**	**Avio 500 Part Number**
2DXCi	2F-SS7-47	2F-SS7-37
4DXCi	4F-SS7-47	4F-SS7-37
8DXCi	8F-SS7-47	8F-SS7-37
14DXCi	14F-SS7-47	14F-SS7-37

SampleSense prep*FAST*

prep*FAST* is an automated inline dilution system for ICP sample introduction.

The high-throughput prep*FAST* system eliminates manual dilution, reduces reagent usage and improves laboratory productivity.

SampleSense integrates fully with the prep*FAST* for an even higher level of automation and ease-of-use.

Avio 500
SampleSense
prep*FAST*

SampleSense prep*FAST* System

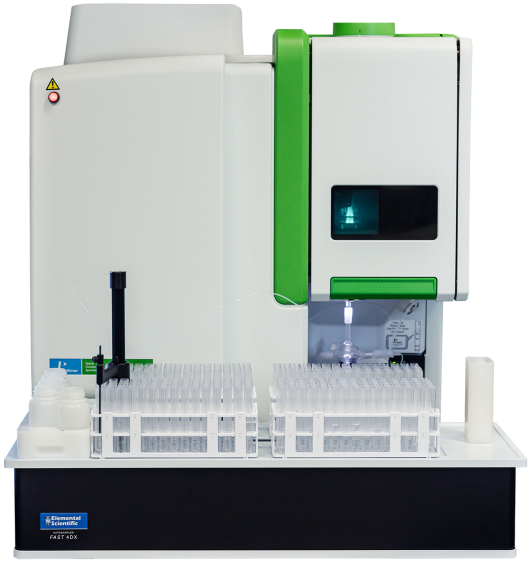
Incorporates a high-throughput valve injection system with optically-sensed sample loading and triggered analysis coupled to an inline autodilution and autocalibration system. Includes DXCi autosampler, prep*FAST* autodilutor, SampleSense SS7+ valve with in-valve diluent and internal standard addition, PFA-ICN nebulizer, prep*FAST* mobile autosampler station, and prep*FAST* installation kit.

SampleSense prep*FAST* Systems for Avio 200 & 500 ICP		
SampleSense prep*FAST* Autosampler	**Avio 200 Part Number**	**Avio 500 Part Number**
2DXCi	2PF-SS8-47	2PF-SS7-37
4DXCi	4PF-SS8-47	4PF-SS7-37
8DXCi	8PF-SS8-47	8PF-SS7-37
14DXCi	14PF-SS8-47	14PF-SS7-37

SampleSense FAST UHT-S

Ultra-high Throughput Automation Systems

SampleSense *FAST* UHT-S is a customized automation solution designed for fast sample analysis where sample volume may be limited. All SampleSense ultra-high throughput systems incorporate a vacuum control valve to further reduce sample consumption while utilizing the sample detection capabilities of the SampleSense valve. By closing the vacuum supply off with this valve, valuable sample is conserved while allowing specialized rinse solutions to be loaded into the sample uptake path while the analysis is taking place.



Avio 500 ICP equipped withSampleSense *FAST* UHT-S sample analysis system

Customized Design

- SampleSense valve automates sample uptake tasks, monitors sample loading and logs sample loading issues
- Vacuum control valve minimizes sample consumption
- Optimized vertical travel and rinse station supports small sample volume containers – increasing sample capacity on the autosampler
- **SampleSense *FAST* UHT-S doubles or triples the normal ICP analysis rate for the highest possible sample throughput**

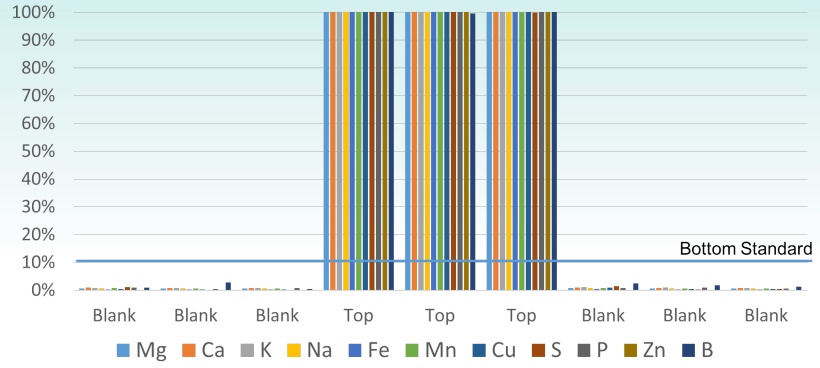
SampleSense *FAST* UHT-S for Mehlich-3-ICP Soil Analysis

Mehlich-3-ICP is a method for determining bioavailable concentrations of 11 extractable micronutrient elements in soil samples. Mehlich-3-ICP is invaluable for determining the amount of fertilizer to apply to farm fields. Because soil analyses must be completed in a narrow time window, ultra-high sample throughtput with high reliability is required.

- 11 Elements determined: B, Ca, Cu, Fe, K, Mg, Mn, Na, S, P, Zn
- ICP read triggered from dual sensor optical sample detection
- 360 samples analyzed in <35 minutes
- 6 second sample-to-sample time
- <2 mL of sample consumed (vacuum control)
- Automatic detection of empty or missing sample tubes
- Most reliable high-throughput system on the market

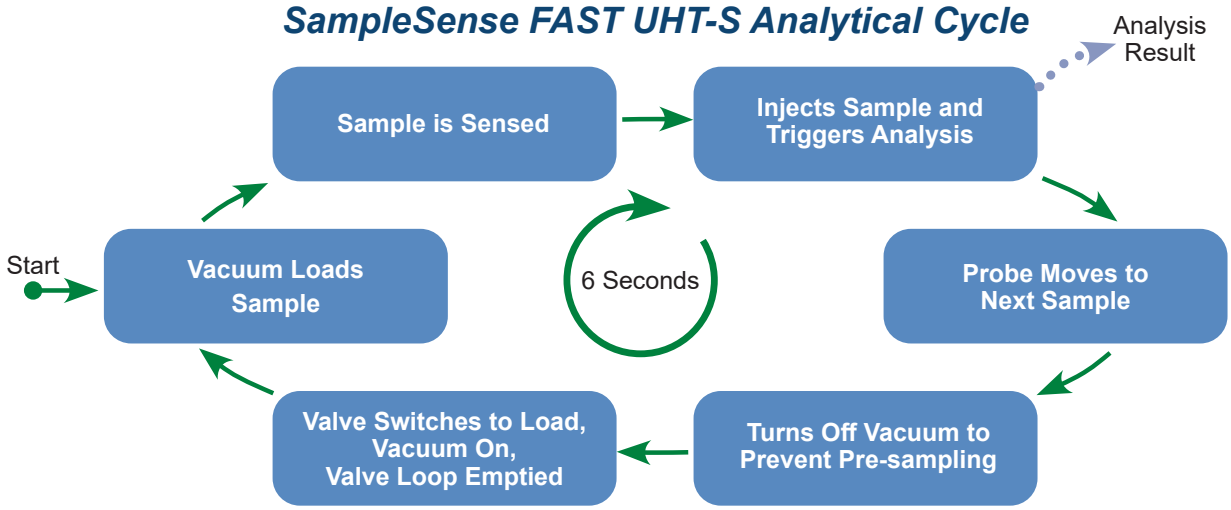
Valve sensors activated, sample is sensed

Rinseout

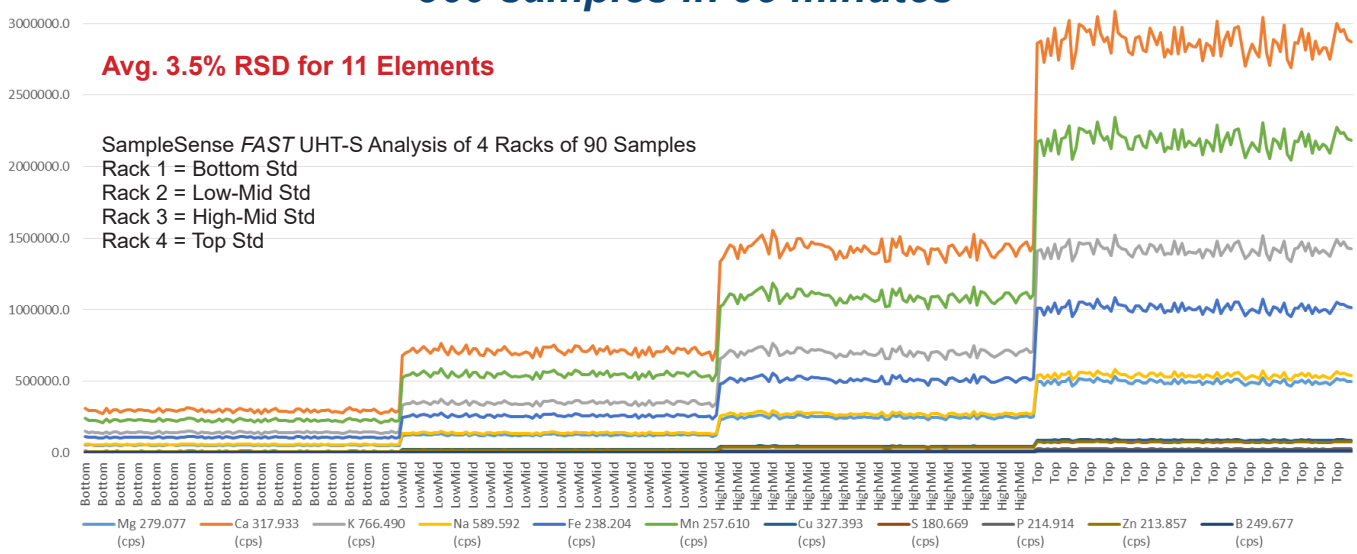


The SampleSense *FAST* UHT-S rinse-out immediately reduces all elements to concentrations well below the bottom standard when using the six second Mehlich-3-ICP procedure. Additional seconds can be added to the rinse-out to meet lab requirements. The system can deliver rinse-out factors of 1,000x, 10,000x or more depending on how clear the spray chamber needs to be before the next sample is introduced.

SampleSense FAST UHT-S Analytical Cycle



360 samples in 35 minutes



Analysis of 360 samples in 35 minutes. The four levels represent a rack of 90 samples, with each of the four calibration standards levels individually loaded with 5 mL of liquid into each of the 90 positions contained in each rack. Excellent stability observed from within each of the four concentration levels.

	SampleSense *FAST* UHT-S Autosampler	Avio 500 Part Number
SampleSense *FAST* UHT-S Systems for Avio 500 ICP	2DXCi	2F-SS6-UHT-37
	4DXCi	4F-SS6-UHT-37
	8DXCi	8F-SS6-UHT-37
	14DXCi	14F-SS6-UHT-37

SampleSense FAST UHT-O

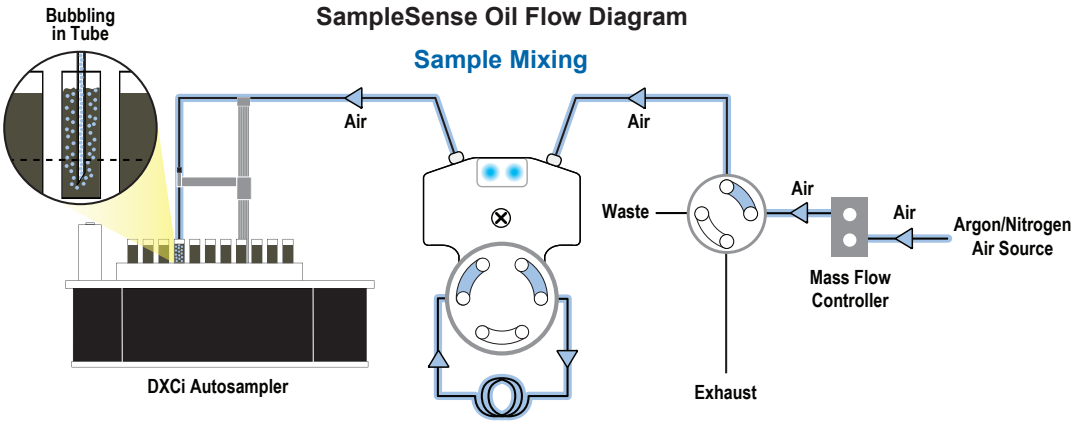
Ultra-high Throughput Automation Systems for Oils

Customized Design for Wear Oils and Lubricants

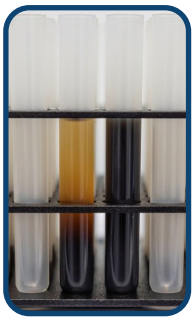
- SampleSense valve automates sample uptake tasks, monitors sample loading and logs sample loading issues
- Vacuum control valve minimizes diluted oil consumption
- Dual mass flow controller module provides gas flows to:
  - Sample probe quickly argon bubble-mixes (4.5 sec) the oil and solvent within each tube immediately prior to sample uptake.
  - Addition Gas port for oxygen to minimize carbon sample deposits on torch injector tube
- Optimized vertical travel and rinse station supports small sample volume containers – while still supporting repeated analysis from the same tube
- **SampleSense *FAST* UHT-O doubles or triples the normal ICP analysis rate while ensuring samples and kerosene diluent are thoroughly mixed**

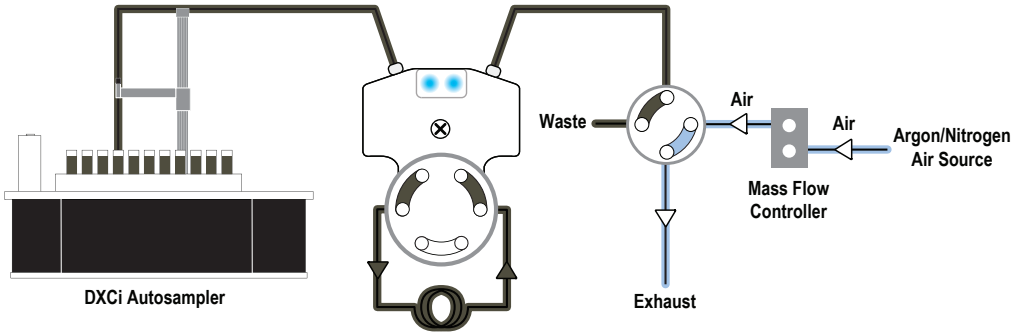
Avio 500 ICP equipped with SampleSense *FAST* UHT-O sample analysis system

Automated Mixing of all Samples Prior to Sample Loading and Analysis



Before and After 4.5 Second Rinse





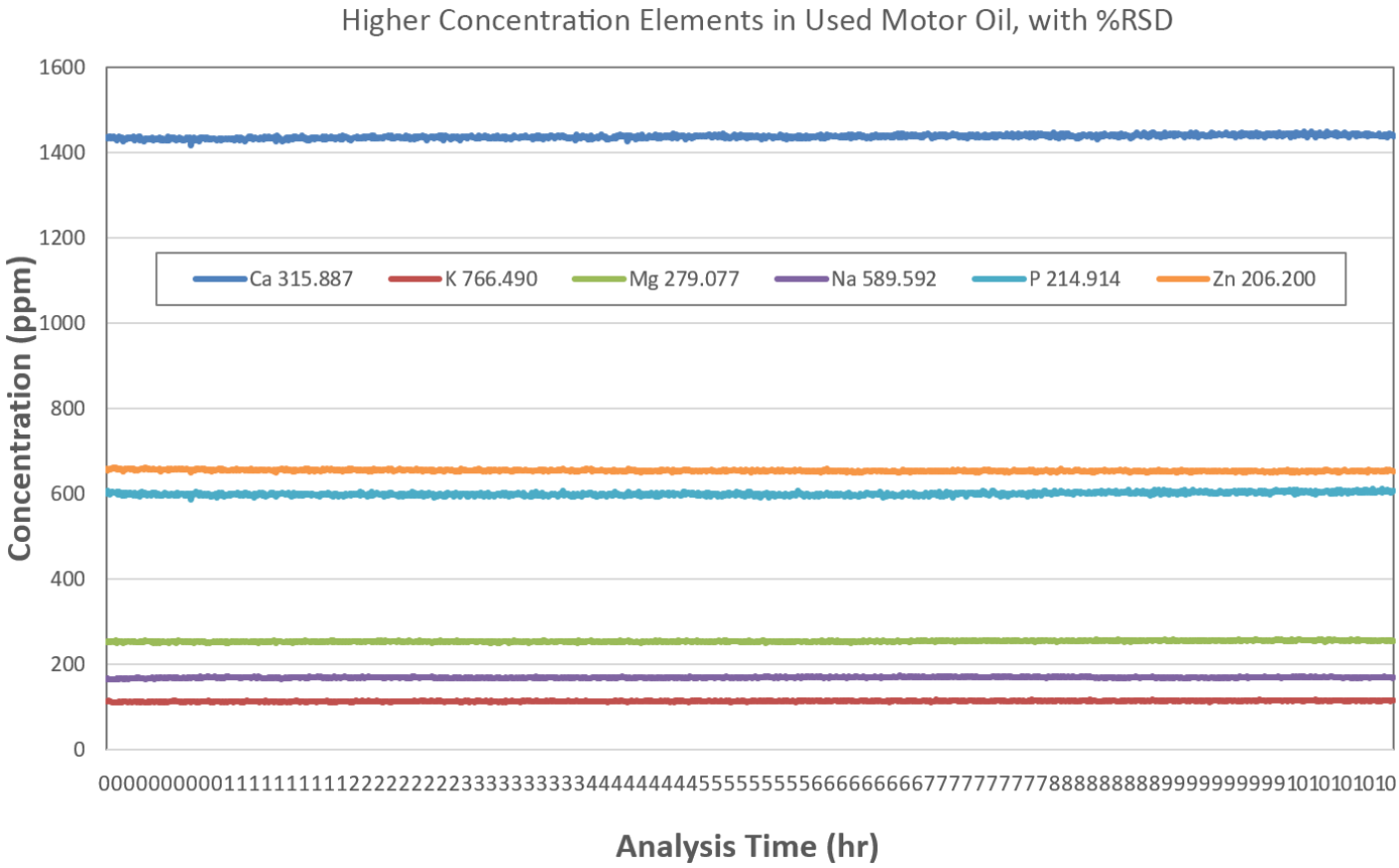
Sample analysis utilizes <2 mL diluted sample

SampleSense *FAST* UHT-O Analysis

- 23 Elements determined: Ag, Al, B, Ba, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Sb, Si, Sn, Ti, V, Zn, + Co as internal standard
- Each sample aliquot dispensed into 8 mL tube with V-Solv (kerosene) diluent addition containing 40 ppm Co
- Each sample and standard stirred for 4.5 sec with argon flow bubbled through sample probe immediately prior to uptake
- Samples loaded with SampleSense optical sensing and ICP read automatically triggered with 2 replicate measurements
- 1.5 mL of sample consumed (vacuum control)
- Automatic detection of empty or missing sample tubes
- 360 samples analyzed in 126 minutes – **21 second sample-to-sample time**

Valve sensors activated, sample is sensed

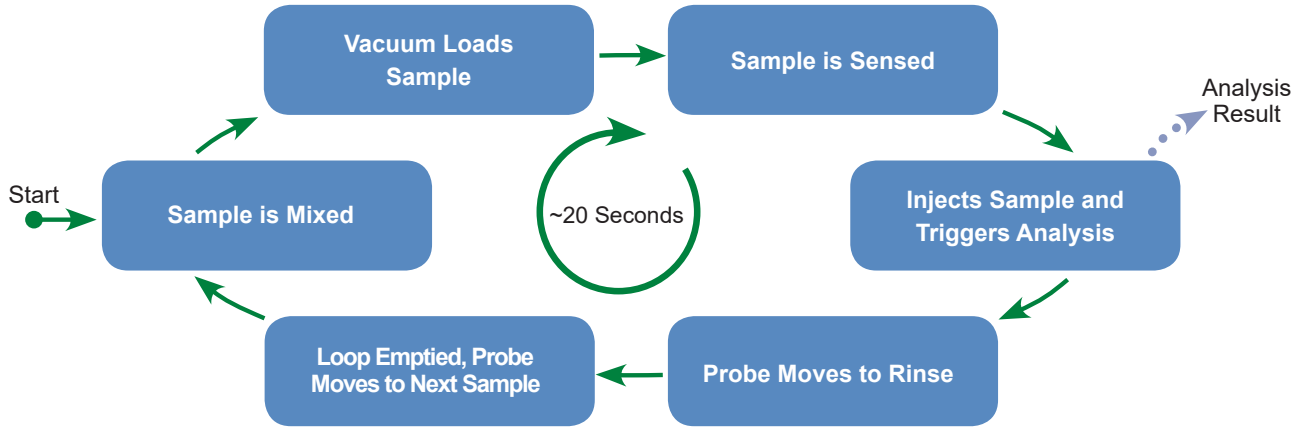
Long term stability with bubble stirring – 10.5 hour analysis



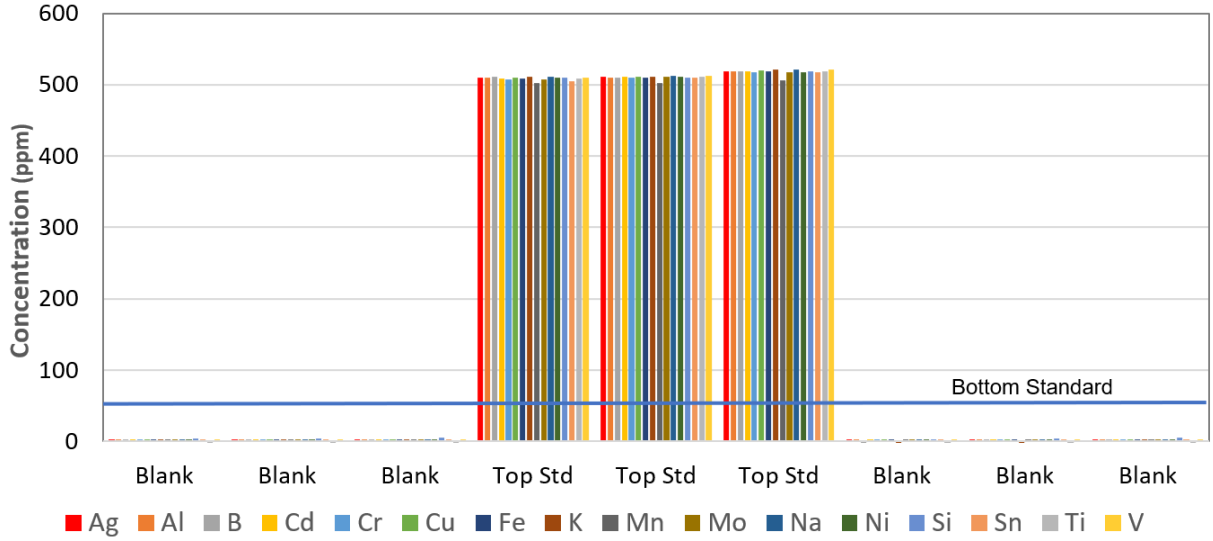
Analysis of 1923 diluted oil samples in under 10.5 hours. Each sample mixed for 4.5 seconds prior to sample uptake by argon gas bubbled from the sample probe and through the sample, eliminating any settling of the oil from the solvent. Results for higher additive elements shown, including the %RSD values for each element. Excellent stability observed for all elements.

SampleSense FAST UHT-O

SampleSense *FAST* UHT-O Analytical Cycle



Rinseout – Wear Metals in Oil



SampleSense *FAST* UHT-O system rinse-out immediately reduces all elements to concentrations well below the bottom standard for oil samples diluted in V-Solv kerosene. Example displays rinse-out of all wear metal elements before and after introduction of three top standards at 500 ppm. Additional time can be added to the procedure to further clear the spray chamber before the next sample is introduced.

SampleSense *FAST* UHT-O Systems	
SampleSense *FAST* UHT-O Autosampler	**Part Number**
4DXCi SampleSense *FAST* UHT-O System	4F-SS6-UHTO-37
8DXCi SampleSense *FAST* UHT-O System	8F-SS6-UHTO-37
14DXCi SampleSense *FAST* UHT-O System	14F-SS6-UHTO-37

Direct ICPMS Analysis of Solid Samples

Elemental Scientific LASERS
INNOVATION to ILLUMINATE

Laser Ablation (LA) is a solid sample introduction technique for ICPMS/ICP and LIBS. Used to directly analyze solid samples, which are placed inside a sample cell and ablated by high power laser pulses. With a beam size ranging from a few microns to hundreds of microns in diameter, spatial imaging or bulk analysis can be performed. The aerosol generated is swept into the ICP/ICPMS via a simple transport line for analysis.

ESL offers a complete range of innovative laser ablation systems and accessories for diverse applications including:

imageBIO266: A purpose-built laser system dedicated to high-speed elemental imaging of biological samples, designed to minimize contamination from the substrate common when using glass microscope slides.

imageGEO193: A purpose-built laser system for high-speed and high-resolution elemental imaging of challenging geological matrices that require high energy.

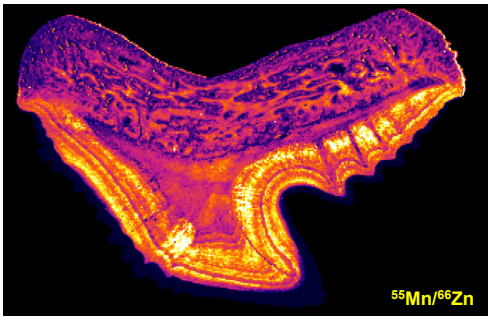
ESL193/ESL213: Reliable laser systems for routine applications in UV/near-UV

Laser SC/LaserTRAX: The only fully automated autosampling systems for laser ablation in high production environments in mining, metallurgy and materials.

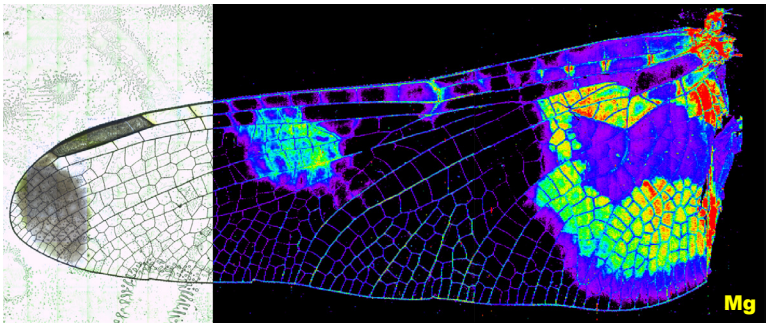
TwoVol3: The *FASTEST* ablation chamber offering ultra-short sample transfer/washout required for imaging applications. It is also convertible for conventional quantitative analysis and upgradable to ESLumen for LIBS data acquisition.

ESLumen: A LIBS spectrometer that uses light emitted from the laser hitting the samples to capture additional spectral information – for elements not measured by ICPMS such as Fluorine.

iolite 4: A comprehensive data processing software and reporting tool for quantitative measurements, imaging, and isotopic abundance calculations.



Tiger Shark Tooth; imageGEO193^{LIBS}



Dragonfly Wing; imageBIO266

prep3™ *for Avio 200 & 500 ICP*

Automated Inline Dilution System for PerkinElmer Avio

prep3 is an inline dilution system which uses peristaltic pumps to perform precise and accurate inline dilution of samples and standards. Syngistix software controls three microperistaltic pumps that deliver sample, diluent, and internal standard to an inline, low-volume mixing device and then into the nebulizer. The total liquid flow is constant, but the ratio of sample to diluent varies to perform the inline dilutions.

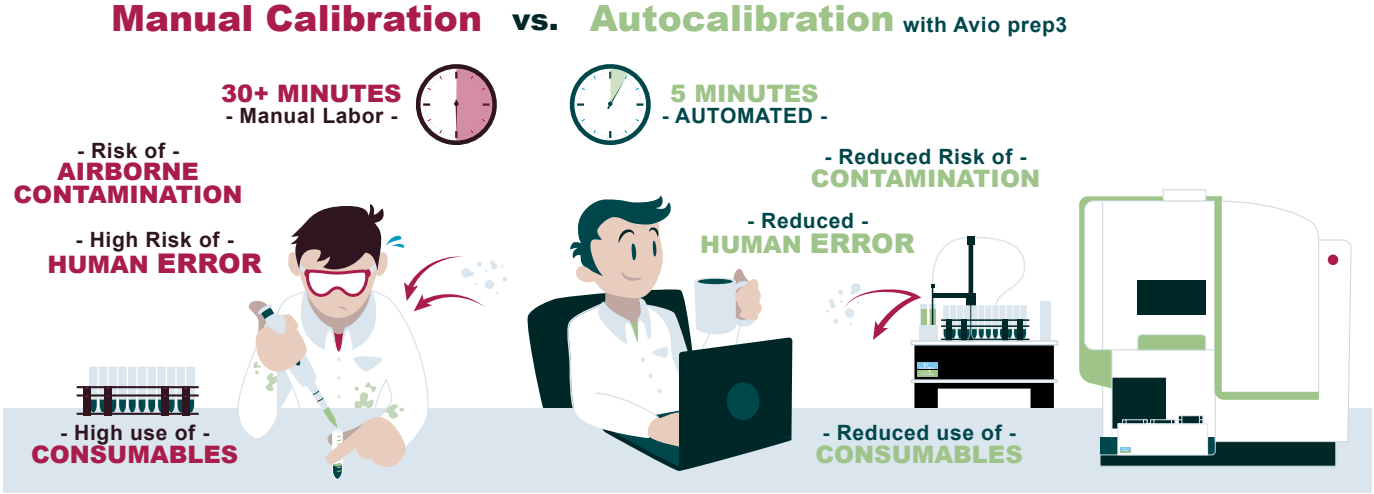
Features

- Triple low-pulsing microperistaltic pump
  - P1 = Carrier
  - P2 = Diluent
  - P3 = Internal standard
- Low-volume mixing device

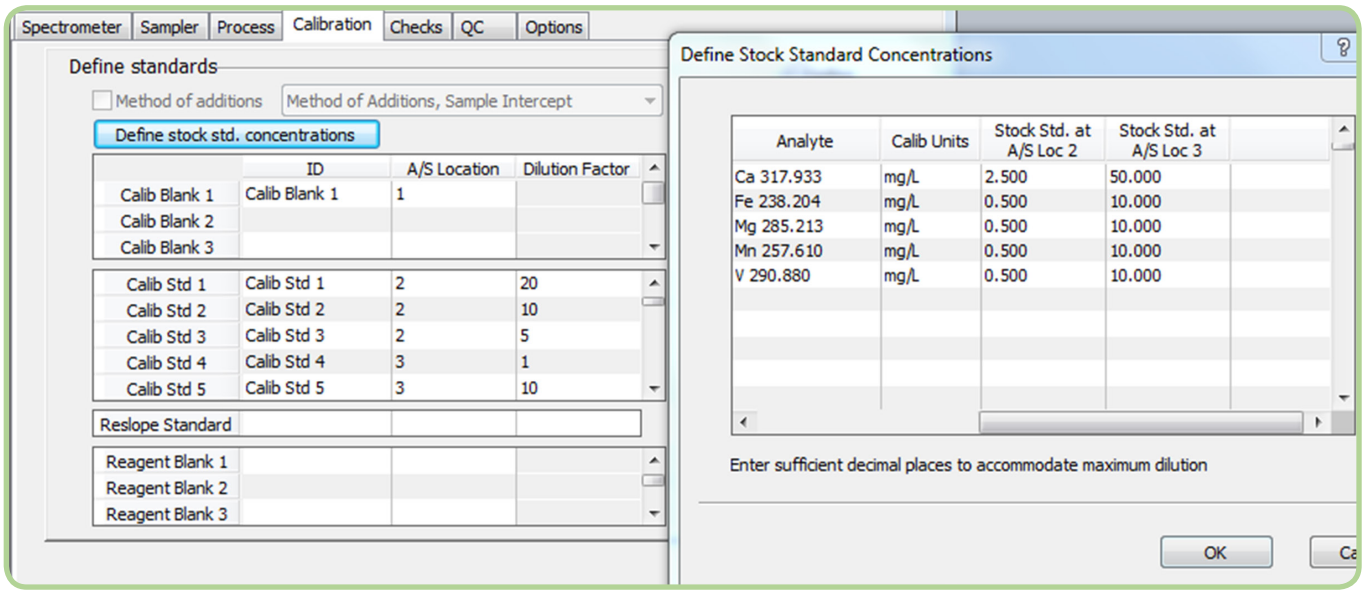
2DXe prep3 on the Avio 200 ICP

Benefits

- Automatic calibration from stock standard solution(s)
- Automatic sample dilution
- Automatic over-range dilution
- Automatic internal standard out-of-range dilution
- Analyze samples from undiluted to up to 25x diluted
- Fully supported by Syngistix software



Autocalibration of multiple stock standards



Defining stock standard concentration and autosampler location in Syngistix software is performed in the calibration tab. In this example, autocalibration from two stock standards creates a calibration curve from 0.025 ppm to 10 ppm for Fe, Mg, Mn, V, and 2.5 ppm to 50 ppm for Ca. Syngistix uses the stock standard locations, concentrations, and dilutions to autocalibrate the Avio.

Automatic predefined dilution of samples
to eliminate manual offline dilution of samples

Sample No	A/S Location	Sample ID	Auto Dil. Factor #
1	101	Sample1	10
2	102	Sample2	10
3	103	Sample3	10
4	104	Sample4	10
5	105	Sample5	10
6	106	Sample6	10
7	107	Sample7	10
8	108	Sample8	10

A

Sample No	A/S Location	Sample ID	Auto Dil. Factor #
1	101	Sample1	20
2	102	Sample2	20
3	103	Sample3	
4	104	Sample4	1
5	105	Sample5	10
6	106	Sample6	5
7	107	Sample7	15
8	108	Sample8	25

B

Syngistix flexibility allows autodilution factors to be the same for all samples (example A) or sample specific (example B). The prep3 eliminates offline manual dilution of samples.

Autodilution of over-range samples
for over-range analytes

Spectrometer | Sampler | Process | Calibration | Checks | QC | Options

Recovery
Sample Limits

☑ Sample limits

Concentration units: ◉ Calibration ○ Sample

Calculate Limits...

☐ Show sample limit range along with out of limit remark

☑ If upper limit is exceeded, then dilute by 5 (B) and reanalyze

	Analyte	Units	Conc	Lower	Upper (A)
1	Ca 317.933	mg/L			
2	Fe 238.204	mg/L			11.0
3	Mg 285.213	mg/L			11.0
4	Mn 257.610	mg/L			11.0
5	V 290.880	mg/L			11.0

The upper concentration range for one or more analytes can be defined for automatic dilution of over-range samples. Set the upper limit (A) and the over-range dilution factor (B).

Autodilution for out-of-range internal standard

Spectrometer | Sampler | Process | Calibration | Checks | QC | Options

Peak Processing
Spectral Corrections
Internal Standards
Internal Stds Checks

☑ Perform internal standard checks

Action taken if lower limit is exceeded

Reanalyze 0 times, Dilute and Reanalyze, dilute by 5

Action taken if Upper Limit is exceeded:

Reanalyze 0 times, Dilute and Reanalyze, dilute by 5

Dilute Further

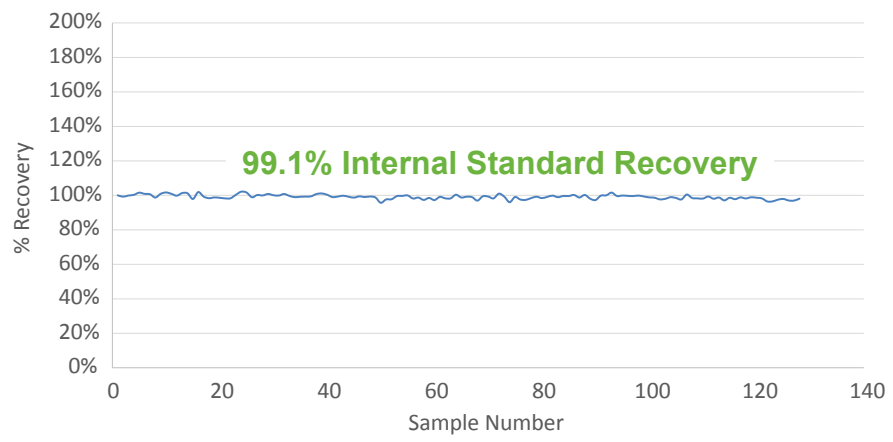
Internal standard limits

	Apply Limits	Int. Std. Name	Check Lower (%)	Check Upper (%)
6	☑	Y 371.029	80	120

Range

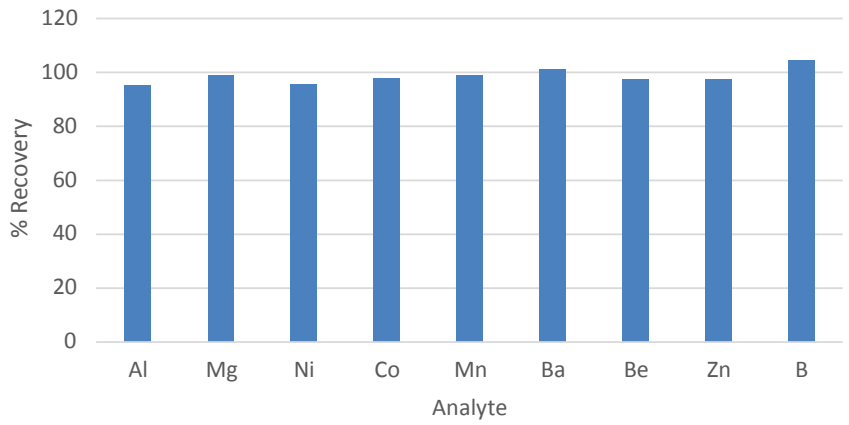
Syngistix monitors the internal standard and the prep3 automatically dilutes out-of-range samples further for reanalysis.

Internal Standard Recovery – 1 ppm Y



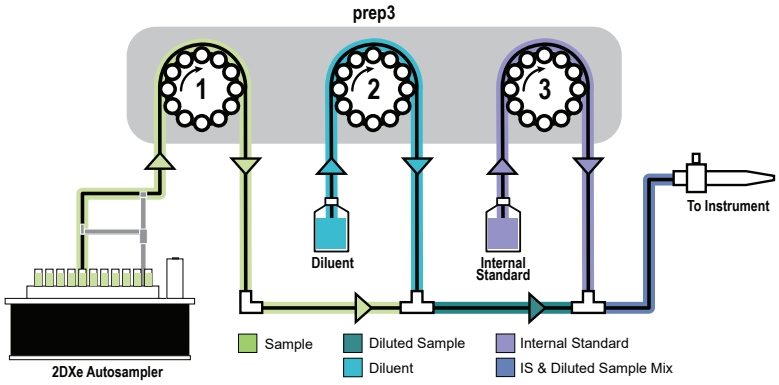
10 hours internal standard recovery. Average recovery: 99.1%

Average Analyte Recoveries



Average recovery for 10 ppm analytes over 13 hours of continuous test. Average recovery: 98.6%

prep3 Flow Path



Description	Part Number
prep3 Inline Autodilution System for PerkinElmer Avio: Includes nebulizer, Triple micro peristaltic pump and autodilution tee assembly, lines, and fittings. (DXe Autosampler required, not included)	prep3-87A
2DXe prep3 Inline Autodilution System for PerkinElmer Avio: Includes 2DXe autosampler, triple micro peristaltic pump and autodilution tee assembly, nebulizer, lines, and fittings.	2Prep3-87A
4DXe prep3 Inline Autodilution System for PerkinElmer Avio: Includes 4DXe autosampler, triple micro peristaltic pump and autodilution tee assembly, nebulizer, lines, and fittings.	4Prep3-87A

brine*FAST* S4™ *for Avio 500 ICP*

Improve Detection Limits For Alkaline Earth and Transition Metals In High Purity Brines

The brine*FAST* is a fully-automated, online preconcentration and matrix removal system that improves detection limits for Ca, Mg, Fe, Ba, Sr, Mn and other elements in undiluted brines by more than an order of magnitude making trace impurity analysis possible with ICP.

Early detection of low and sub-ppb alkaline earth and transition metals in high-purity brines improves chlor-alkali plant process control and prevents costly damage to fluoropolymer membrane cells. Undiluted 30% brines may be sampled and analyzed directly, eliminating sample preparation and reducing contamination.

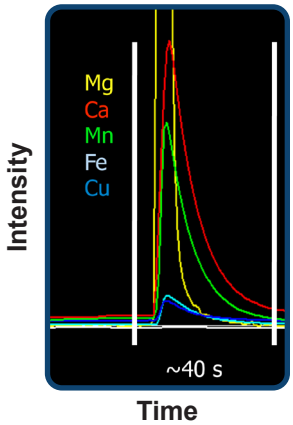
2DXCi brine*FAST* S4 system for PerkinElmer Avio 500

Features:

- Fully automated, inline preconcentration and matrix removal
- Direct mode with up to 50x fixed inline dilution
- Syringe-driven reagents
  - Consistent chemistry
  - Maximum throughput
  - Cleanliness
- No daily maintenance
- Detection limits in brine up to 400x better than traditional sample introduction

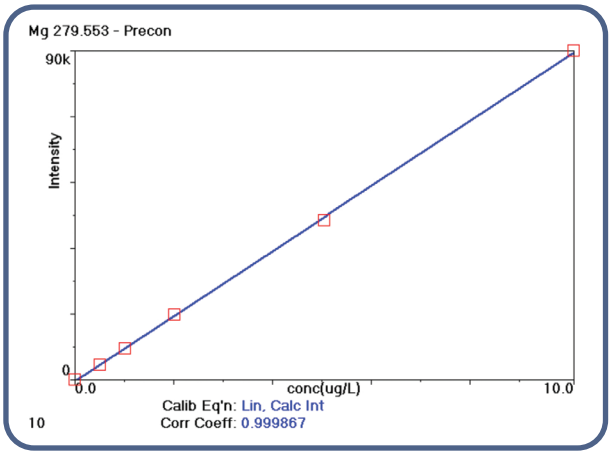
Applications:

- Preconcentration mode for determination of low and sub-ppb Ca, Mg, and other metals in 30% brine
- Chlor-alkali plant product monitoring for caustic soda and bleach
- Determination of alkali earth metals and many transition metals in any high-matrix sample
- High throughput *FAST* analysis with inline dilution in direct mode

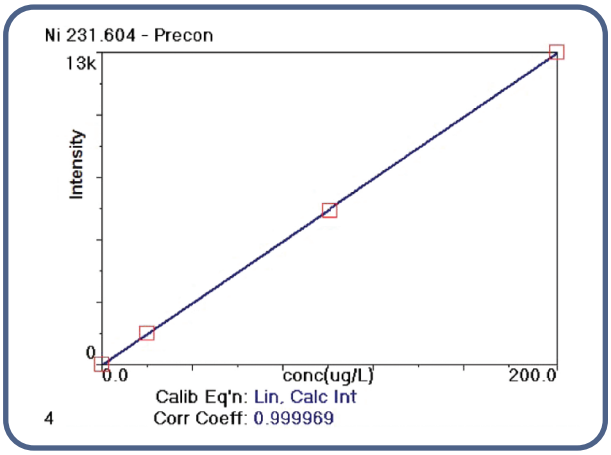


Elution Profiles

Simultaneous elution profiles for preconcentration elements allows simple quantification after matrix removal.



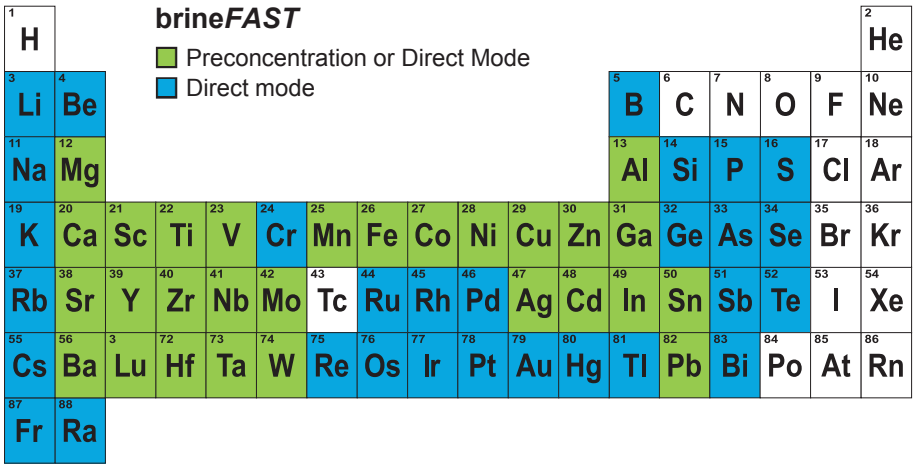
Typical calibration for 50% caustic soda (10x diluted) demonstrating linearity at higher concentrations. If needed, higher level calibrations at the ppm level are also linear.

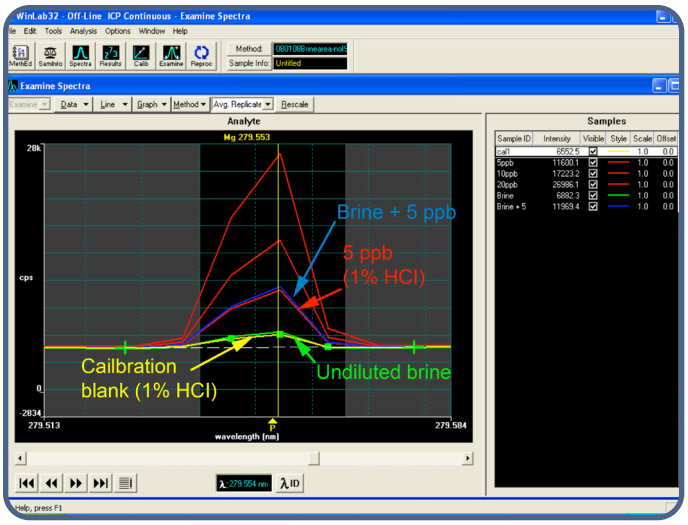


Typical calibration for ultra-pure brine, <10 ppb.

All brine*FAST* S4 Systems Include:

- DXCi *FAST* autosampler
- S400V syringe pump module
- *FAST* DXi dual valve module and all connections
- brine*FAST* S4 concentrator column
- brine*FAST* S4 cleanup column
- Mobile autosampler station





Spectral data shows equal response for a Mg spike in a 1% HCl standard and 30% brine.

Percent Spike Recovery Comparison in 30% Brine		
Analyte	Traditional Introduction (spiked at 100 ppb)	brine*FAST* S4 (spiked at 5 ppb)
Ca	132	103
Mg	64	96
Fe	104	95
Ba	106	99
Sr	75	99
Mn	111	99

Comparison of spike recoveries for traditional analysis and the brine*FAST* S4 preconcentration technique. Note that the spike levels are 20x lower with the brine*FAST* S4 than with the original introduction system.

Spike recovery in 50% caustic soda (10x diluted)	
Analyte	**% Recovery**
Fe	99
Ni	99
Cu	99
Pb	101

Spike recoveries in 50% caustic soda (10x diluted) show excellent recovery against a calibration prepared in diluted nitric acid. Spike level is 50 ppb (500 ppb for Fe).

Method Detection Limits Comparison in 30% Brine			
Analyte	Traditional (ppb)	brine*FAST* S4 (ppb)	Improvement Factor
Ca	8.0	0.02	410
Mg	1.7	0.01	190
Fe	6.3	0.2	28
Ba	1.4	0.2	7
Sr	1.1	0.01	150
Mn	1.2	0.02	57

Description	Part Number
2DXCi brine*FAST* S4 system for Avio 500	2BF-S4-37C
Spare brine preconcentration column	CF-IDA
Spare trace metals cleanup column	CF-M-0600

hydrideICP™

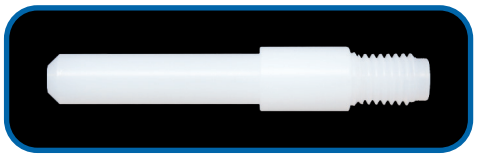
Compact Hydride Generation System for Avio 200/500 ICP

The hydrideICP, a standalone hydride generation system with precision micro peristaltic pump, provides sub-ppb detection limits for hydride-forming elements such as As, Se, Sb, and Hg.

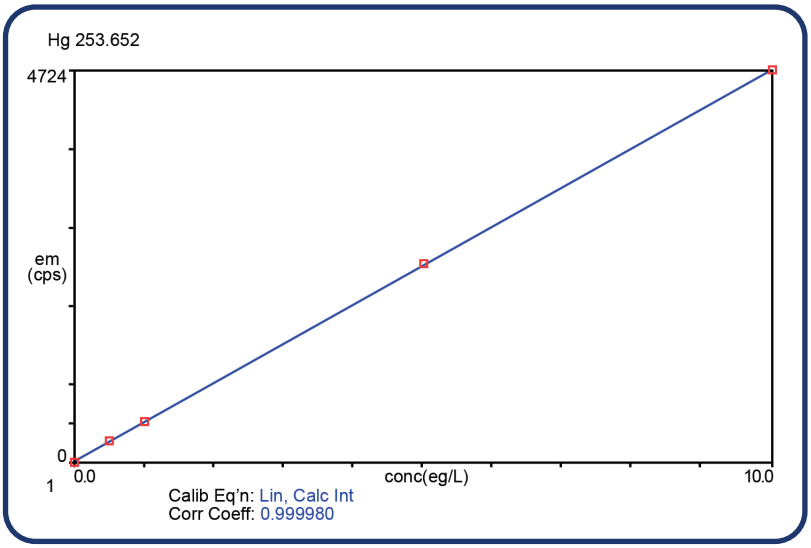
hydrideICP System

Benefits:

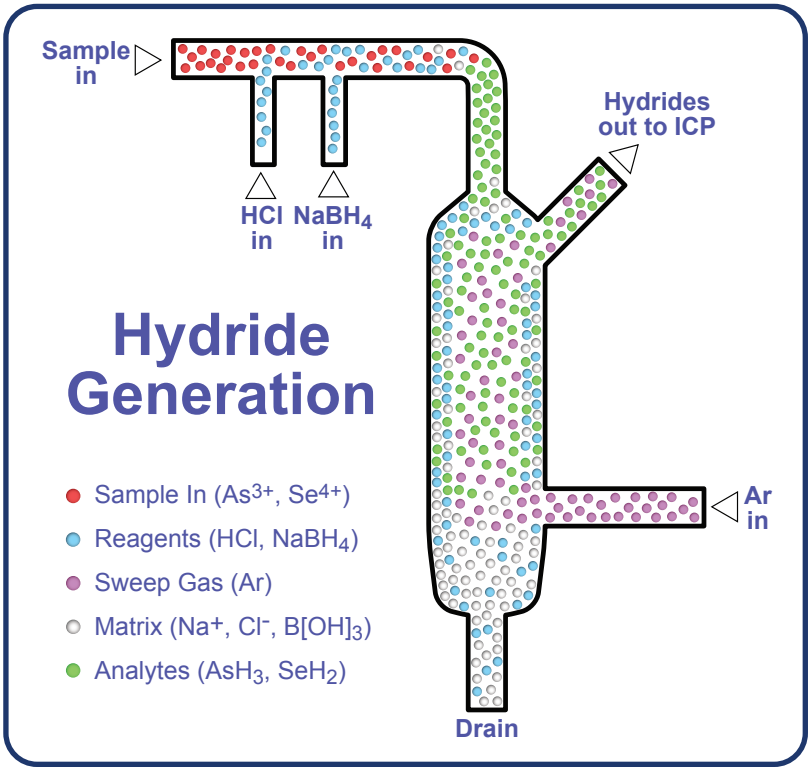
- Increased sensitivity, up to 100x for hydride-forming elements
- Improved detection limits for As, Hg, Se, Sb, and other hydride-forming elements
- Improved stability
  - MP^2 micro peristaltic pump precisely mixes sample and reagents, producing a stable formation of H_2 gas and hydrides
- Compact
  - hydrideICP is the smallest system of its kind on the market (95 mm x 118 mm x 140 mm)
- Chemically resistant construction
  - MP^2 micro peristaltic pump with ceramic pins, a PFA mixing block and quartz GLS
- Convenient
  - hydrideICP is completely integrated into the MP^2 pump



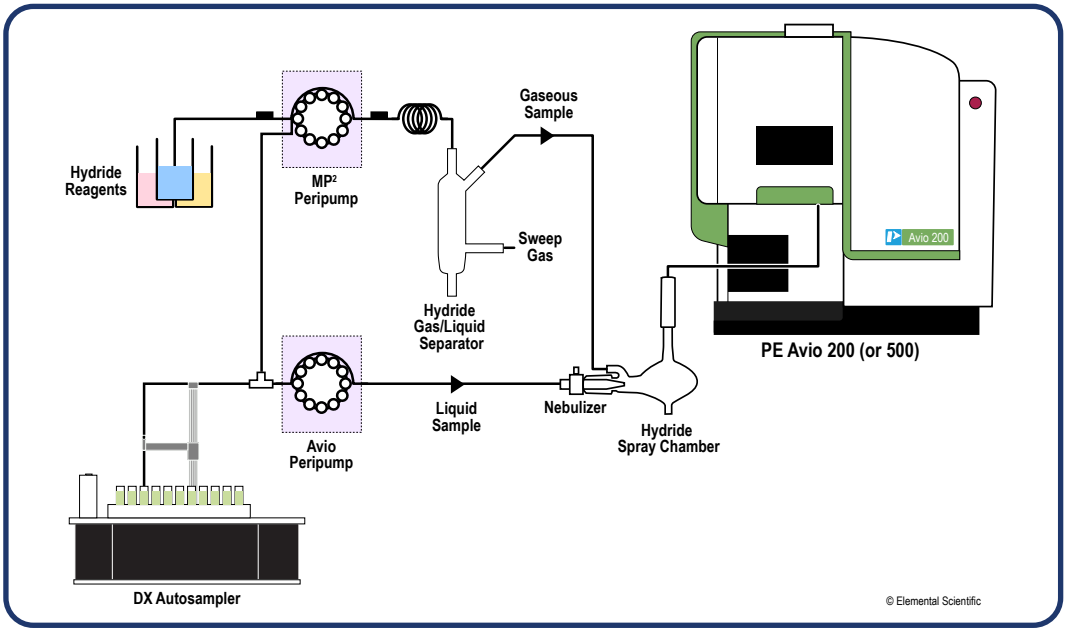
The universal spray chamber adapter is a gas-liquid separator to the Avio 200/500 spray chamber.



Hg Calibration – 0, 0.5, 1, 5, and 10 ppb (Normal Resolution)



HydrideICP's gas liquid separator is the smallest, highest performing and most stable on the market. The design promotes rapid mixing of sample and reagents, resulting in an efficient reaction and separation of hydride gases from sample liquids in a small volume.



HydrideICP configured to operate in simultaneous mode with both hydride generation and direct nebulization introduction being analyzed in one analysis.

Description	Part Number
HydrideICP Generation System. HydrideICP Generator Kit (Hydride quartz gas-liquid separator, four way tee, MP² precision micro peristaltic pump, universal spray chamber adapter and mounting plate).	HG-MP2-6-A
Quartz spray chamber with two inlets. Supports simultaneous hydride and direct nebulization modes with the hydrideICP.	C3Q-37-H

hydride S31™ *for Avio 500 ICP*

Hydride Generation with hydride S31 *FAST*

The hydride S31 is a compact, syringe-driven hydride generation system that produces ultra-low detection limits for hydride-forming elements.

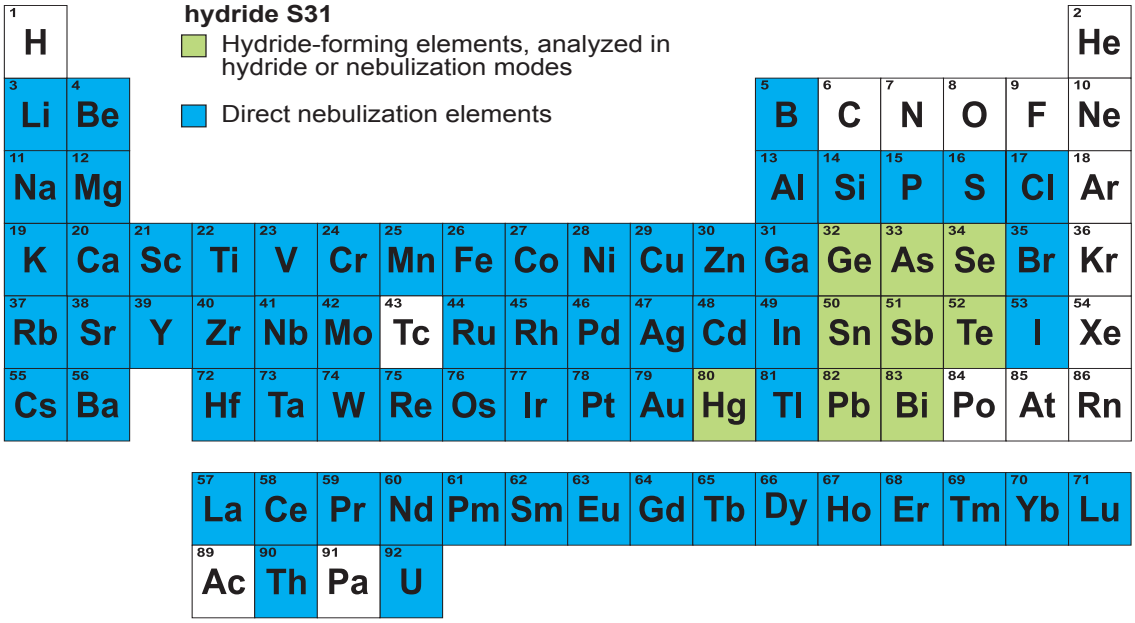
The 3-in-1 syringe barrel on the syringe module provides pulse-free reagent delivery for the best precision, and the patent-pending hydride gas liquid separator provides high sensitivity. The *FAST* sample valve in the S31 system provides high sample throughput and excellent analyte washout.

hydride S31 system
for the Avio 500 ICP

Design Features:

- Syringe-driven reagents for hydride generation; no peristaltic pump reagent lines to replace
- *FAST* for high-throughput and excellent washout
- Sub-ppb detection limits for hydride-forming elements
- Simple operation with Avio 500 ICP and ESI autosamplers

hydride S31 for the NexION 1000/2000 ICPMS			
Detection limits (3 s) for hydride-forming elements (in hydride mode)	**Analyte**	Mass	LOD (ppb)
	As	75	0.08
	Se	79	0.1
	Sb	122	0.3
	Hg	201	0.1

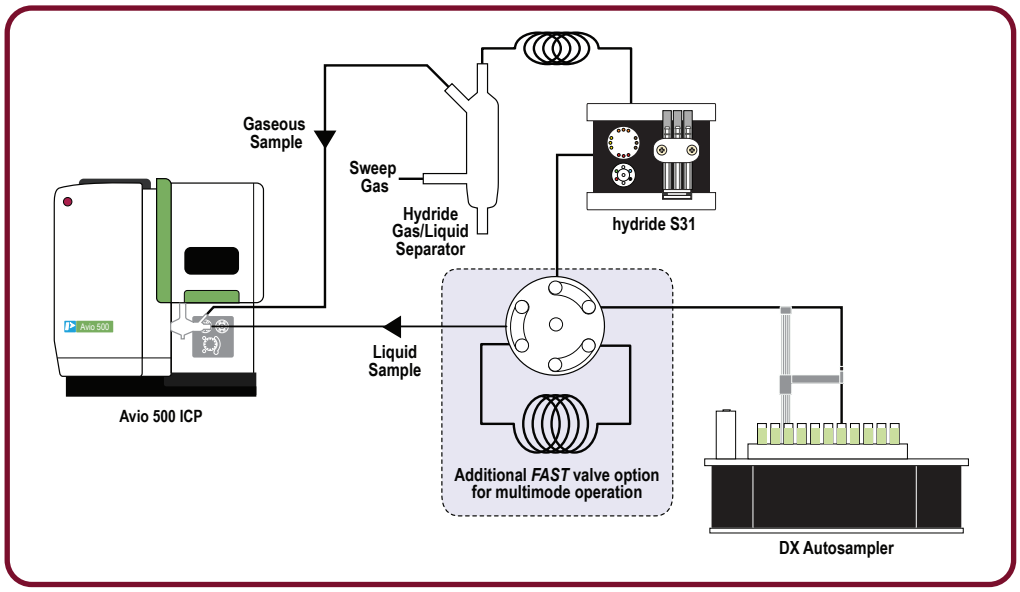


Simultaneous Hydride Generation and Direct Nebulization with hydride S31

The integration of an additional *FAST* valve provides multi-mode functionality to the hydride S31 and the Avio 500 for the highest flexibility and sample throughput.

- Selection between the following modes of operation:
  - Simultaneous determination of hydride-forming elements with hydride generation and direct nebulization for other elements
  - Hydride and direct nebulization determinations run sequentially
  - Independent analysis by either hydride or direct nebulization

Single Valve *FAST* DXi for Avio 500 ICP required for simultaneous hydride and direct nebulization option (not included)



hydride S31 system diagram including autosampler and *FAST* valve

Hydride S31 configuration with additional *FAST* valve for high throughput multi-mode analysis. Non-hydride forming elements are analyzed through the Liquid Sample pathway using a nebulizer. Hydride forming elements benefit from high sensitivity hydride generation through Gaseous Sample pathway. The Avio 500 acquisition can be configured to analyze interfered elements (such as As, Se) when the nebulizer is introducing carrier liquid, thus avoiding Cl or other polyatomic interferences. Hydride S31 can also be operated simultaneously or sequentially with direct nebulization.

hydride S31 System	
Description	**Part Number**
hydride S31 module for any DX *FAST* system. Includes S31 module for hydride generation. (DX *FAST* autosampler and C3Q-37-H spray chamber required, not included)	HFX-57
Avio 500 hydride baffled quartz cyclonic spray chamber with 8 mm ZipFit connector for ZipTorch. Includes hydride gas inlet at nebulizer entrance and drain line. (see page 57). For use with Avio ZipTorches (see page 59).	C3Q-37-H

Turn ANY DX FAST System Into a hydride S31 System!

Just add the hydride S31 module

Autosampler Enclosures and ULPA Filtered Environments

Autosampler Enclosures

Enclosures protect samples and standards from airborne contamination. An exhaust port (100 mm, included) may be connected to the laboratory ventilation system to exhaust acid fumes and protect the laboratory environment and equipment. Enclosures can be purchased with or without an ULPA filter.

C3V2-ULPA
Enclosure for 2DX autosampler with ULPA Filter

Enclosures for DXe, DX and DXCi Autosamplers

Autosampler Model	Enclosure Only	Enclosure with ULPA Filter
Enclosure for MicroDX	SC-1607-DX	SC-1607-DX-1000
Enclosure for 2DX	C3V2	C3V2-ULPA
Enclosure for 4DX	C3V4	C3V4-ULPA
Enclosure for 8DX	C3V8	C3V8-ULPA
Enclosure for 14DX	C3V14	C3V14-ULPA

Ultra-low Particulate Arrester Air Filter

The ULPAclean 10 filter creates a clean, positive pressure environment for samples and standards and prevents airborne contamination. The ULPAclean 10 removes 99.9995% of 0.1 µm particles or larger.

ULPAclean 10 can run off the autosampler power or can be plugged directly into an outlet (24VDC operation). Two air volume settings are available for quiet operation, 1.0 or 0.5 m^3/min.

ULPA10
ULPAclean 10 Filter

Description	Part Number
ULPAclean 10 filter for autosampler enclosure	ULPA10

Mobile Stations for DXe, DX and DXCi Autosamplers

Mobile Autosampler Stations

The mobile autosampler station provides a small-footprint platform for 2 and 4 DX-series autosamplers.

Benefits:
- Mobile with locking wheels for flexible positioning
- Convenient location for rinse and waste containers
- Shelf for additional sample introduction equipment, such as prep*FAST*

SC-1210-DX mobile station with 2DX autosampler

SC-1410-DX mobile station with 4DX autosampler

Description	Part Number
Mobile autosampler station for 2DX autosampler including electrical conduit for D-type valves (autosampler not included)	SC-1210-DX-P
Mobile autosampler station for 2 DXe, DX or DXCi (autosampler not included)	SC-1210-DX

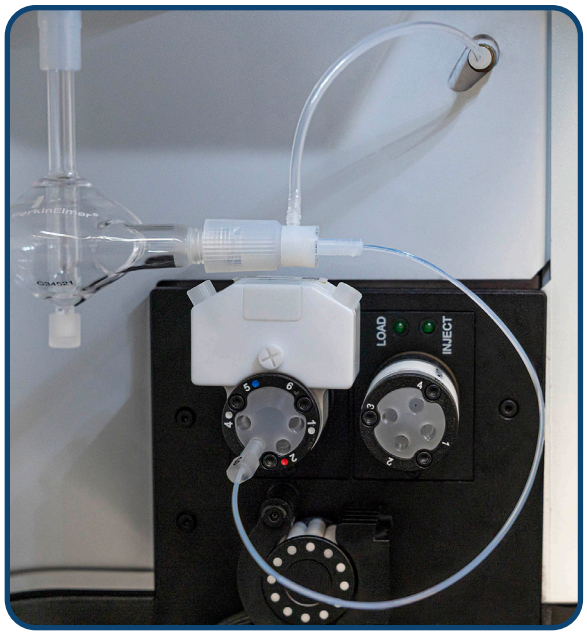
Description	Part Number
Mobile autosampler station for 4 DXe, DX or DXCi including electrical conduit (autosampler not included)	SC-1410-DX-P
Mobile autosampler station for 4 DXe, DX or DXCi (autosampler not included)	SC-1410-DX

High-performance PFA nebulizers with Integrated Capillaries

PFA Integrated Capillary Nebulizer for *FAST* and prep*FAST*

These high-performance PFA nebulizers were designed for *FAST* and prep*FAST* applications to minimize the number of connections between the valve and the nebulizer. An integrated fitting on the nebulizer's sample capillary line connects directly into *FAST* and prep*FAST* valves making the systems even more user-friendly. The self-aspirating MicroFlow fluoropolymer nebulizers are chemically resistant and an essential part of the ICP laboratory.

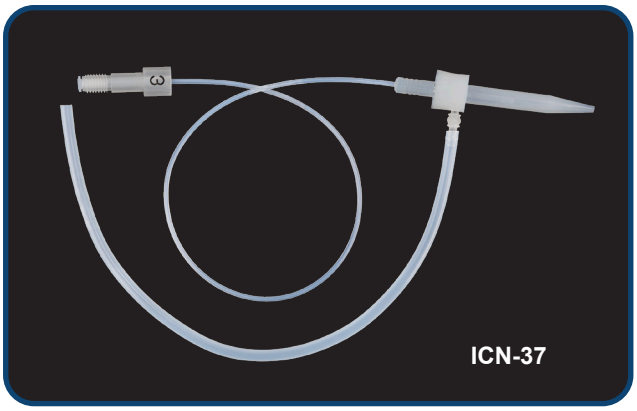
PFA integrated capillary nebulizers can produce a fine aerosol from aggressive acids, alkalis, organics, and high-salt solutions. They are resistant to clogging and produce high sensitivity at a low sample flow rate. They are the ideal nebulizer for *FAST* and prep*FAST* systems, ICP instruments with a wide range of sample types or when unknown samples are analyzed.



Integrated capillary nebulizer and prep*FAST* with SampleSense on an Avio ICP

Benefits:

- Integrated capillary to eliminate additional connection at nebulizer
- Optimized flow rate for use with all *FAST* and prep*FAST* valve-equipped systems
- Custom capillary length to minimize dead volume and uptake delay time on Avio 200 and 500 ICP
- Coded connector for direct and proper port connection to all *FAST* and prep*FAST* valves
- Chemically-resistant, ideal for strong acids, alkalis, and organic solvents
- Produces a fine aerosol for high transport efficiency and high-sensitivity
- Permanent gas line with easy installation on Avio 200 and 500 ICP systems

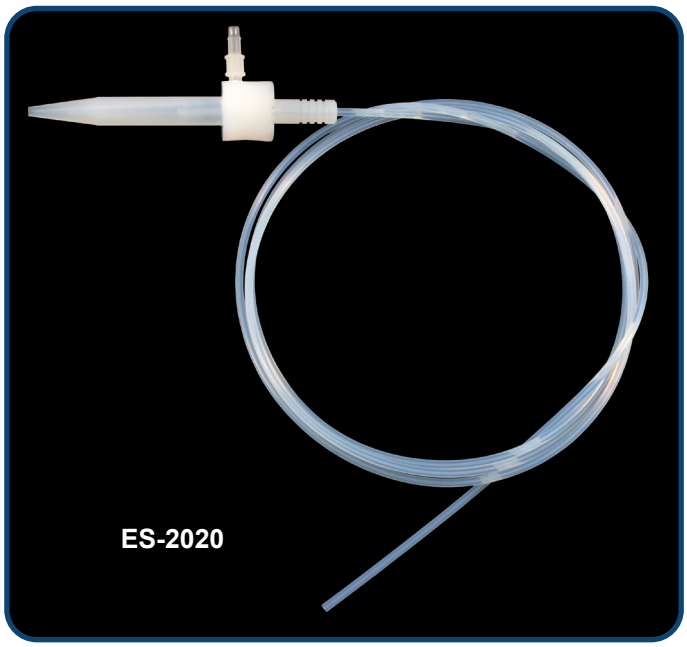


Model	Part Number
PFA Integrated Capillary Valve Nebulizer for *FAST* and prep*FAST* systems on the Avio 200 and 500 ICP	ICN-37

PFA Nebulizers with Integrated Capillaries

PFA Nebulizers with Integrated Capillaries

Self-aspirating PFA MicroFlow fluoropolymer nebulizers are chemically resistant and an essential part of the ICP laboratory. PFA nebulizers can produce a fine aerosol from aggressive acids, alkalis, organics, and high-salt solutions. They are resistant to clogging and produce high sensitivity at a low sample flow rate. They are the ideal nebulizer for ICP instruments with a wide range of sample types or when unknown samples are analyzed.



Benefits:

- Integrated capillary for connection-free introduction of samples at low flow rates
- Available with self-aspiration rates between 20 and 400 microliters per minute
- Chemically-resistant, ideal for strong acids, alkalis, and organic solvents
- Produces a fine aerosol for high transport efficiency and high-sensitivity
- Can be peristaltic pumped when introducing organic solvents

PFA Nebulizers with Integrated Fluoropolymer Capillaries

Model	Measured self-aspiration rate (@1 L/m Ar)	Part Number
PFA-20	20 µL/min	ES-2020
PFA-50	50 µL/min	ES-2000
PFA-100	100 µL/min	ES-2002-0002
PFA-200	200 µL/min	ES-2003-0002
PFA-400	400 µL/min	ES-2005-0002

Other flow rates made to order

PFA and Polypropylene High-Efficiency MicroFlow Nebulizers for the Avio 200 and 500 ICP

MicroFlow nebulizers are resistant to clogging and are reliably self-aspirated or pumped to produce a fine aerosol for high transport efficiency and high sensitivity.

PFA-ST Nebulizers

The PFA-ST MicroFlow nebulizer is made from high purity, HF resistant PFA. It has an exchangeable external sample uptake capillary. The sample uptake rate is controlled by the diameter of the external capillary or probe.

Benefits:

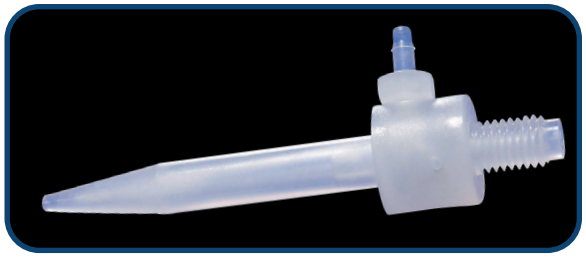
- All PFA construction
- Exchangeable uptake capillaries allow one nebulizer to be used at different self-aspiration rates from 20 µL/min to 700 µL/min
- Chemically resistant – ideal for strong acids, alkalis and organics
- Can be pumped from <0.02 mL/min to 3.0 mL/min
- Direct analysis of volatile and non-volatile organic solvents
- Longer lifetime than glass or quartz nebulizers

Description	Application	Part Number
ST3-70 MicroFlow PFA nebulizer with external 1/4-28 threaded connector.	For general high sensitivity and high performance	ST3-57
PFA-ST for prep*FAST* self-aspirating nebulizer with external 1/4-28 threaded connector.	prep*FAST*	PF-2040

PolyPro-ST Nebulizer

The PolyPro-ST nebulizer is a low-cost, HF-resistant alternative to the PFA nebulizer. The PolyPro nebulizer has a lower chemical resistance than the PFA nebulizer but has the same high-efficiency aerosol generation. Both are robust nebulizers that can self-aspirate with an exchangeable external sample uptake capillary or can be used with a peristaltic pump.

Description	Part Number
Poly-pro self-aspirating nebulizer with external 1/4-28 threaded connector.	ES-4040-57

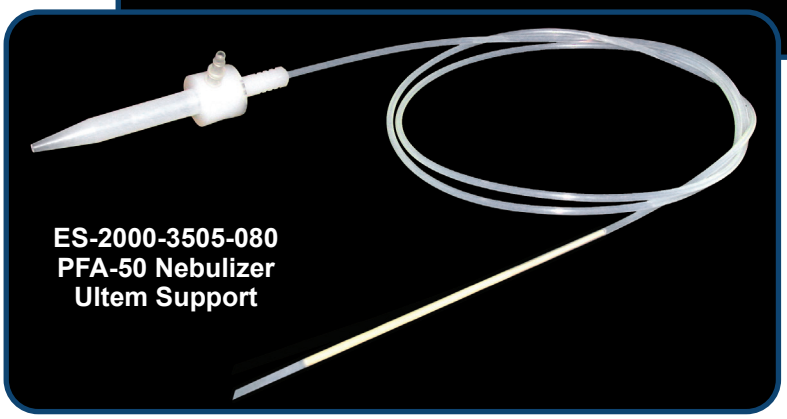


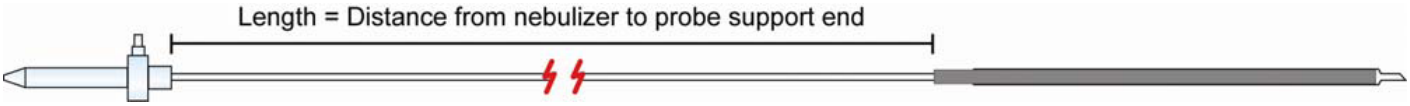
PFA Nebulizers with Integrated Probes for the Avio 200/500 ICP

Self-Aspirating PFA Nebulizers with Integrated Probes

These nebulizers self-aspirate at low flow rates with the same benefits of the PFA MicroFlow nebulizer. The integrated sampling probe is constructed by encapsulating a rigid support material between layers of fluoropolymer to provide a chemically-resistant probe that is mechanically stable and resilient.

Probes can be custom made to specific lengths and materials at no extra charge.





PFA MicroFlow Nebulizers with Integrated Autosampler Probe

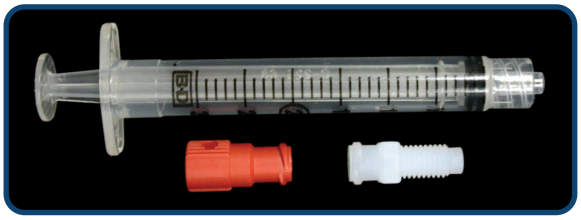
Model	Autosampler Type	Self-aspiration rate (@1 L/m Ar)	Length	Support Material	Application	Part Number
PFA-20	MicroDX DX	20 µL/min	80 cm	Carbon Fiber	Environmental/Clinical	ES-2020-3503-080
			100 cm	Ultem	High Purity Semiconductor	ES-2020-3505-080
PFA-50	MicroDX DX	50 µL/min	80 cm	Carbon Fiber	Environmental/Clinical	ES-2000-3503-080
			100 cm	Ultem	High Purity Semiconductor	ES-2000-3505-080
PFA-100	MicroDX DX	100 µL/min	100 cm	Carbon Fiber	Environmental/Clinical	ES-2002-3503-100
				Ultem	High Purity Semiconductor	ES-2002-3505-100
PFA-200	MicroDX DX	200 µL/min	100 cm	Carbon Fiber	Environmental/Clinical	ES-2003-3503-100
				Ultem	High Purity Semiconductor	ES-2003-3505-100
PFA-400	MicroDX DX	400 µL/min	100 cm	Carbon Fiber	Environmental/Clinical	ES-2005-3503-100
				Ultem	High Purity Semiconductor	ES-2005-3505-100

Syringe Flush Kit / Nebulizer Gas Line / Obstruction Removal

Syringe Flush Kit for ST Nebulizers

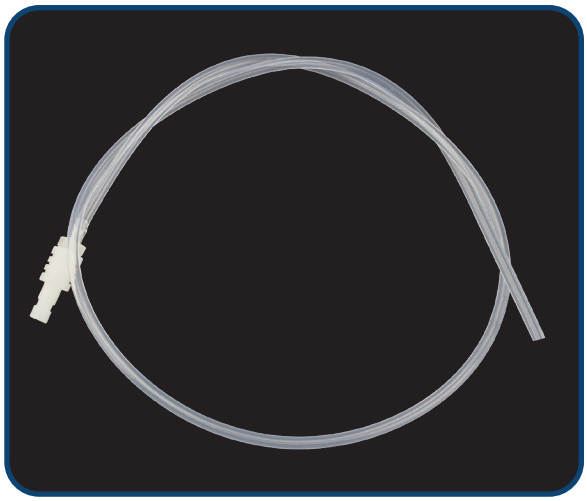
The syringe flush kit is used in two ways. With the white fitting it can back flush the sample capillary leading to the ST nebulizer. With the red fitting it can attach to the sample liquid port on the ST nebulizer for foreflushing.

Description	Part Number
Syringe flush kit. Includes 3 mL syringe, two luer to 1/4-28 adapters.	SC-0599-0109



Nebulizer Gas Line

The Nebulizer Gas Line connects the nebulizer to the argon gas supply on the instrument. This nebulizer gas line contains quick connects for a secure connection to any PFA-ST nebulizer.

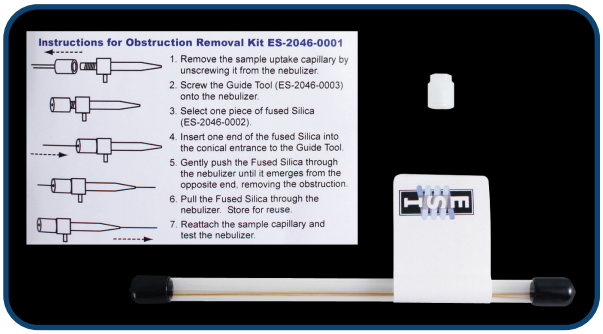


Description	Part Number
Gas line for PFA-ST nebulizers	GL-ST-57

Nebulizer Obstruction Removal Kit

While naturally resistant to obstructions, PFA nebulizers may occasionally require maintenance. Use this kit to safely remove obstructions in all PFA-ST nebulizers for long-term high performance. Never back-flush a PFA-ST nebulizer.

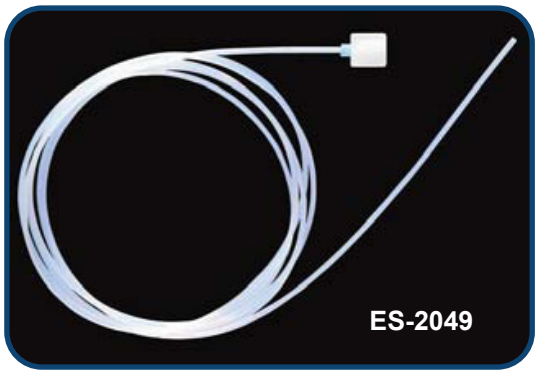
Description	Part Number
Fused silica obstruction removal kit for ST-type nebulizers. Includes one guide, 10 pieces of fused silica and instructions.	ES-2046-0001



Sample Capillaries / Probes

Sample Capillaries for ST Nebulizers

I.D.	Self-aspiration rate (@1 L/m Ar)	Part Number
0.15 mm	20 µL/min ■ (red)	ES-2045
0.20 mm	50 µL/min ■ (purple)	ES-2043
0.25 mm	100 µL/min ■ (green)	ES-2042
0.30 mm	200 µL/min ■ (yellow)	ES-2047
0.50 mm	400 µL/min ■ (orange)	ES-2041
0.80 mm	700 µL/min ■ (blue)	ES-2044
1.00 mm	1 mL/min ■ (gray)	ES-2049



Sample capillary attached to PFA Nebulizer

Carbon Fiber Supported Autosampler Probes for ST Nebulizers

ST nebulizer probes connect directly to any ST-type nebulizer. The 1/4-28 threaded fitting provides a secure, zero-dead-volume connection with no additional fittings required.

Probes for SC DX Autosamplers			
Probe i.d.	Capillary Length	Self-aspiration rate (@1 L/m Ar)	Part Number
0.25 mm	80 cm	100 µL/min	ES-5037-3250-080
0.50 mm	80 cm	400 µL/min	ES-5037-3500-080
0.25 mm	150 cm	100 µL/min	ES-5037-3255-150
0.50 mm	150 cm	400 µL/min	ES-5037-3505-150

Also available with Ultem support.

MEINHARD®

Concentric Nebulizers for Avio 200/500 ICP

MEINHARD® Plus Nebulizers have the lowest dead volume of any glass or quartz nebulizer. The low dead volume and high sensitivity provide excellent detection limits and washout.

Each MEINHARD® Plus nebulizer comes with the FitKit+ gas and sample quick connect fittings. Patented permanent non-degradable PFA connector eliminates contamination risk and risk of leak. The gas connection fits snugly over the maria on the sidearm of the nebulizer.

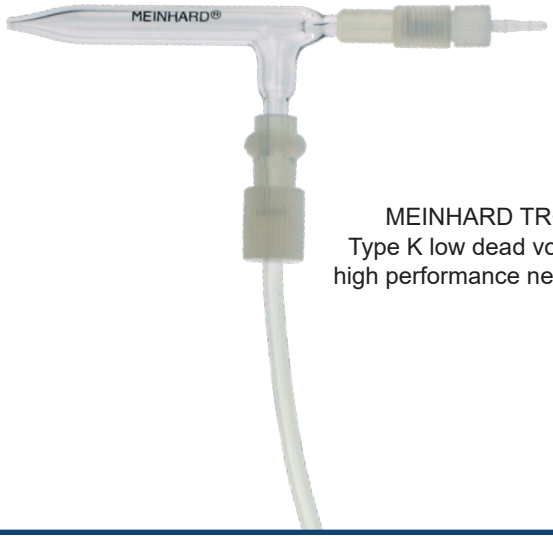
Features for all MEINHARD® Plus Nebulizers:

- Self aspiration rate 0.5 mL/min with argon flow 1 L/min at 50 PSI (3.4 bar/345 kPa).
- Peristaltic pumped rate 0.1 mL/min to 3.0 mL/min.
- Includes FG Gas Quick Connect (PFA).

Glass Concentric Nebulizers

The Type K borosilicate glass nebulizer is an economical concentric nebulizer used for high solids.

Description	Part Number
MEINHARD® borosilicate glass, high solids nebulizer, Type K, 0.7 mL/min, 50 PSI	TRP-50-K1



MEINHARD TR+,
Type K low dead volume
high performance nebulizer

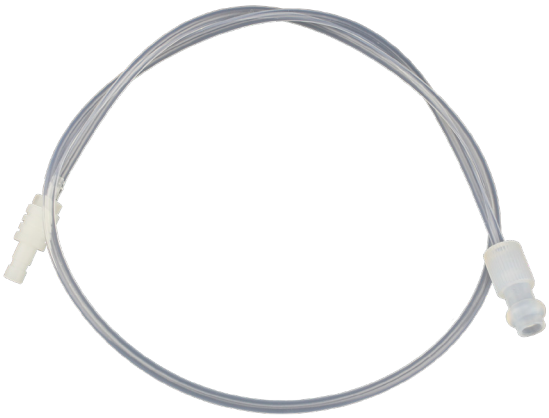
TR+ glass high sensitivity concentric nebulizer with low internal volume.

Description	Part Number
MEINHARD® TR+ glass nebulizer, Type K, low internal volume	TR-50-K1

Nebulizer Lines

Description	Part Number
FAST connector for MEINHARD® Plus Series Nebulizer (F2), 0.25 mm i.d.	F-F2-25-14

Description	Part Number
4 mm nebulizer liquid-end connnector kit F2.	F2-50-026-ZZ



Description	Part Number
Nebulizer gas line for MEINHARD® concentric nebulizers	GL-5747

Plus Nebulizer PFA Liquid Quick Connectors

The sample connector is a low dead-volume quick connect for MEINHARD® Plus nebulizers. It offers a fast stabilization time and a reliable seal with chemically resistant PFA. Three versions are available in a variety of flow rates for different ICP applications.

Benefits:

- Fast stabilization time and ultra-low dead-volume
- High purity PFA fluoropolymer construction
- Easy to connect and disconnect

Sample connectors available:

F0: Encapsulated micro tubing for microflow rates with the lowest internal volume of any nebulizer.
F1: Detachable solution capillary for a wide range of applications, optional for all Plus-series nebulizers.
F2: Integrated solution capillary for self-aspiration or pumping, included with all Plus-series nebulizers.

F0 Encapsulated Micro Tubing

F0 Encapsulated micro tubing for low uptake rates from 0.1 to 0.5 mL/min and the lowest internal volume of any nebulizer.

Includes	Part Number
0.25 mm i.d. ■ (green marker) 70 cm long micro capillary.	F0-25

F1 Detachable Capillary

F1 Detachable capillary for a wide range of applications.

Includes	Part Number
0.80 mm i.d. ■ (blue marker) 70 cm long capillary.	F1-80

F2 Standard Integrated Capillary

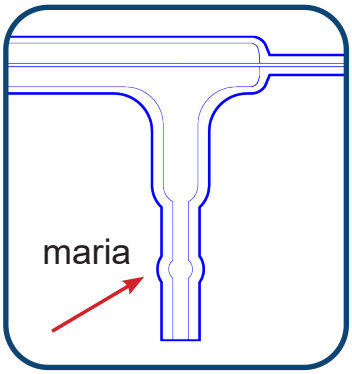
F2 Standard integrated capillary for self-aspiration or pumping.

Includes	Part Number
0.5 mm i.d. ■ (orange marker) 70 cm long capillary.	F2-50

Plus Nebulizer PFA FitKit Nebulizer Gas Quick Connect

The PFA FitKit Quick Connects are, a revolutionary new gas and sample fitting system for MEINHARD® Plus nebulizers. The kit includes a gas connection (FG), standard integrated capillary sample connection (F2) and two other sample connection (F1 and F0) options to choose from.

FG gas connection forms a tight seal over the maria on the sidearm of the MEINHARD® nebulizers. FG offers the benefits of an easy-to-use quick connect while maintaining high purity for sensitive ICP applications. In a test that simulated a backflow event, FG produced concentrations of elements like Fe and Cr that were four orders of magnitude lower than concentrations leached from a conventional fitting (Figure 1).



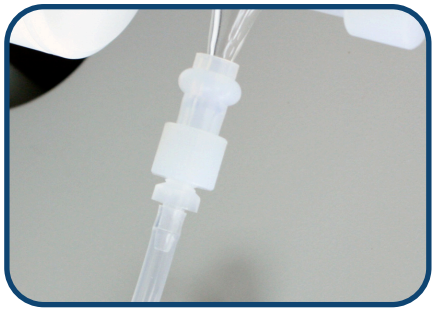
Benefits:

- High-purity PFA fluoropolymer construction
- Easy to connect and disconnect nebulizer line
- One connection fits any MEINHARD® nebulizer

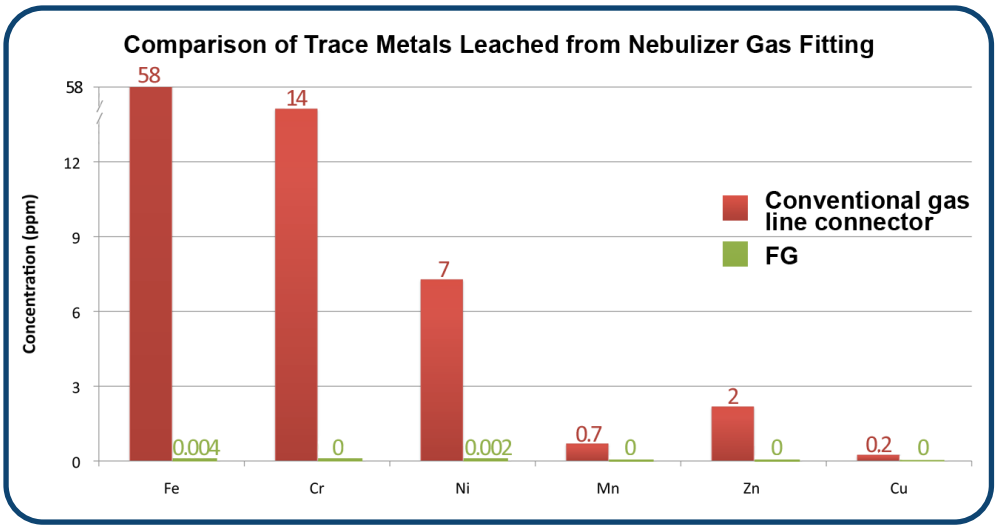
FG Gas Quick Connect for MEINHARD® Nebulizers

FG Gas Quick Connect for MEINHARD® Nebulizers with maria for both small bore and standard bore nebulizers.

Application	Part Number
For use with all MEINHARD® nebulizers	FG



FG Gas Quick Connect with connector for PFA tubing



Conventional gas line connector

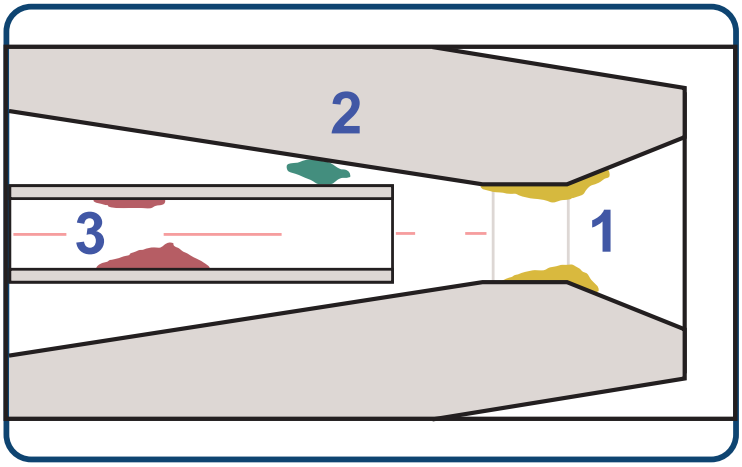
PFA quick connect gas line (FG)

Figure 1. Leach test of a conventional gas line connector and PFA FG

Pearl Nebulizer Cleaner For All Quartz And Glass Concentric Nebulizers

With this device, a cleaning solution can be pumped manually in reverse, through both the sample and gas passages. Recommended cleaning solutions are – Sigma-Aldrich RBS-25 diluted about 20x, Deconex similarly diluted – or – either of these, but with the addition of 10% methanol. When the wet-cleaning process is finished, rinse with DI water and flush dry with compressed air or inert gas.

The diagram below shows the 3 main types of blockages that can occur in pneumatic concentric nebulizers.

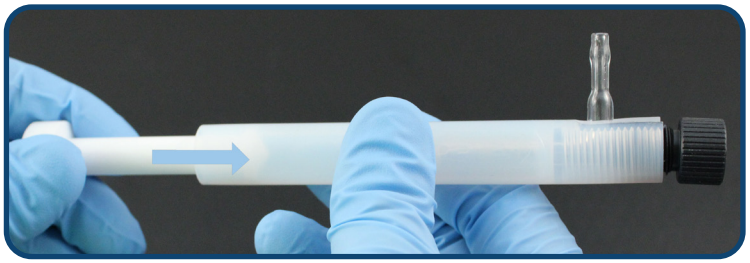


PRL-02 Nebulizer Cleaner

1. Deposits at this point are typically composed of salts coming out of solution. Such deposits can usually be removed by repeated rinsing of a concentric nebulizer with an appropriate solvent.

2. This sort of obstruction is the worst type, capable of breaking the tip of a glass capillary. If the deposit is insoluble, the only sure way to remove it is with a PEARL cleaner.

3. Deposits inside the capillary may go unnoticed for quite a while, particularly if the sample is pumped. Paper and textile fibers are often at fault.



Pumping cleaning solution through concentric nebulizer.

Description	Part Number
Pearl nebulizer cleaner for all glass and quartz concentric nebulizers	PRL-02

pergo 500 High Solids Accessory

The *pergo* 500 improves performance of all concentric nebulizers. It maintains nebulizer efficiency – which decreases long before a clogged tip is detected – and improves sensitivity and stability by preventing unnoticed salt crystals from forming in the nebulizer tip.

A water vapor permeable membrane humidifies the ICP nebulizer gas stream. By increasing humidity in the argon nebulizer, the *pergo* 500 prevents salt deposits in the nebulizer, improving short and long-term signal stability.

pergo 500
high solids accessory

Benefits:

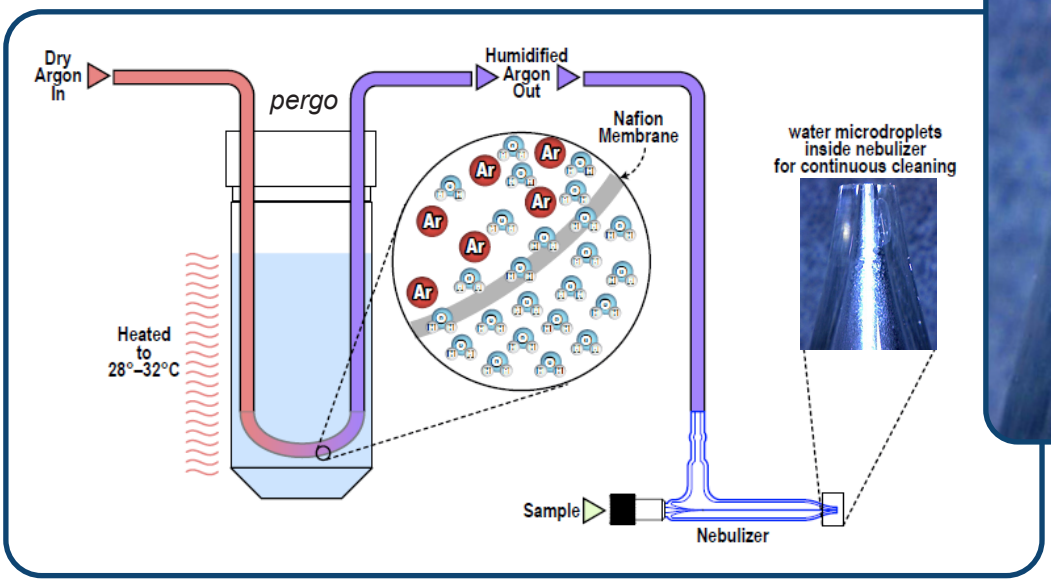
- Dissolves salt crystals in nebulizer tip
- Improved short and long-term stability
- Improved detection limits
- Speeds up washout
- Reduced long-term drift
- Extends the length of productive analytical runs

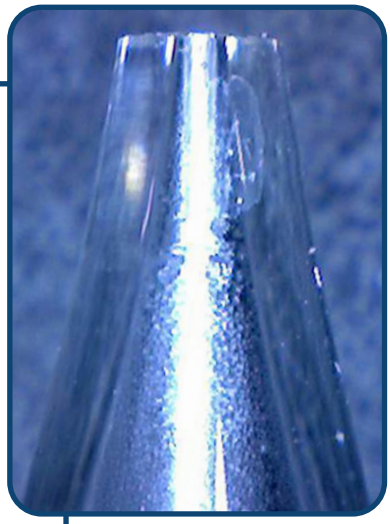
Features:

- Safe and easy to use with atmospheric pressure water reservoir
- Solid PFA reservoir with friction-fit cap for easy access
- Allows use of high-sensitivity nebulizers for high-TDS samples
- Supports both MEINHARD® and PFA MicroFlow nebulizers

Channels on *pergo* 500 provides humidity to the nebulizer gas

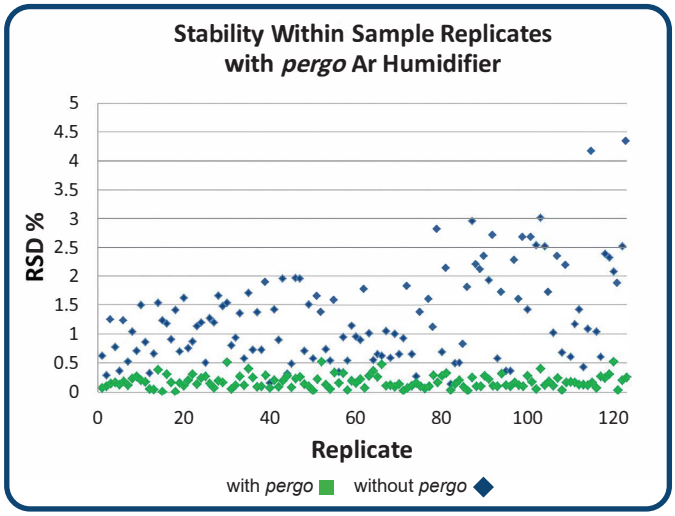
Avio 200 ICP with *pergo* 500 high solids accessory



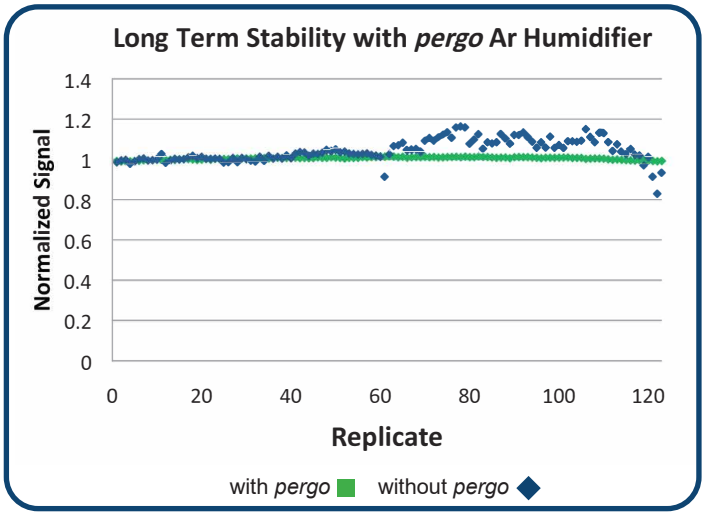


Water microdroplets continuously clean the inside of the nebulizer and prevent salt deposits.

Ar nebulizer gas is humidified using a tube-shaped membrane placed in a PFA water reservoir at atmospheric pressure. The water vapor condenses inside the nebulizer tip, preventing salt build-up.



RSDs for seawater samples improve significantly when the *pergo* is utilized.



Improved long term stability is achieved when utilizing the *pergo*, reducing signal drift and extending the length of analysis runs.

Description	*pergo* Part Number
pergo 500 argon high solids accessory for the Avio 200 and 500 ICP	pergo 500

Online Mixing Kits for Addition of Internal Standard

Online Mixing Kit

The kit for online addition of internal standard is an easy way to use internal standards without having to manually spike each sample with internal standard. The kit can also be used to mix any two reagents for other purposes. The low dead-volume, fluoropolymer mixing tee ensures good mixing at all typical ICP flow rates for a wide variety of liquids, including HF.

Includes:

- Low dead-volume, fluoropolymer mixing tee
  - 0.25 mm I.D. (green) for flow rates <1 mL/min
  - 0.5 mm I.D. (orange) for flow rates >0.3 mL/min
- Internal standard probe and addition line
- Fluoropolymer peripump fittings
- Peristaltic pump tubing starter pack

Online Dilution:

The online mixing kits include a starter pack of peristaltic pump tubing for the MP^2 micro peristaltic pump. Approximate dilution factors are defined by choosing the size of the sample and internal standard peristaltic pump tubing. Other pump tubing sizes are available.

Online mixing kit for addition of internal standard

Dilution Factors with Starter Pack Tubing

Sample Tubing		IS / Diluent Tubing					
		Orange	Green	Black	Black	Red	Red
Orange	Green	2		5		10	
Black	Black	1.25		2		3.25	
Red	Red	1.11		1.44		2	

Online Mixing Kits

Part Numbers 0.25 mm I.D. (Green)	Part Numbers 0.5 mm I.D. (Orange)	Description
IS-ST-25	IS-ST-50	For use with PFA-ST nebulizers.
IS-MP-25	IS-MP-50	For use with MEINHARD® Plus nebulizers.*
N/A	IS-BRG-50	For use with MiraMist and similar nebulizers.

Online Mixing Kits with Nebulizer Included

Part Numbers 0.25 mm I.D. (Green)	Part Numbers 0.5 mm I.D. (Orange)	Description
ISN-ST54-25	N/A	For use with PFA-ST nebulizers. Includes PFA-ST nebulizer.
N/A	ISN-TRP-50	For use with MEINHARD® Plus nebulizers. Includes TR+ high sensitivity glass nebulizer.

Quartz Cyclonic Spray Chambers

Press Fit Cyclonic Spray Chambers for ZipTorch

Description	Avio 200 Part Number	Avio 500 Part Number	Addition Gas Port	Hydride	PC³ Compatible
Quartz cyclonic baffled cyclonic spray chamber with PFA outlet connection for One-Piece ZipTorch	ES-3147-1011-20	ES-3137-1011-20			✓
Quartz cyclonic baffled cyclonic spray chamber with addition gas port and PFA outlet connection for One-Piece ZipTorch	C3QX-47-P	C3QX-37-P	✓		✓
Quartz cyclonic baffled cyclonic spray chamber with hydride gas port and PFA outlet connection for One-Piece ZipTorch	C3Q-47-H	C3Q-37-H		✓	✓

Used with one-piece ZipTorches on page 59.

Ball/Socket Cyclonic Spray Chambers for Standard Avio Torch

Description	Avio 200 Part Number	Avio 500 Part Number	Addition Gas Port	Hydride	PC³ Compatible
Quartz cyclonic baffled cyclonic spray chamber with 12/5 socket connection for standard Avio injector	ES-3147-1018-20	ES-3137-1018-20			✓
Quartz cyclonic baffled cyclonic spray chamber with addition gas port and 12/5 socket connection for standard Avio injector	C3QX-47	C3QX-37	✓		✓
Quartz baffled cyclonic spray chamber with hydride gas port and 12/5 socket connection for standard Avio injector	C3Q-37-H-S			✓	

High Performance HF-resistant PFA Spray Chambers

High Performance PFA Spray Chambers

HF resistant, high sensitivity PFA spray chambers for high purity applications.

Description	Application	Part Number
High Performance PFA spray chamber with o-ring-free PFA endcap	HF resistant, high sensitivity PFA spray chamber for semiconductor and other high purity applications.	M200-5370
High Performance PFA spray chamber with o-ring-free PFA endcap and **additional gas port**		M200-5371

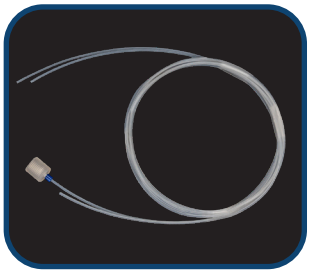
Spray Chamber Accessories

Spray Chamber Clamp

The socket clamp maintains a secure connection between the 12/5 injector ball and spray chamber socket.

Description	Part Number
Clamp for 12/5 socket.	ES-2110-0002

Spare Spray Chamber Drain Line

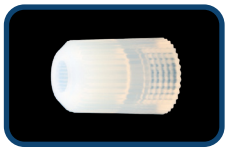


Description	Part Number
Spray chamber drain line kit for Avio 200/500. Includes 32 cm line leading from spray chamber drain to peripump and 160 cm line from peripump to waste bottle. 32 cm line has ¼-28 fitting common to all Avio 200/500 spray chamber drain ports.	ES-2044-64

Spray Chamber Plugs

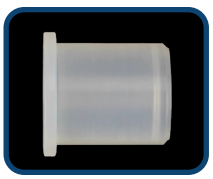
Description	Application	Part Number
Cyclonic spray chamber AMS matrix gas plug	Plugs the matrix gas port when AMS gas is not used or during storage.	S033045
Spray chamber nebulizer port plug	Plugs the nebulizer port to prevent contamination during storage.	S032950
Spray chamber outlet plug	Plugs the spray chamber outlet to prevent contamination.	S033048

PFA Secure Nut



Description	Application	Part Number
Long (6 mm) PFA spray chamber secure nut	Secures nebulizer to Avio spray chamber.	ES-3199-0003-R

Spray Chamber Adapter



Description	Application	Part Number
Avio 200/500 cyclonic spray chamber adapter	Adapts cyclonic spray chamber to Avio sapphire and platinum injectors.	S011361

Avio 200 and 500 Interchangeable ZipTorches

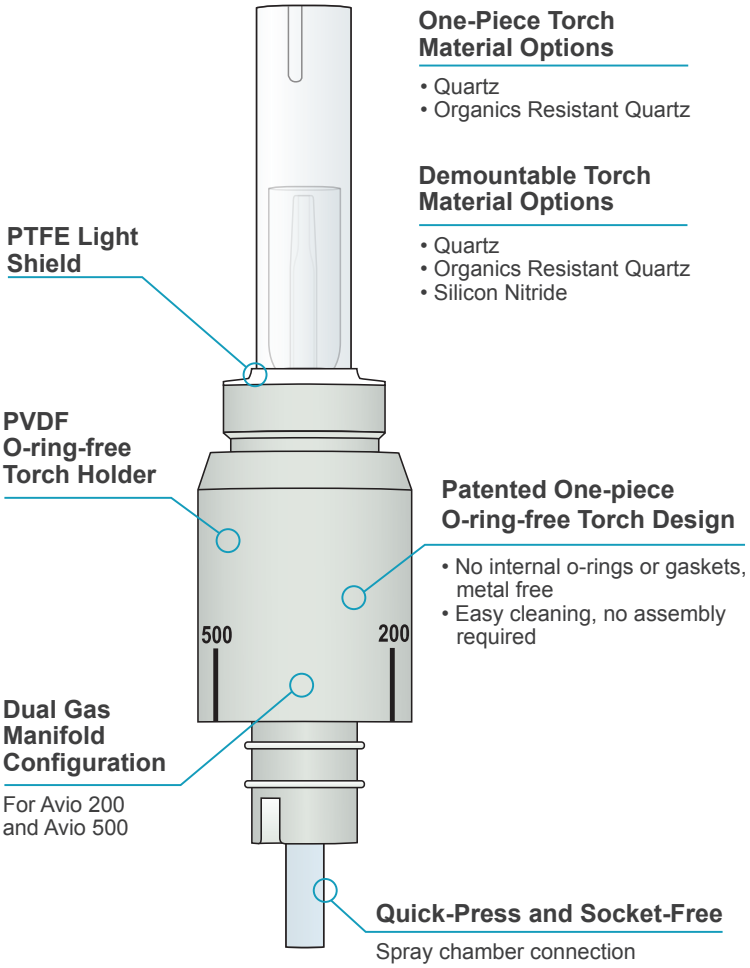
The ZipTorch is a new torch design for Avio 200 and Avio 500 ICPs. ZipTorches can be used interchangeably between the two systems. They are available with fixed or demountable injector options to work with any application on either – or both – Avio systems.

ZipTorch Design

- One-piece base
- Dual gas connections to support both Avio 200 & 500
- No internal o-rings
- Quick-press and socket-free spray chamber connection
- Available in
  - One-piece or demountable
  - Silicon nitride, quartz or organics quartz

ZipTorch Benefits

- Easy cleaning
- Highly reproduceable installation position
- No user contact with torch tubes
- One torch for both Avio 200 and 500
- Torch or injector can be exchanged in seconds
- Eliminate ground glass ball joint connectors and clamps



ZipTorch For Avio – Ease of Installation

The interchangeable ZipTorch can be installed in seconds in either the Avio 200 or 500

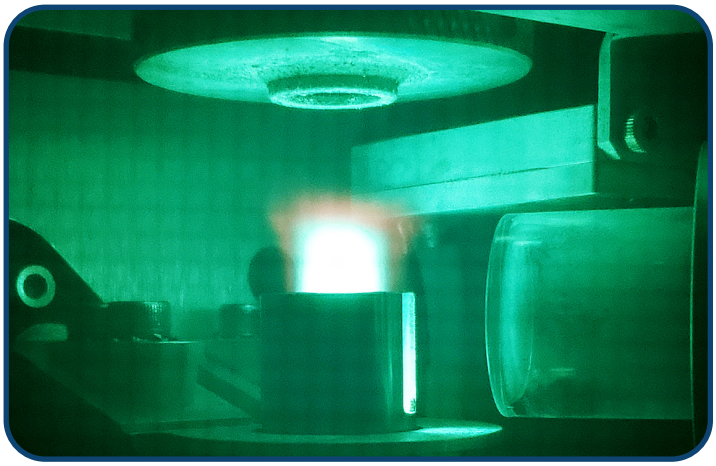
Installing a ZipTorch on Avio 200

Installing a ZipTorch on Avio 500

SAMPLE INTRODUCTION

Ultimate in Chemical Resistance and Extended Lifetime

The Nitride ZipTorch is a direct replacement for the standard Avio 200 & 500 torches. It provides substantial enhancements in chemical resistance over standard quartz torches, significantly reducing both replacement costs and observed backgrounds levels.



Nitride torch while nebulizing Yttrium on the Avio ICP

ZTN-D-37
Demountable Nitride
ZipTorch

Strength

- Silicon nitride is a ceramic material that is not compromised by the high temperatures of the argon plasma.
- Heat is conducted more evenly across the silicon nitride torch body, reducing thermal stress and resulting in significant advantages over quartz torches that can form stress cracks and fail.

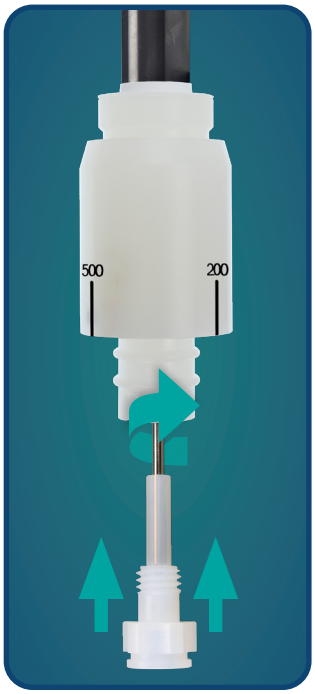
Chemical Resistance

- The Nitride torch is highly resistant to chemical attack by high matrix components in the plasma. Nitride torches do not devitrify and have a long lifetime.
- Nitride ZipTorch is the optimal torch for analyzing samples high in salts, fusion digests, and organic solvents.
- Low background levels for silicon measurements are achieved.

Economical

- Compared to quartz, up to 100x lifespan can be expected when running high matrix samples.
- Eliminating frequent replacement of quartz torches results in significantly reduced operating costs.

Nitride ZipTorch installed in Avio 500



Quickly and easily install injectors into demountable torches

Nitride ZipTorch Design Advantages

- Direct replacement of standard Avio 200 and 500 torches
- No impact on analytical performance – same detection capability
- Utilizes the same interchangeable injectors (quartz, sapphire, and platinum) as the Quartz Demountable ZipTorch for flexibility when application demands change
- Unique construction with both the intermediate and outer tubes made from silicon nitride provides the longest life and highest possible chemical resistance

***Every* ICP-OES System Should Experience the Benefits of a Silicon Nitride ZipTorch**

Selecting the Best Torch for your Application(s)

✓ = Good ✓ = Better ☑ = Best

1-1.5 mm injectors for organic solvents, 2 mm standard size, and 2.5 mm for high matrix samples

Torch	Aqueous	Low Volatility Organics	High Volatility Organics	High Salt Matrix / Fusion	Benefits
Quartz One-Piece	✓	✓			Simplicity with one-piece design
Quartz Demountable	✓	✓	✓		Flexibility to change injectors, injector material, injector diameter
Quartz One-Piece Organic	✓	✓	✓		- Greater resistance to cracking from heat - Simplicity with one-piece design
Quartz Demountable Organic	✓	✓	✓		- Greater resistance to cracking from heat - Added flexibility to change injectors
Silicon Nitride Demountable	☑	☑	☑	☑	- No devitrification from sample matrix - Greatly extended life without replacement – lower cost - Flexibility to change injectors - Appropriate for all sample types

One-piece ZipTorches

The one-piece ZipTorch has an integrated quartz injector for simplicity, easy maintenance and quick torch alignment.

Description	Injector Size	Avio 200/500 Part Number
Quartz one-piece ZipTorch with injector and PVDF o-ring-free holder for Avio ICP	1 mm	T10Q-37
	1.5 mm	T15Q-37
	2 mm	T20Q-37
	2.5 mm	T25Q-37
Organics quartz one-piece ZipTorch with injector and PVDF o-ring-free holder for Avio ICP	1 mm	T10-O-37
	1.5 mm	T15-O-37
	2 mm	T20-O-37

T20Q-37 One-piece ZipTorch

Demountable ZipTorches

The demountable ZipTorch utilizes a removable and replaceable injector. Recommended for use with HF applications (using sapphire or Pt injectors) or when the user prefers to remove the injector for cleaning without dismounting the torch.

Description	Avio 200/500 Part Number
Demountable quartz ZipTorch with PVDF o-ring-free holder for Avio ICP	DTQ-37
Demountable organic ZipTorch with PVDF o-ring-free holder for Avio ICP	DTO-37
Demountable silicon nitride ZipTorch with PVDF o-ring-free holder for Avio ICP	ZTN-D-37

DTQ-37 Demountable Quartz ZipTorch

DTO-37 Demountable Quartz Organics ZipTorch

ZTN-D-37 Demountable Silicon Nitride ZipTorch

Injectors for Demountable ZipTorches

These injectors are designed for use with the quartz, organics and silicon nitride demountable torches.

- Quartz is used for wide range of non-HF aqueous applications and organic solvents
- Sapphire is utilized for environmental, geochemistry, and HF applications
- Platinum is used with volatile organic solvents and HF-containing semiconductor-grade chemicals

Description	Size	Avio 200/500 Part Number
Quartz demountable injectors for Avio ZipTorches	1 mm	IDQ10-37
	1.5 mm	IDQ15-37
	2 mm	IDQ20-37
	2.5 mm	IDQ25-37
Sapphire demountable injectors for Avio ZipTorches	1.5 mm	IDS15-37
	2 mm	IDS20-37
Platinum demountable injector for Avio ZipTorches	2 mm	IDPt20-37

IDQ15-37 Quartz Injector

IDS15-37 Sapphire Injector

IDPt20-37 Platinum Injector

FAST DXi

Upgradable Integrated Precision Micro Peristaltic Pump for Avio 200/500

The *FAST* DXi is a microperistaltic pump integrated to the Avio 200/500. It can be easily upgraded to *FAST*, prep*FAST* or other automation applications by adding valve actuators and other necessary components. It allows laboratories the flexibility to start with a high-quality, long-lived peristaltic pump and add automation components as needed.

- Direct replacement for standard peristaltic pump
- Connects to any DX autosampler
- Integrated to Syngistix software control

Precision

- Accurate pumping across a wide range of rates from low 0.20 µL/min to 10 mL/min
- Faster analysis with high precision.

Low Pulsation

- 12 closely-spaced rollers maintain consistent flow rate and improve signal stability

Chemical Resistance

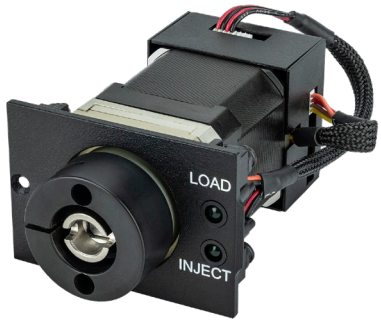
- Ceramic pins and PTFE-coated metal components are resistant to acids and organic solvents
- Long-life motor and drive assembly

DXi-4-47-FR2
FAST DXi populated with a dual valve actuator.
(Valve shown but not included)

DXi-4-47-FR1
FAST DXi populated with a single valve actuator.
(Valve shown but not included)

FAST DXi's for Avio 200/500			
Description	**# of Valve Actuators**	**Avio 200 Part Number**	**Avio 500 Part Number**
FAST DXi integrated 4 channel MP² peripump with single *FAST* valve actuator	1	DXi-4-47-FR1	DXi-4-37-FR1
FAST DXi integrated 4 channel MP² peripump with dual *FAST* valve actuators for prep*FAST*	2	DXi-4-47-FR2	DXi-4-37-FR2

Valve not included with actuators.



ES-5599-V1-47
FAST valve actuator

FAST Valve Actuator		
Description	**Avio 200 Part Number**	**Avio 500 Part Number**
Additional *FAST* valve actuator to convert integrated MP² to *FAST* with one actuator for *FAST.*	ES-5599-V1-47	ES-5599-V1-37
Additional *FAST* valve actuator to convert *FAST* DXi from *FAST* to prep*FAST* with two actuators for prep*FAST.*	ES-5599-V2-47	ES-5599-V2-37

Stand Alone MP² Precision Micro Peristaltic Pumps

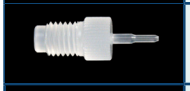
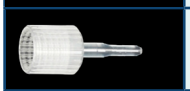
MP² Precision Micro Peristaltic Pumps

The MP² is a compact, precise, stand-alone micro peristaltic pump with a flow rate range from 0.20 µL/min to 10 mL/min and is available with one to eight channels. Optimized for low-flow rates, the MP² uses either MPP tubing or standard 3-stop pump tubing.

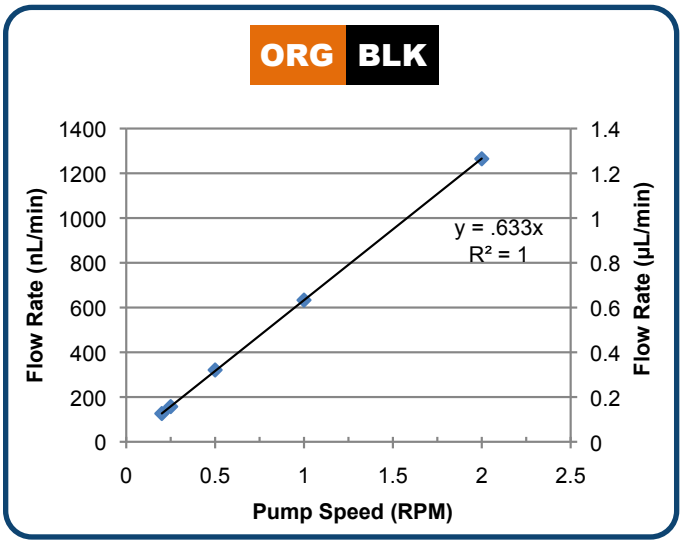
CONTROLLED BY THE INSTRUMENT PC USB PORT	
Number of Channels	**Part Number**
1 channel MP² precision micro peristaltic pump	MP2-1-PC
2 channel MP² precision micro peristaltic pump	MP2-2-PC
3 channel MP² precision micro peristaltic pump	MP2-3-PC
4 channel MP² precision micro peristaltic pump	MP2-4-PC
6 channel MP² precision micro peristaltic pump	MP2-6-PC
8 channel MP² precision micro peristaltic pump	MP2-8-PC

Includes: Cable to control with DX Autosampler

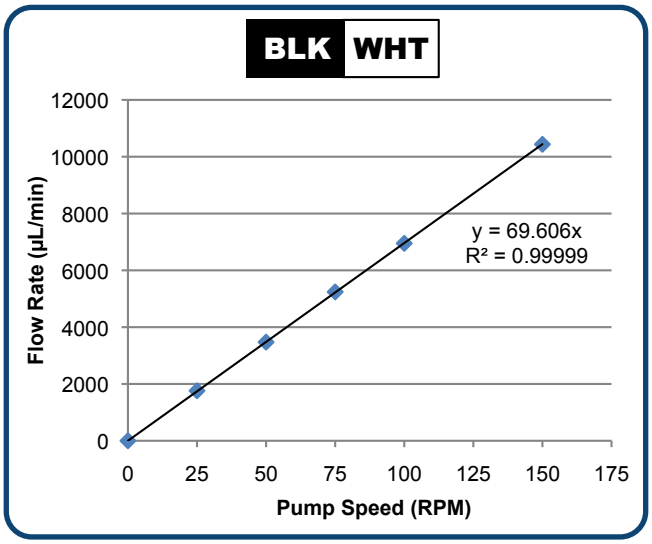
MP2-4-PC
stand-alone, precision
micro peristaltic pump

CTFE PERIPUMP FITTINGS (Non-barbed) Used in Low Pressure Applications			
	Qty	**Size**	**Part Number**
	1	Female (small)	ES-2501-PPF1
	1	Male (small)	ES-2501-PPM1
	5	Female	S033156-V
	5	Male	S032956-V

CTFE PERIPUMP FITTINGS (Barbed) Used in High Pressure Applications			
	Qty	**Size**	**Part Number**
	1	Female (small)	ES-2501-PPF2
	1	Male (small)	ES-2501-PPM2
	5	Female	S033156-V
	5	Male	S032956-V



MP² pump linearity <1 µL/min



MP² pump linearity up to 10 mL/min

MP² Pump Tubing

Tubing for MP² Micro Peristaltic Pumps (Packs of 12)

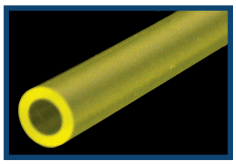
				Non-Flared			Flared*	
i.d.	Stop Colors		Calibration Slope (µL/min per RPM)	PVC 2-stop	*Santoprene® 2-stop	Solva 2-stop	PVC 2-stop	Solva 2-stop
0.13 mm	Orange	Black	0.6	MPP-013-PVC			MPP-013-F-PVC	MPP-013-F-S
0.19 mm	Orange	Red	1.3	MPP-019-PVC			MPP-019-F-PVC	MPP-019-F-S
0.27 mm	Orange	Blue	2.7	MPP-027-PVC			MPP-027-F-PVC	MPP-027-F-S
0.38 mm	Orange	Green	4.7	MPP-038-PVC	MPP-038-PHR		MPP-038-F-PVC	MPP-038-F-S
0.44 mm	Green	Yellow	7.6	MPP-044-PVC			MPP-044-F-PVC	MPP-044-F-S
0.51 mm	Orange	Yellow	9.5	MPP-051-PVC			MPP-051-F-PVC	MPP-051-F-S
0.57 mm	White	Yellow	11	MPP-057-PVC			MPP-057-F-PVC	MPP-057-F-S
0.64 mm	Orange	White	14	MPP-064-PVC			MPP-064-F-PVC	MPP-064-F-S
0.76 mm	Black	Black	19	MPP-076-PVC	MPP-076-PHR	MPP-076-S	MPP-076-F-PVC	MPP-076-F-S
0.89 mm	Orange	Orange	24	MPP-089-PVC		MPP-089-S	MPP-089-F-PVC	MPP-089-F-S
0.95 mm	White	Black	28	MPP-095-PVC		MPP-095-S	MPP-095-F-PVC	MPP-095-F-S
1.02 mm	White	White	31	MPP-102-PVC		MPP-102-S	MPP-102-F-PVC	MPP-102-F-S
1.09 mm	White	Red	33	MPP-109-PVC		MPP-109-S	MPP-109-F-PVC	MPP-109-F-S
1.14 mm	Red	Red	35	MPP-114-PVC		MPP-114-S	MPP-114-F-PVC	
1.22 mm	Red	Grey	46	MPP-122-PVC		MPP-122-S		
1.30 mm	Grey	Grey	47	MPP-130-PVC	MPP-130-PHR	MPP-130-S		
1.42 mm	Yellow	Yellow	50	MPP-142-PVC		MPP-142-S		
1.52 mm	Yellow	Blue	51	MPP-152-PVC	MPP-152-PHR	MPP-152-S		
1.65 mm	Blue	Blue	55	MPP-165-PVC		MPP-165-S		
1.75 mm	Blue	Green	58	MPP-175-PVC		MPP-175-S		
1.85 mm	Green	Green	61	MPP-185-PVC		MPP-185-S		
2.06 mm	Purple	Purple	64	MPP-206-PVC		MPP-206-S		
2.29 mm	Purple	Black	65	MPP-220-PVC		MPP-220-S		
2.54 mm	Purple	Orange	67	MPP-254-PVC		MPP-254-S		
2.79 mm	Purple	White	69	MPP-279-PVC		MPP-279-S		
3.17 mm	Black	White	70	MPP-317-PVC	MPP-317-PHR	MPP-317-S		
Bridge Length				72 mm	72 mm	72 mm	72 mm	72 mm

*For easy insertion of PFA capillaries **i.d. = internal diameter**

Non-Flared

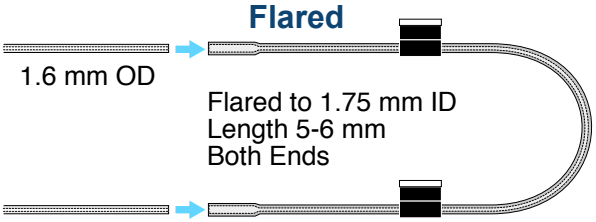
PVC

Santoprene®



SOLVA

Flared



MP² PUMP TUBING KIT	
Description	**Part Number**
MP² Pump Tubing Kit comprised of 34 packs of 12 tubes, one package of each white highlighted part number in the table above. Includes: 26 packs of PVC tubing (0.13 to 3.17 mm i.d.) 3 packs of *Santoprene® tubing and 5 packs of Solva tubing. Kit also includes: 30 CTFE Fluoropolymer Peristaltic pump Fittings: 5 small female, 5 small male, 5 medium female, 5 medium male, 5 large female and 5 large male.	MPP-K-1

*Santoprene® is a product of ExxonMobil.

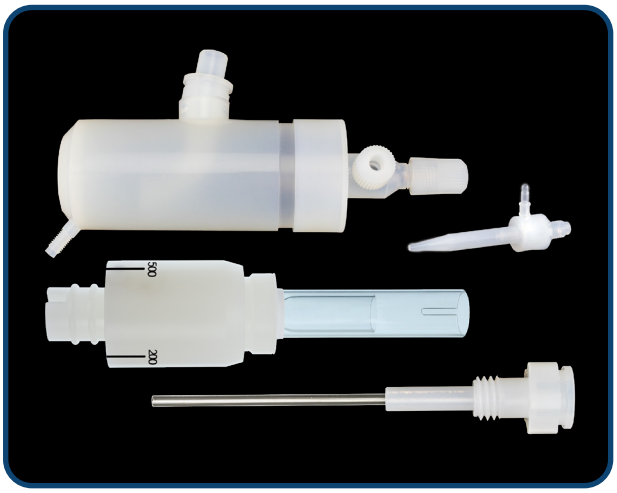
HF-Resistant Sample Introduction Kit

Sample Introduction Kit

The PFA kit is an ultra-pure, HF-resistant introduction system for the Avio ICP. All wetted surfaces are PFA and the injector is sapphire. It is used for the analysis of HF-containing samples for mining, semiconductor and other applications.

Benefits:

- Easy installation
- Clean PFA components for lower background equivalent concentration (BEC) and detection limits
- O-ring-free connections – ensures lowest BEC's, highest chemical resistance and easy cleaning
- Chemically resistant – suitable for nearly all samples, including strong acids, alkalis and organic solvents
- Low sample consumption – ideal for VPD and preconcentrated samples
- Fast washout



M237-DV-29 Series HF-Resistant PFA Sapphire Sample Introduction Kit for PE Avio

M237-DV-29 HF-Resistant Sample Introduction Kit installed on the Avio 500

Description	Part Number
Complete HF-resistant sample introduction kit for PerkinElmer Avio ICP. Includes: High Performance PFA spray chamber with PFA PureCap endcap, ST3 High Pressure MicroFlow PFA nebulizer, Demountable quartz torch with PVDF o-ring-free holder and 2 mm demountable sapphire injector.	M237-DV-29

PC³ Peltier Cooled Cyclonic Spray Chambers

The PC³ is a small, robust Peltier cooled cyclonic spray chamber. The PC³ spray chambers offer the advantages of low memory effects, constant temperature, fast rinse-out, and high sample transport efficiency when coupled with the Avio 200/500 ICP systems. The cooled outer walls of the PC³ spray chamber enhances long-term signal stability and reduces solvent loading when both aqueous and organic solvents are analyzed. For low flow rate applications, the heating mode can be used to improve sensitivity by increasing transport efficiency into the plasma.

PC3X-47-29 PC^{3X} on the Avio 200

PC^{3X} Peltier Cooler / Heater

The PC^{3X} is a compact, Peltier-cooled or heated inlet system which incorporates the Avio cyclonic spray chamber. It operates in both cooling and heating modes for the spray chamber. The thermal stabilization of the spray chamber improves the long-term stability of the ICP response by isolating the sample introduction from laboratory temperature changes during the analysis.

System Design

- Temperature control from -10 °C to +80 °C
- Temperature stability ±0.1 °C
- Improved long-term stability through thermal stabilization of spray chamber
- Completey o-ring-free for organic solvent analysis

PC^{3X} Complete Kit for Avio Includes:

- PFA-ST MicroFlow Nebulizer
- Quartz Cyclonic Spray Chamber
- PC³ Adjustable Mounting Shelf

Description	Avio 200 Part Number	Avio 500 Part Number
PC^{3X} Complete system for Avio ICP	PC3X-47-29	ES-4190-37-29
PC^{3X} thermally stabilized inlet system for Avio cyclonic spray chamber (Spray chamber and mounting shelf not included)	PC3X-37	
PC^{3X} adjustable mounting shelf for Avio ICP	ES-2999-4721-R1	ES-2999-3721-R1

PC3X-47-29
PC^{3X} on the Avio 200

PC-LT on the Avio 500 for volatile organic solvent analysis

PC³-LT

The PC³-LT is a low temperature Peltier cooler for cyclonic spray chambers on the Avio 200/500 ICP systems. It provides lower temperatures to reduce the solvent load on the plasma for the analysis of volatile organic solvents.

System Design

- Controlled directly through Syngistix 2.0 and higher
- Temperature control from -20 °C to +2 °C
- Temperature stability ±0.1 °C
- Completey o-ring-free for organic solvent analysis

PC-LT Complete Kit for Avio Includes:

- PFA-ST MicroFlow Nebulizer
- Quartz Cyclonic Spray Chamber
- Transfer Line

Description	Temperature	Part Number
PC³-LT Peltier-cooled sample introduction system with spray chamber for Avio.	+2 °C / -20 °C	ES-9190-37-29

High Purity Valves

High purity valve stators and rotors provide for the selection of liquid flow path with low contamination and low carryover for the optimum ICP results.

P-Series Two position sampling valves

V-Series Syringe pump refill valves

M-Series Multiposition stream selector/flow director valves

S-Series Semiconductor grade ultra-high purity valves

8 Port Valve – P7+ **Part Number: PF-P7X**

Description: P7+ CTFE high-flow 8 port valve head for prep*FAST*
Specifications: CTFE stator, PFA rotor, 1 mm, 0.5 mm
Applications: prep*FAST,* inline dilution and internal standard addition

6 Port Valve – P7 **Part Number: PF-P7**

Description: 7 port syringe loading valve
Specifications: CTFE stator, PFA rotor, 1.0 mm
Applications: *FAST,* prep*FAST* e

12 Port Syringe Valve – V12 **Part Number: PF-V12**

Description: 12 port syringe loading valve
Specifications: CTFE stator, PFA rotor, 1.0 mm
Applications: S400V, brine*FAST* syringe valve

8 Port Valve – M8 **Part Number: PF-M8**

Description: M8 CTFE high-flow 8 port stream selector valve
Specifications: CTFE stator, PFA rotor
Applications: SmartTuner

11 Port Syringe Valve – S11 **Part Number: SDX-S11**

Description: 11 port syringe loading valve
Specifications: CTFE stator, PFA rotor, 1.0 mm
Applications: prep*FAST* S and scoutDX

Examples of a Stator and Rotor

Description

CTFE replacement stator for V12 *FAST* valve

Description

1 mm PFA rotor

High Purity Valves with Spare Rotors and Stators

P-SERIES VALVES WITH REPLACEMENT STATORS AND ROTORS						
# of Ports	Bore Size	Stator Material	Rotor Material	Part Number Complete Valve	Part Number Stator	Part Number Rotor
3 - P3	1.0 mm	CTFE	PFA	PF-P3	PF-P3S	PF-P3R
4 - P4	1.0 mm	CTFE	PFA	PF-P4	PF-P4S	PF-P4R
6 - P6	1.0 mm	CTFE	PFA	PF-P6	PF-P6S	PF-P6R
6 - P6-8	1.0 mm	PPS	PFA	PF-P6-8	PF-P6S-8	PF-P6R
7 - P7	0.5/1.0 mm	CTFE	PFA	PF-P7	PF-P7S	PF-P6R
7 - P7-8	0.5/1.0 mm	PPS	PFA	PF-P7-8	PF-P7S-8	PF-P6R
8 - P7+	0.5/1.0 mm	CTFE	PFA	PF-P7X	PF-P7XS	PF-F6R
P7+IC	1.0 mm	CTFE	PFA	PF-P7XIC	PF-P7XS	PF-P6R
8 - P8	1.0 mm	CTFE	PFA	PF-P8	PF-P8S	PF-P8R
10 - P10	1.0 mm	CTFE	PFA	PF-P10	PF-P10S	PF-P10R
11-P11	1.0 mm	CTFE	PFA	PF-P11	PF-P11S	PF-P10R
11-A11b	0.5/1.0 mm	CTFE	PFA	PF-A11b	PF-A11bS	PF-A11bR
13 - P13	0.5/1.0 mm	CTFE	PFA	PF-P13	PF-P13S	PF-P13R
5 - A5e	0.5/1.0 mm	CTFE	PFA	PF-A5e	PF-A5eS	PF-F6R
7 - A7e	0.5/1.0 mm	CTFE	PFA	PF-A7e	PF-A7eS	PF-F6R
7 - A7µ	1.0 mm	CTFE	PFA	PF-A7u	PF-A7uS	PF-A7uR
6 - PM6	0.5 mm	CTFE	PFA	PF-PM6	PF-PM6S	PF-PM6R
7 - PM7	0.5 mm	CTFE	PFA	PF-PM7	PF-PM7S	PF-PM6R
8 - PM7+	0.5 mm	CTFE	PFA	PF-PM7X	PF-PM7XS	PF-PM6R
4 - P4H	1.6 mm	CTFE	PFA	PF-P4H	PF-P4HS	PF-P4HR
5 - P5H	1.6 mm	CTFE	PFA	PF-P5H	PF-P5HS	PF-P4HR
6 - P6H	1.6 mm	CTFE	PFA	PF-P6H	PF-P6HS	PF-P6HR
7 - P7H	1.6 mm	CTFE	PFA	PF-P7H	PF-P7HS	PF-P6HR
7 - P7-8H	1.6 mm	PPS	PFA	PF-P7-8H	PF-P7-8HS	PF-P6HR
7 - P7HP	0.5 mm	CTFE	PVDF	PF-P7HP	PF-P7HPS	PF-P6HPR
8 - P7HP	0.5 mm	CTFE	PVDF	PF-P7XHP	PF-P7XHPS	PF-P6HPR

High Purity Valves, Stators and Rotors

V-SERIES VALVES WITH REPLACEMENT STATORS AND ROTORS						
# of Ports	Bore Size	Stator Material	Rotor Material	Part Number Complete Valve	Part Number Stator	Part Number Rotor
6 - V6	1.0 mm	CTFE	PFA	PF-V6	PF-V6S	PF-V6R
6 - V6H	1.6 mm	CTFE	PFA	PF-V6H	PF-V6HS	PF-V6HR
6 - V6HP	0.5 mm	CTFE	PVDF	PF-V6HP	PF-V6HPS	PF-V6HPR
9 - V9	1.0 mm	CTFE	PFA	PF-V9	PF-V9S	PF-V9R
10 - V9(cp)	1.0 mm	CTFE	PFA	PF-V9 (cp)	PF-V9S (cp)	PF-V9R (cp)
12 - V12	1.0 mm	CTFE	PFA	PF-V12	PF-V12S	PF-V12R
12 - V12H	1.6 mm	CTFE	PFA	PF-V12H	PF-V12HS	PF-V12HR
13 - V13	1.0 mm	CTFE	PFA	PF-V13	PF-V13S	PF-V13R
18-V18H	1.6 mm	CTFE	PFA	PF-V18H	PF-V18HS	PF-V18HR
V8C	1.0 mm	CTFE	PFA	PF-V8C	PF-V8CS	PF-V12R
V9H	1.6 mm	CTFE	PFA	PF-V9H	PF-V9HS	PF-V9HR

M-SERIES STREAM SELECTION VALVE						
# of Ports	Bore Size	Stator Material	Rotor Material	Part Number Complete Valve	Part Number Stator	Part Number Rotor
3 - M3	1.0 mm	CTFE	PFA	PF-M3	PF-M3S	PF-M3R
3 - M3H	1.6 mm	CTFE	PFA	PF-M3H	PF-M3HS	PF-M3HR
4 - M4	1.0 mm	CTFE	PFA	PF-M4	PF-M4S	PF-M4R
6 - M6	1.0 mm	CTFE	PFA	PF-M6	PF-M6S	PF-M6R
8 - M8	1.0 mm	CTFE	PFA	PF-M8	PF-M8S	PF-M8R
8 - M8H	1.6 mm	CTFE	PFA	PF-M8H	PF-M8HS	PF-M8HR
8 - M8HP	0.5 mm	CTFE	PVDF	PF-M8HP	PF-M8HPS	PF-M8HPR
10 - M10	1.0 mm	CTFE	PFA	PF-M10	PF-M10S	PF-M10R

S-SERIES VALVES WITH REPLACEMENT STATORS AND ROTORS						
# of Ports	Bore Size	Stator Material	Rotor Material	Part Number Complete Valve	Part Number Stator	Part Number Rotor
4 - S4	0.5/1.0 mm	CTFE	PFA	PF-S4	PF-S4S	PF-S4R
9 - S9	1.0 mm	CTFE	PFA	PF-S9	PF-S9S	PF-S9R
11 - S11	1.0 mm	CTFE	PFA	SDX-S11	PF-S11S	PF-S11R

X-SERIES VALVES WITH REPLACEMENT STATORS AND ROTORS						
# of Ports	Bore Size	Stator Material	Rotor Material	Part Number Complete Valve	Part Number Stator	Part Number Rotor
11-X11	1.0 mm	CTFE	PFA	PF-X11	PF-X11S	PF-P10R

Replacement Syringes for Syringe Pumps

0.3 mL Syringes	
Description	**Part Number**
0.3 mL quartz syringe o-ring free quartz syringe for prep*FAST* Syrix syringe pump	PF-S1003
0.3 mL o-ring free fluropolymer syringe for prep*FAST* syringe pump	PF-S3003

PF-S1003

3 mL Syringes	
Description	**Part Number**
3 mL quartz syringe	PF-S1030
3 mL quartz syringe, pre-cleaned for prep*FAST* S	PF-S1030C
3 mL CTFE syringe	PF-S3030
3 mL CTFE syringe, pre-cleaned for prep*FAST* S	PF-S3030C
3 mL quartz syringe, short high pressure, for prep*FAST* IC	PF-HS1030-STW
3 mL quartz syringe, tall high pressure, for prep*FAST* IC	PF-HS1030

PF-S1030

6 mL Syringes	
Description	**Part Number**
6 mL quartz syringe for prep*FAST* Offline	PF-S1060
6 mL quartz syringe, pre-cleaned for prep*FAST* S	PF-S1060C
6 mL CTFE syringe	PF-S3060
6 mL CTFE syringe, pre-cleaned for prep*FAST* S	PF-S3060C
6 mL quartz syringe, short high pressure, for prep*FAST* IC	PF-HS1060-STW
6 mL quartz syringe, tall high pressure, for prep*FAST* IC	PF-HS1060

PF-S1060

12 mL Syringe	
Description	**Part Number**
12 mL PFA syringe	PF-S3120
12 mL quartz syringe, short high pressure, for prep*FAST* IC	PF-HS1120-STW
12 mL quartz syringe, tall high pressure, for prep*FAST* IC	PF-HS1120

PF-S3120

Manual Sampling Probes

Probes

These probes offer high chemical resistance for applications involving strong acids, alkalis, and organics. A contoured design reduces carryover, while an all-fluoropolymer wetted sample flow path reduces contamination.

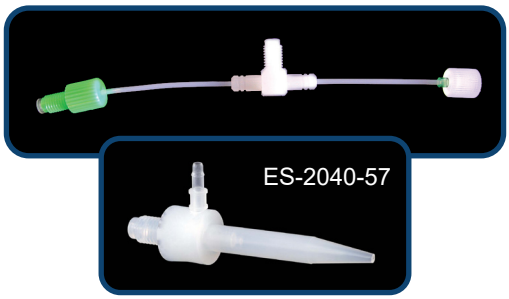
Description	Size	Part Number
PFA carrier/internal standard probe for *FAST* valve	0.50 mm i.d. ■ (orange), 150 cm	SC-5037-3501
PFA internal standard probe for use with standard addition tee or P7 *FAST* valve internal standard addition line		SC-5037-3503

Description	Size	Part Number
PFA *FAST* sample probe for high-flow *FAST* valve, carbon fiber supported	0.80 mm i.d. ■ (blue), 150 cm	SC-5037-3755-150
	1.00 mm i.d. ■ (gray), 150 cm	SC-5037-3995-150

Internal Standard Addition Tee for PFA-ST Nebulizer

Specially designed mixing tee is perfect for online addition of internal standard or online dilution. Achieves excellent mixing with minimal dead volume. 0.5 mm i.d. capillary is recommended for applications with flow rates >0.3 mL/min.

Description	Part Number (14 cm)	DXi Part Number (25 cm)
0.25 mm i.d. ■ (green) Attaches to port #3	SC-0317-1250	SC-0317-1250-25
0.50 mm i.d. ■ (orange) Attaches to port #3	SC-0317-1500	SC-0317-1500-25

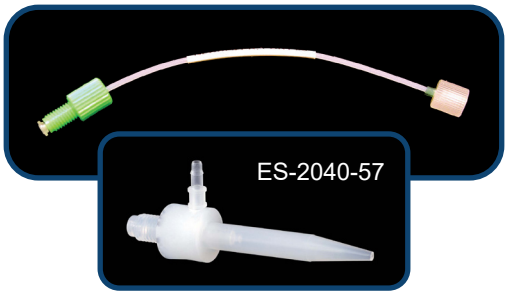


PFA-ST Nebulizer

FAST Valve Connecting Line for PFA-ST Nebulizer

Connects the *FAST* valve to an PFA-ST nebulizer to achieve fast signal stabilization time and short wash times.

Description	Part Number (14 cm)	DXi Part Number (25 cm)
0.25 mm i.d. ■ (green) Attaches to port #3 of the *FAST* valve.	SC-0317-0250	SC-0317-0250-25
0.50 mm i.d. ■ (orange) Attaches to port #3 of the *FAST* valve.	SC-0317-0500	SC-0317-0500-25



PFA-ST Nebulizer

PFA-ST or MEINHARD® nebulizers are recommended for use with the *FAST* system for optimum throughput and performance. Connecting lines are offered for most nebulizers that laboratories may already have.

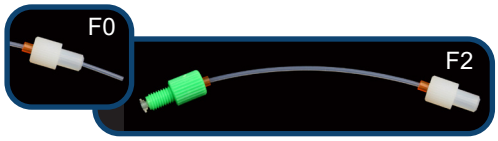
Internal Standard Addition Line for P7 *FAST* Valve

Connects the internal standard peripump tubing or probe to a P7 valve for online addition of internal standard.

Description	Part Number
Internal standard line for P7 valve with XL fitting. 0.5 mm i.d. ■ (orange)	SC-0317-450P-10

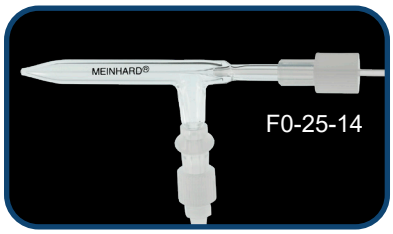
FAST Valve Connecting Line for MEINHARD® Plus Nebulizers

PTFE *FAST* valve line that connects the *FAST* valve (port #3) to a MEINHARD® Plus nebulizer to achieve fast signal stabilization time and short wash times.



Description	Fitting Type	Part Number (14 cm)	DXi Part Number (25 cm)
0.25 mm i.d. ■ (green), 14 cm Attaches to port #3 of the *FAST* valve.	F0	F0-25-14	F0-25-25
	F2	F-F2-25-14	F-F2-25-25
0.50 mm i.d. ■ (orange), 14 cm Attaches to port #3 of the *FAST* valve.	F0	F0-50-14	F0-50-25
	F2	F-F2-50-14	F2-50-25

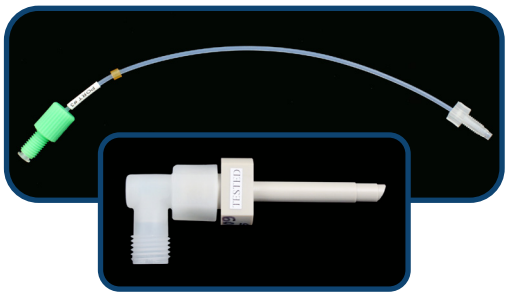
See page 51 for more information about the F0 and F2 fittings.



MEINHARD® glass and quartz nebulizers

FAST Valve Connecting Line for PerkinElmer Gem Cone Nebulizer

PTFE *FAST* valve line that connects the *FAST* valve (port #3) to a PerkinElmer Gem Cone nebulizer to achieve fast signal stabilization time and short wash times.

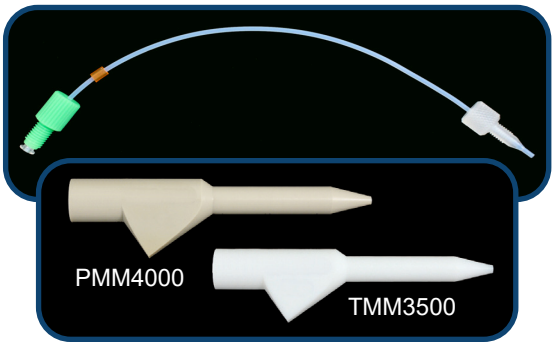


Description	Part Number
0.50 mm i.d. ■ (orange), 25 cm. Attaches to port #3 of the *FAST* valve.	SC-0317-0500-25GC
1.00 mm i.d. ■ (gray), 25 cm. Attaches to port #3 of the *FAST* valve.	SC-0317-0990-25GC

PerkinElmer Gem Cone Low-flow Nebulizer

FAST Valve Connecting Line for MIRA MIST Nebulizer

PTFE *FAST* valve line that connects the *FAST* valve (port #3) to a MIRA MIST nebulizer to achieve fast signal stabilization time and short wash times.

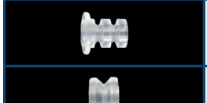
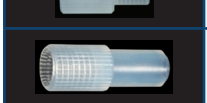
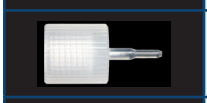
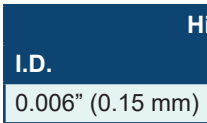
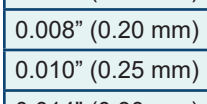


Description	Part Number
0.50 mm i.d. ■ (orange), 17 cm. Attaches to port #3 of the *FAST* valve.	SC-0317-0500-BG
1.00 mm i.d. ■ (gray), 17 cm. Attaches to port #3 of the *FAST* valve.	SC-0317-0990-BG

MIRA MIST PEEK and PTFE Nebulizers

Fittings / PFA Tubing / Spares Kits

Easy to use, ultra-clean fittings and PFA tubing are ideal for all trace metal analysis applications. Ferrules install quickly and easily for high-flow applications. Low-flow valve fittings have low dead volume, leak-free integrated ferrule connections.

	Description	Qty	Suggested Use	P/N
	Black, high-flow nut (1/4-28) for *FAST* valve and 1/16" (1.6 mm) ferrule	10	Use with 1/16" (1.6 mm) o.d. PFA tubing for low and moderate flow rates (0.1 mL/min - 2 mL/min)	SC-0599-0116-K
	White, high-flow nut (1/4-28) for *FAST* valve and 1/8" (3.2 mm) ferrule	10	Use with 1/8" (3.2 mm) o.d. PFA tubing for high-flow rates and vacuum applications (>2 mL/min)	SC-0599-0108-W
	1/16" (1.6 mm) Ferrule for high-flow fitting (1/4-28)	10	Use with 1/16" (1.6 mm) o.d. PFA tubing	SC-0599-F16
	1/8" (3.2 mm) Ferrule for high-flow fitting (1/4-28)	10	Use with 1/8" (3.2 mm) o.d. PFA tubing	SC-0599-F08
	Black, low-flow nut (M5/10-32) for *FAST* valve	10	Use with 1/16" (1.6 mm) o.d. PFA tubing for low-flow rates (<0.1 mL/min)	SC-0599-0001
	Female Perilink fitting, barbed	1	Adapts 10/32 to pump tubing	S033156
	Female Perilink fitting	5	Adapts 10/32 to pump tubing	S033156-V
	Male Perilink fitting, barbed	1	Adapts 10/32 to pump tubing and for use with internal standard tee	S032956
	Male Perilink fitting	5	Adapts 10/32 to pump tubing and for use with internal standard tee	S032956-V
	PFA-ST Nebulizer to Micro Fitting Adapter, PFA	1	Allows for use of tubing with 10/32 fitting with PFA-ST nebulizer	S033161
	MEINHARD® Plus Nebulizer to micro fitting adapter	1		S033101
	CTFE peristaltic pump fittings, female	1	For use in low pressure applications.	ES-2501-PPF1
	CTFE peristaltic pump fittings, female, barbed	1	For use in high pressure applications	ES-2501-PPF2
	CTFE peristaltic pump fittings, male	1	For use in low pressure applications	ES-2501-PPM1
	CTFE peristaltic pump fittings, male, barbed	1	For use in high pressure applications	ES-2501-PPM2

High Purity Fluoropolymer Tubing (5 m coil)			
I.D.	O.D.	Color Code	Part Number
0.006" (0.15 mm)	1/16" (1.6 mm)	(red)	5MT-015
0.008" (0.20 mm)	1/16" (1.6 mm)	(purple)	5MT-02
0.010" (0.25 mm)	1/16" (1.6 mm)	(green)	5MT-025
0.014" (0.30 mm)	1/16" (1.6 mm)	(yellow)	5MT-03
0.019" (0.50 mm)	1/16" (1.6 mm)	(orange)	5MT-05
0.031" (0.80 mm)	1/16" (1.6 mm)	(blue)	5MT-08
0.039" (1.00 mm)	1/16" (1.6 mm)	(gray)	5MT-1
0.063" (1.60 mm)	1/8" (3.2 mm)		5MT-16

Sample Loops

PTFE crimp free *FAST* or prep*FAST* loops provide low resistance for fast loading and rinse out.

Standard for *FAST* Systems

1 mm i.d. *FAST* High-Flow Sample Loops

Description	Size	Part Number
Recommended for use with 1.0 mm i.d. ■ (gray) probe. 1.6 mm o.d., 1/4-28 fittings.	300 µL loop	SC-0318-03
	500 µL loop	SC-0318-05
	1.0 mL loop	SC-0318-10
	1.5 mL loop	SC-0318-15
Applications	2.0 mL loop	SC-0318-20
FAST, prep*FAST*, prep*FAST* M5, prep*FAST* e, brine*FAST*, sea*FAST*	2.5 mL loop	SC-0318-25
	3.0 mL loop	SC-0318-30
	4.0 mL loop	SC-0318-40

SC-0318-25 2.5 mL sample loop

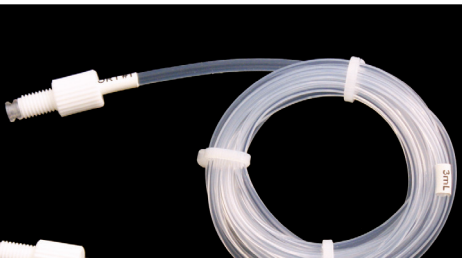
0.8 mm i.d. *FAST* High-Flow Sample Loops

Description	Size	Part Number
Recommended for use with 0.8 mm i.d. ■ (blue) probe. 1.6 mm o.d., 1/4-28 fittings.	100 µL loop	SC-0319-01
	200 µL loop	SC-0319-02
	300 µL loop	SC-0319-03
	500 µL loop	SC-0319-05
	1.0 mL loop	SC-0319-10
Applications	1.5 mL loop	SC-0319-15
Legacy *FAST* systems, and special applications	2.0 mL loop	SC-0319-20
	2.5 mL loop	SC-0319-25
	3.0 mL loop	SC-0319-30
	4.0 mL loop	SC-0319-40

SC-0319-10 1 mL sample loop

1.6 mm i.d. *FAST* High-Flow Sample Loops

Description	Size	Part Number
Recommended for use with 1.0 mm i.d. ■ (gray) probes and applications requiring larger sample volumes or high flow rates. 3.2 mm o.d., 1/4-28 fittings.	250 µL loop	SC-0315-025
	500 µL loop	SC-0315-05
	1.0 mL loop	SC-0315-10
	2.0 mL loop	SC-0315-20
Applications	3.0 mL loop	SC-0315-30
soil*FAST*, oil*FAST*, and large volume *FAST*	4.0 mL loop	SC-0315-40
	6.0 mL loop	SC-0315-60
	8.0 mL loop	SC-0315-80



SC-0315-30 3 mL sample loop

PFA Sample Vessels

PFA Vials

PFA vials are ideal for applications that require the highest purity. Made of ultra-pure, ultra-chemically resistant material, these vials are an excellent choice for high purity, semiconductor and micro samples.

- **Non-contaminating**
- **HF-resistant**
- **Graduated**
- **Conical bottom**
- **Temperature range of -200 °C to 260 °C**
- **Self-standing**

Vials	Fits Racks
V-14-0311CG-X	MR-21-14 (pg 85), MR-40-14 (pg 85), SR4-60-14 (pg 87)
V-14-0312CG-X	
V-14-0314CG-X	

Part Number	Qty
V-14-0311CG-X	10
Description	**Volume**
14 mm o.d. graduated PFA micro vial	1 mL Brim full 2 mL

Part Number	Qty
V-14-0312CG-X	10
Description	**Volume**
14 mm o.d. graduated PFA micro vial	2 mL Brim full 3 mL

Part Number	Qty
V-14-0314CG-X	10
Description	**Volume**
14 mm o.d. graduated PFA micro vial	4 mL Brim full 4.5 mL

Part Number	Qty
ES-7225-0001	1
Description	
ETFE tweezers for removal of PFA cap with knob	

Part Number	Qty
V-14-0309-X	10
Description	
PFA cap for 14 mm micro vials	

Part Number	Qty
V-15-0300-X	10
Description	
PFA snap-on cap for 14 mm graduated PFA micro vials	

Part Number	Qty
V-15-0301-X	10
Description	
PFA cap with knob for 14 mm graduated PFA micro vials.	

PFA Bottles and Vials

PFA bottles and vials are ideal for a wide range of demanding fluid handling and storage applications in general laboratory, semiconductor, and environmental industries.

Bottles / Vials	Fits Racks
V-31-15-X	SR2-21-30 (pg 86), MR-10-30 (pg 85)
V-31-30-X	SR2-27-31 (pg 86), MR-10-30 (pg 85), ST10-31 (pg 88)
V-31-60-X	LR-21-30 (pg 84), LMR-21-30-R (pg 84), SR2-27-31 (pg 86), HR-21-30 (pg 85), ST10-31 (pg 88)
V-28-0360-V	SR2-27-28 (pg 86), ST10-28 (pg 88)
V-50-0360	SR2-12-50 (pg 86), ST2-9-50 (pg 89), ST4-9-50 (pg 89), SR4x-20-50 (pg 87)

Part Number	Qty
V-28-0360-V	5
Description	**Volume**
28 mm o.d. PFA bottle and cap	20 mL

Part Number	Qty
V-50-0360	1
Description	**Volume**
50 mm o.d. PFA bottle and cap with TFM insert	125 mL

- Semiconductor, high-purity, and aggressive chemical applications
- The most translucent PFA vials available
- Low absorption of biological materials for many research applications

Part Number	Qty
V-31-15-X	10
Description	**Volume**
30 mm o.d. graduated PFA vial	15 mL

Part Number	Qty
V-31-30-X	10
Description	**Volume**
30 mm o.d. graduated PFA vial	30 mL

Part Number	Qty
V-31-60-X	10
Description	**Volume**
30 mm o.d. graduated PFA vial	60 mL

Part Number	Qty
PFA-K29-X	10
Description	
Screw cap for 30 mm o.d. vials	

2 mL PVDF Autosampler Vial

A low cost alternative to PFA for many ultra-trace metal analyses

PVDF sample vials are a lower cost alternative to our high-performance PFA vials. These high-tensile-strength, fluoropolymer vials can replace more expensive PFA vials in many applications.

- Semiconductor-grade PVDF fluoropolymer
- High dielectric and mechanical strength, flexible
- Excellent for the analysis of Nitric Acid, Hydrochloric Acid, Hydrofluoric Acid, or Ammonium Hydroxide
- Resistant to most mineral and organic acids, as well as aliphatic and aromatic hydrocarbons, alcohols, halogenated solvents, and oxidizing agents
- Self-standing
- Conical internal bottom for micro-sample analysis
- Suitable for most semiconductor pure chemicals
- Not recommended for ketones, acetone, ethyl acetate, and MIBK
- Optional PFA enclosures
- Available standard or pre-cleaned

V-14-0712-X
2 mL PVDF
autosampler vial

V-14-0712-X
2 mL PVDF autosampler vial
with PFA cap

PVDF Vials and PFA Caps		
Description	**Qty**	**Part Number**
PVDF vial, 2 mL	10	V-14-0712-X
PVDF vial, 2 mL	100	V-14-0712-C
PVDF vial, 2 mL	1000	V-14-0712-M
PFA cap for V-14 vial	10	V-14-0309-X
PFA cap for V-14 vial	100	V-14-0309-C

Pre-cleaned PVDF Vials and Caps		
Description	**Qty**	**Part Number**
Pre-cleaned PVDF vial, 2 mL	100	VPC-14-0712-C
Pre-cleaned PFA cap for V-14 vial	100	VPC-14-0309-C

Bottles / Vials	Fits Racks
V-14-0712-X	MR-21-14 (pg 85), MR-40-14 (pg 85), SR4-60-14 (pg 87)

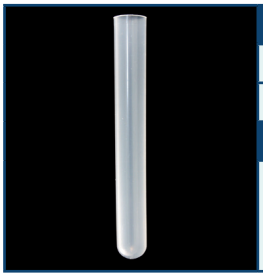
Non-PFA Sample Vessels

Non-PFA Vials, Tubes and Bottles

Non-PFA sample vessels manufactured from plastics, such as polypropylene, polyethylene and polystyrene, are a sensible alternative to consider when breakage, surface inertness, and/or disposal costs are a concern.

Vials	Fits Racks
V-8-0505-C	MR-60-08 (pg 85), MR-90-08 (pg 85)
V-13-0200-R-XC	LR-90-13-R (pg 84), LMR-90-13-R (pg 84), LMR-90-13-R-3T (pg 84), ST-PR-5 (pg 88)
V-20-0290-D	LR-40-20 (pg 84)
V-16-0225-LX	HR-60-16 (pg 85), LR-60-16 (pg 84), LMR-60-16-R (pg 84), SR2-80-16 (pg 86), ST-PR-5 (pg 88)
V-28-0260-L	HR-21-30 (pg 85), ST10-28 (pg 88), LR-21-30 (pg 84), LMR-21-30-R (pg 84), SR2-27-28 (pg 86), ST-PR-5 (pg 88), ST-EX-5B (pg 88)
V-50-0460-XII	SR4x-20-50 (pg 87), SR2-12-50 (pg 86), ST-PR-5 (pg 88), ST2-9-50 (pg 89), ST4-9-50 (pg 89)
V-61-0661-XII	SR4x-15-60 (pg 87), ST7-60 (pg 89), ST-PR-5 (pg 88), ST-EX-5B (pg 88)

Part Number	Qty
V-8-0505-C	100
V-8-0505-D	500
Description	**Volume**
8 mm o.d. centrifuge tube	0.5 mL



Part Number	Qty
V-13-0200-R-XC	90
V-13-0200R-D	500
Description	**Volume**
13 mm o.d. polypropylene tube with rounded bottom	8 mL

Part Number	Qty
V-16-0225-LX	60
V-16-0225-D	500
Description	**Volume**
16 mm o.d. polypropylene tube with screw cap	15 mL

Part Number	Qty
V-20-0290-L	50
V-20-0290-D	500
Description	**Volume**
20 mm o.d. polypropylene tube with screw cap	20 mL

Part Number	Qty
V-28-0260-L	50
V-28-0260-D	500
Description	**Volume**
28 mm o.d. polypropylene tube with screw cap	50 mL

Part Number	Qty
V-50-0460-XII	12
V-50-0460-XXIV	24
Description	**Volume**
50 mm o.d. HDPE wide mouth bottle with cap	125 mL

Part Number	Qty
V-61-0661-XII	12
V-61-0661-C	100
Description	**Volume**
61 mm o.d. polyethylene wide mouth bottle	250 mL

Microplates

Microplates

Microplates are ideal for micro-volume applications such as storage and sample transfer.

All microplates can be used on the following DXe, DX, and DXCi autosampler models: 2 and 4

Description	Part Number
1 Pk (5 ea) 24 well, 10 mL microplate, square well, pyramid bottom	MT-24-10mL-02

Description	Part Number
1 Pk (5 ea) 48 well, 5 mL microplate, square well, pyramid bottom	MT-48-5mL-02

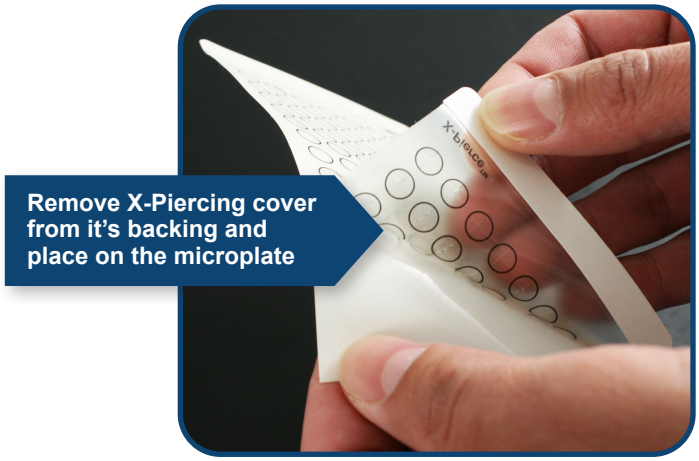
Description	Part Number
1 Pk (3 ea) 48 well, 7.5 mL microplate, square well, pyramid bottom	MT-48-7.5mL-02

Description	Part Number
1 Pk (5 ea) 96 well, 2 mL microplate, square well, pyramid bottom	MT-96-2mL-02
1 Pk (5 ea) 96-well, 500 µL microplate, polystyrene	MT-96-500-05-V

X-Piercing Film Cover / XP Probe Arm

X-Piercing Microplate Cover

The X-piercing cover minimizes evaporation of micro samples awaiting analysis and protects against environmental contamination.

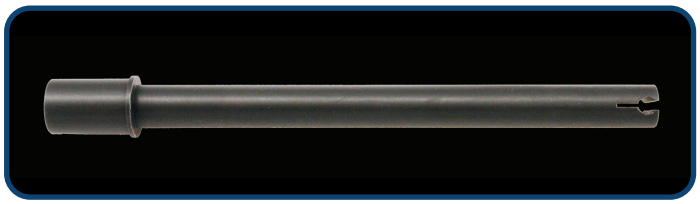


Description	Qty	Part Number
X-Piercing film cover for 96 well microplate	25	MT-96-XP-50

XP Probe Arm

The XP probe arm must be used in place of the reset probe arm when an X-Piercing cover has been applied to a 96 well microplate.

Description	Qty	Part Number
XP Probe arm for 2DX / 4DX Autosampler	1	SC-0105-DX-XP



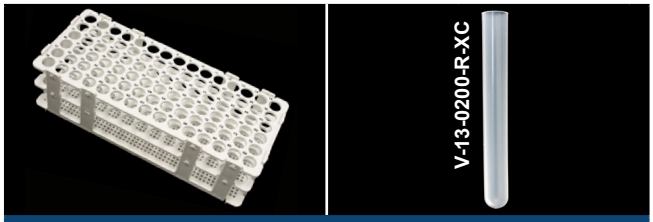
CONSUMABLES

Large Autosampler Racks

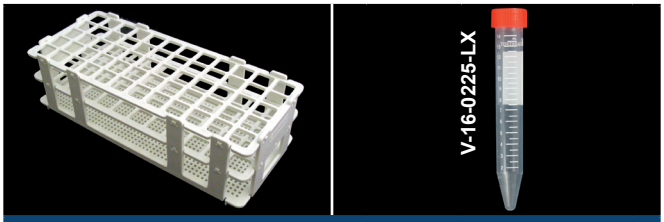
Autosampler Racks (LR Size)

Plastic large racks are recommended for aqueous samples.

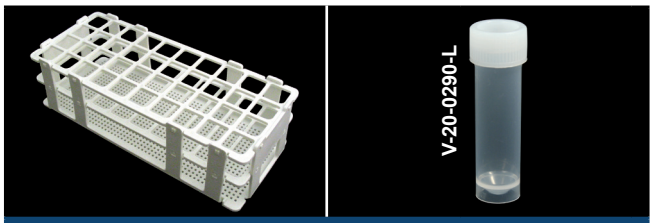
All LR racks can be used on the following DXe, DX, and DXCi autosampler models: 2, 4, 8, and 14



Description	Diam.	Part Number
90 position large polypropylene sample rack for 8 mL tubes	13 mm	LR-90-13-R



Description	Diam.	Part Number
60 position large polypropylene sample rack for 15 mL tubes	16 mm	LR-60-16



Description	Diam.	Part Number
40 position large polypropylene sample rack for 20 mL tubes	20 mm	LR-40-20

Description	Diam.	Part Number
21 position large polypropylene sample rack for 50 mL and 60 mL tubes	30 mm	LR-21-30

Autosampler Coated Metal Racks (LR Size)

Metal racks are coated with an epoxy paint that forms a protective barrier over the rack material.

All coated metal racks can be used on the following DXe, DX, and DXCi autosampler models: 2, 4, 8, and 14

Description	Diam.	Part Number
90 position metal large sample rack for 8 mL tubes	13 mm	LMR-90-13-R

Description	Diam.	Part Number
90 position 3 tier metal large sample rack for 8 mL tubes	13 mm	LMR-90-13-R-3T

Description	Diam.	Part Number
60 position metal large sample rack for 15 mL tubes	16 mm	LMR-60-16-R

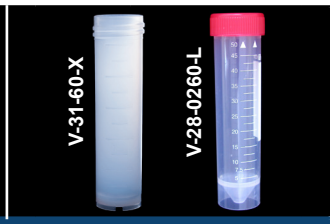
Description	Diam.	Part Number
21 position metal large sample rack for 50 mL and 60 mL tubes	30 mm	LMR-21-30-R

Heated and Micro Autosampler Racks

Autosampler Heated Racks (LR Size)

All heated racks can be used on the following DXe, DX, and DXCi autosampler models: 2 and 4

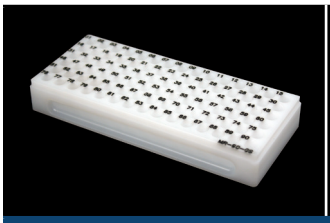
Description	Diam.	Part Number
60 position heated large sample rack for 15 mL tubes	16 mm	HR-60-16



Description	Diam.	Part Number
21 position heated large sample rack for 50 mL and 60 mL tubes	30 mm	HR-21-30

Autosampler Racks (MR Size)

All MR racks can be used on the following DXe, DX, and DXCi autosampler models: Micro, 2, and 4



Description	Diam.	Part Number
90 position CPVC micro sample rack for 0.5 mL tubes	8 mm	MR-90-08

Description	Diam.	Part Number
60 position CPVC micro sample rack for 0.5 mL tubes	8 mm	MR-60-08

Description	Diam.	Part Number
40 position CPVC micro sample rack for 1 mL, 2 mL and 4 mL tubes	14 mm	MR-40-14

Description	Diam.	Part Number
21 position CPVC micro sample rack for 1 mL, 2 mL and 4 mL tubes	14 mm	MR-21-14

Description	Diam.	Part Number
10 position PVCC micro sample rack for 15 mL and 30 mL tubes	30 mm	MR-10-30

Description	Part Number
PVCC Cover for SC-micro racks	MR-00-01

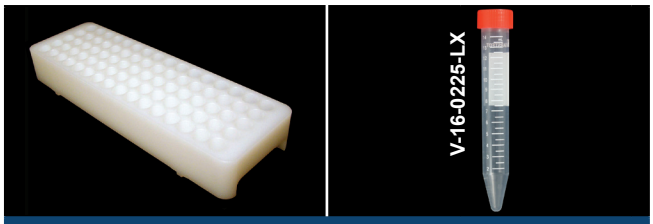
CONSUMABLES

Super Autosampler Racks

Large-volume samples can be analyzed using Avio super racks without transferring the sample to a smaller tube, reducing prep time and chance of contamination.

Autosampler Racks (SR2 Size)

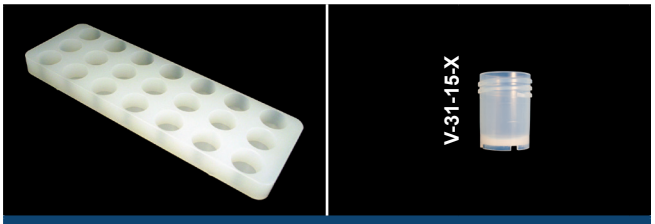
All SR2 racks can be used on the following DXe, DX, and DXCi autosampler models: 2



Description	Diam.	Part Number
80 position HMPE super sample rack for 15 mL tubes	16 mm	SR2-80-16

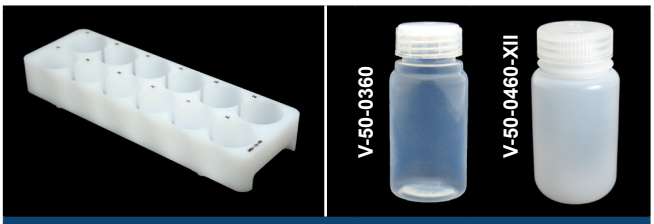
Description	Diam.	Part Number
27 position HMPE super sample rack for 20 mL and 50 mL tubes	28 mm	SR2-27-28

Description	Diam.	Part Number
27 position HMPE super sample rack for 15 mL, 30 mL and 60 mL tubes	31 mm	SR2-27-31



Description	Diam.	Part Number
21 position HMPE super sample rack for 15 mL tubes	30 mm	SR2-21-30

Description	Diam.	Part Number
21 position super sample rack for 125 mL bottles	35 mm	SR2-21-35



Description	Diam.	Part Number
12 position HMPE super sample rack for 125 mL bottles	50 mm	SR2-12-50

Autosampler Racks (SR4 Size, Type 1)

All SR4 racks can be used on the following DXe, DX, and DXCi autosampler models: 2 and 4

Description	Diam.	Part Number
60 position HMPE super sample rack for 1 mL, 2 mL and 4 mL tubes	14 mm	SR4-60-14

Description	Part Number
PP Cover for 60 position SR-4 super rack	SR4-00-01

Autosampler Racks (SR4 Size, Type 2)

All SR4 type 2 racks can be used on the following DXe, DX, and DXCi autosampler models: 4

Description	Diam.	Part Number
15 position HMPE super sample rack for 250 mL bottles	60 mm	SR4x-15-60

Description	Diam.	Part Number
20 position HMPE super sample rack for 125 mL bottles	50 mm	SR4x-20-50

The SR4x-15-60 super rack will hold fifteen 100 mL volumetric flasks or 250 mL bottles

SR4x-15-60 super rack with 100 mL volumetric flasks

Autosampler Racks (ST Size, Type 1)

All ST type 1 racks can be used on the following DXe, DX, and DXCi autosampler models: 2, 4, 8, and 14

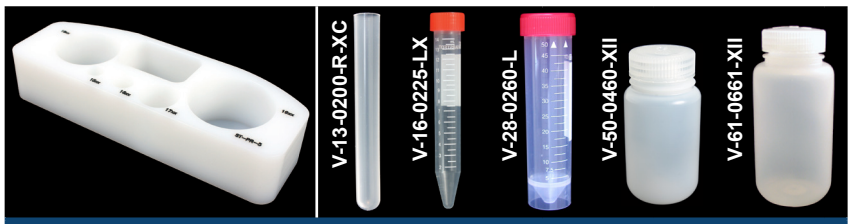
Description	Diam.	Part Number
10 position PVDF standards rack for 20 mL and 50 mL tubes	28 mm	ST10-28

Description	Diam.	Part Number
10 position PP high purity standards rack for 30 mL and 60 mL tubes	31 mm	ST10-31

Static Rinse/Organic Rinse Racks (ST Size, Type 1)

All static and organic rinse racks can be used on the following DXe, DX, and DXCi autosampler models: 2, 4, 8, and 14

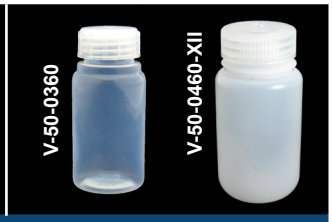
Description	Diam.	Part Number
5 position HMPE extra standards rack for 50 mL and 250 mL bottles. Fits over SC DX rinse station.	28 mm 60 mm	ST-EX-5B



Description	Diam.	Part Number
5 position HMPE priority samples rack for 8 mL, 15 mL, 50 mL, 125 mL and 250 mL bottles. Fits over DX rinse station. For PE prep*FAST* only.	13 mm 16 mm 28 mm 50 mm 60 mm	ST-PR-5

Autosampler Racks (ST Size, Type 2)

All ST type 2 racks can be used on the following DXe, DX, and DXCi autosampler models: 2

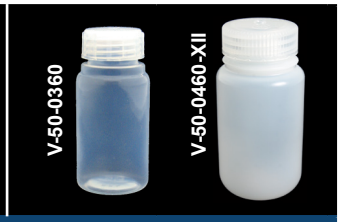


Description	Diam.	Part Number
9 position HMPE standards rack for 125 mL bottles. Recommended for prep*FAST* with DXCi. Includes 9, 125 mL HDPE bottles w/cap.	50 mm	ST2-9-50

Autosampler Racks (ST Size, Type 3)

The ST type 3 rack can be used on the following DXe, DX, and DXCi autosampler models: 4 and 14

Description	Diam.	Part Number
7 position HMPE standards rack for 250 mL bottles	60 mm	ST7-60

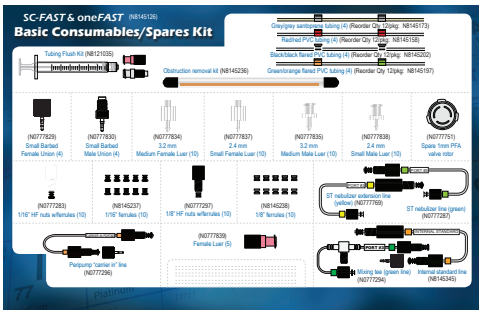


Description	Diam.	Part Number
9 position HMPE standards rack for 125 mL bottles. Recommended for prep*FAST.* Includes 9, 125 mL HDPE wide mouth standard bottles w/caps.	50 mm	ST4-9-50

FAST Spares Kits

FAST Spares Kit

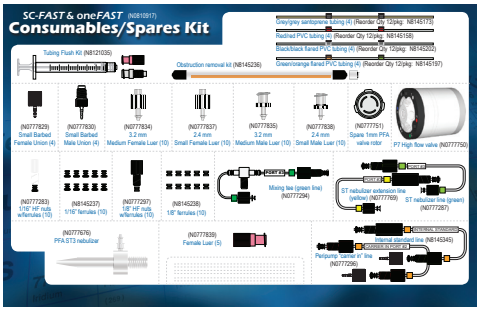
Assorted fittings and tubing for *FAST* systems.



Description	Part Number
FAST Spares Kit for Avio 200/500	SC-0380-R1

FAST Deluxe Spares Kit

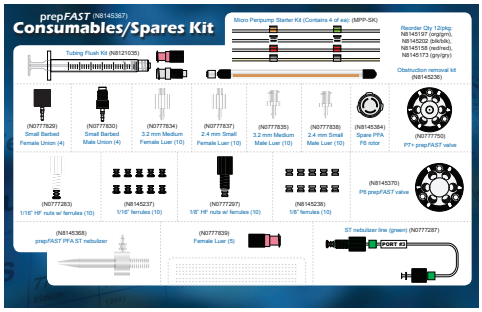
All of the assorted fittings and tubing in the *FAST* Spares Kit with the addition of a PFA-ST nebulizer, spare *FAST* valve, and internal standard tee.



Description	Part Number
FAST Deluxe Spares Kit for Avio 200/500	SC-0370-37-D

prep*FAST* Spares Kit

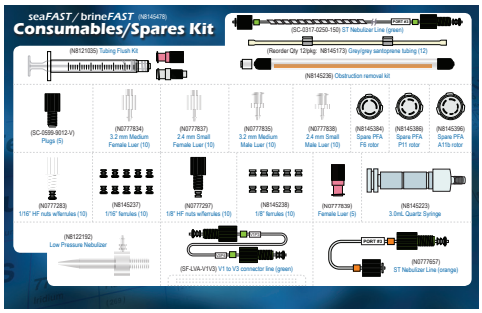
Includes prep*FAST* PFA-ST3 nebulizer, P7+ and P6 valves, PFA F6 rotor, tubing flush kit, ST nebulizer line, and spare fittings and tubing for prep*FAST*.



Description	Part Number
prep*FAST* Spares Kit	PF-0370

sea*FAST* / brine*FAST* Spares Kit

Includes all of the assorted fittings and tubing in the *FAST* Spares Kit with the addition of a PFA-ST nebulizer, 3 mL quartz syringe, and assorted fittings.



Description	Part Number
sea*FAST*/brine*FAST* Spares Kit	SF-0370

Installation and Training

Silver Level ESI Installation & Training

The silver level installation and training package is a 1-day on-site installation and method development for *FAST*.

Includes: Hardware installation
Software methods
Basic system familiarization
Travel time & expenses for ESI employee or contractor
FAST standard spares kit (SC-0380-R1)

Description	Part Number
On-site, 1-day installation and application development for *FAST* high throughput system	FI-SC-01
On-site 1-day installation and implementation for SampleSense *FAST*	FI-F-SS7
On-site 1-day installation and implementation for SampleSense *FAST* UHT	FI-F-SS6

Gold Level ESI Installation & Training

The gold level installation and training package is a 2½-day, on-site installation and method development for the *FAST* and prep*FAST*.

Includes: Hardware installation
Software methods
Basic system familiarization
Necessary method validation
User Training
Travel time & expenses for ESI employee or contractor
Spares kit (see page 90)

Description	Part Number
On-site, 2½-day installation and application development for *FAST* systems	FI-SC-02-54
On-site, 2½-day installation and application development for prep*FAST* systems	FI-PF-02
On-site 2½-day installation and application development for SampleSense prep*FAST*	FI-PF-SS8
On-site, 2½-day installation and application development for sea*FAST*/brine*FAST* systems	FI-SF-02
On-site, 4-day installation and application development for prep*FAST* IC systems	IC-0303

The *FAST* Deluxe, prep*FAST*, or sea*FAST*/brine*FAST* Spares Kit is included with the Gold Installation & Training.

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