



**Elemental Scientific**

# SampleTRAX SF

Barcoded Sample Tracking and ICPMS Analysis of High Purity Semiconductor Grade Chemicals



ICP | ICPMS

# sampleTRAX SF



sampleTRAX SF Analytical Station

sampleTRAX SF is an advanced, automated sample identification system that uses barcodes to track samples from time of collection through reception to final analysis and data reporting. Direct analysis of semiconductor grade chemicals by ICPMS at less than 1 ppt are achieved with sampleTRAX SF.

## Sample Identification

- Barcode scanning accesses information including:
  - Sample type
  - Sample information (Line / Sampling point / Name / etc.)
  - Method of standardization and analysis
  - QC protocol

## Ultra Pure

- Automated capping and recapping of bottles and vials
- Ultra-clean
- <1 ppt semiconductor metals
- Automated matrix-matched MSA, addition or external calibration
- Analytical stations for ICPMS instruments

## Laboratory Automation

- Bottle tracking
- Bottle history (cleaning, sample, chemical, analysis, concentration)
- Chemical grouping
- Chemical specific rinse function per chemical
- Customized network, bottle cycle
- Data management



250 mL bottle with 2D bottom, 2D cap and 1D side barcode

# Fully Automated Sample Identification and Tracking for Ultra-Pure Chemicals



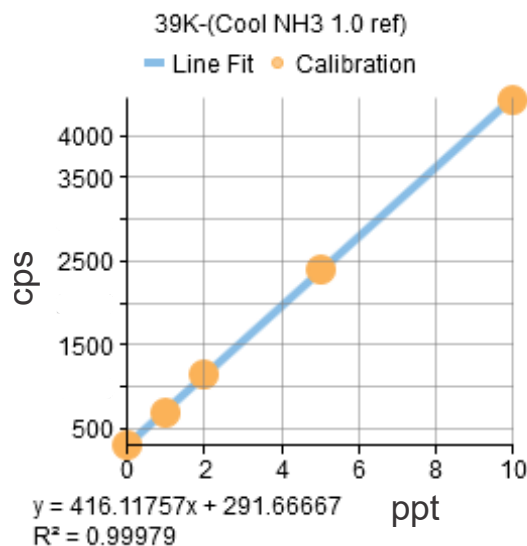
An integrated barcode reader scans the bottom of a PFA bottle to identify sample information before analysis.

## How It Works

sampleTRAX SF analytical station automatically:

1. Scans bottles
2. Groups samples by chemical type
3. Analyzes grouped chemicals in a user-defined order
4. Performs wash method specific to each chemical type after each group is analyzed
5. Generates and reports data

## Autocalibration of 39K from a Single Stock Solution

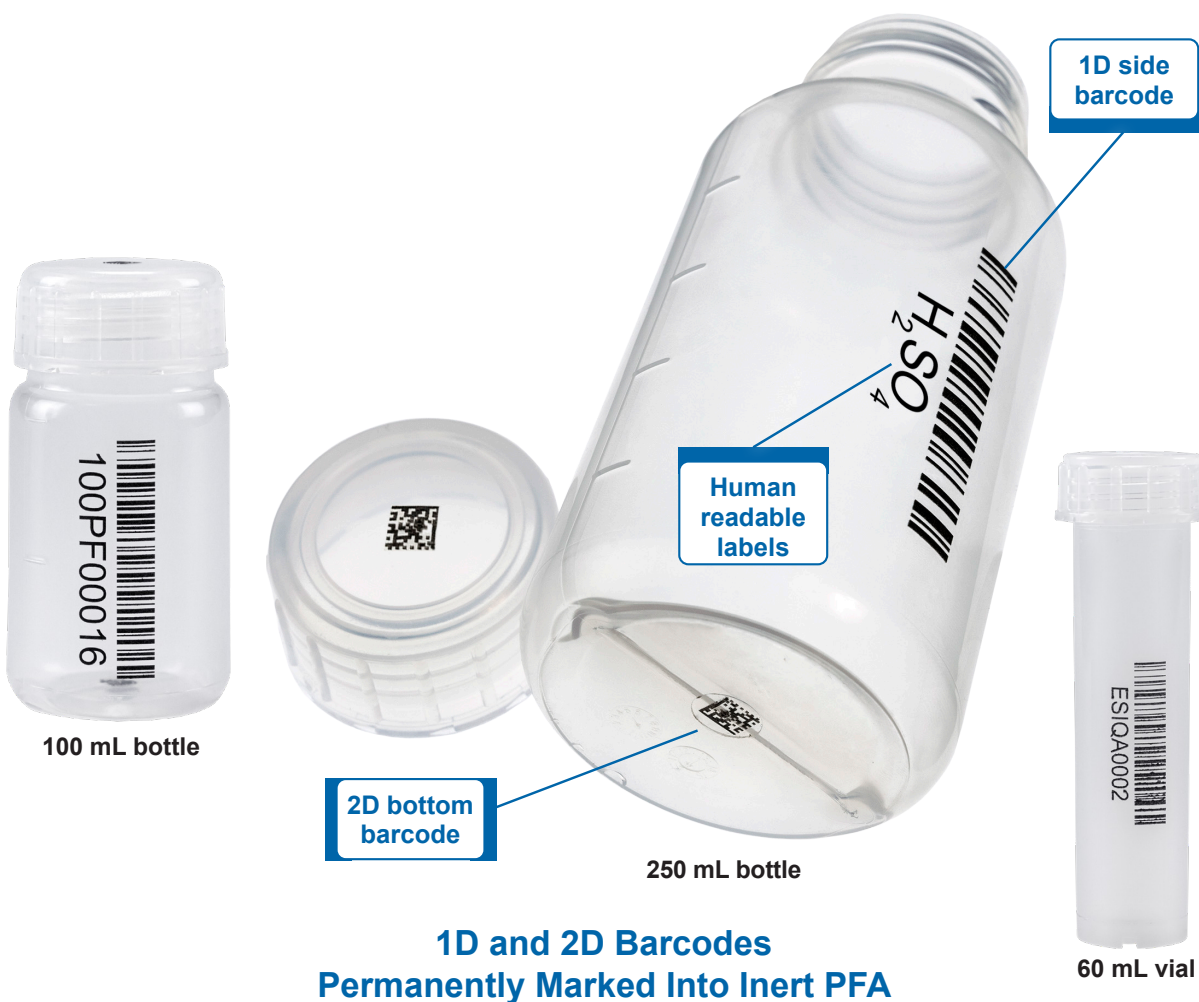


\* All calibration strategies automated (MSA, Addition, External)

# Barcoded Bottles

## Compatible precleaned and barcoded bottles, vials and caps

See the back page for more details.



### 1D and 2D Barcodes Permanently Marked Into Inert PFA

#### Benefits

- Chemically inert barcodes
- Non-contaminating markings into acid-resistant PFA
- Reusable
- 2D barcoded bottles are compatible with sampleTRAX SF scanning automation systems
- Track bottle position and sample identity
- Precleaned

#### Types

- Bottles and vials
  - 2D bottom barcoded
  - 1D side barcoded
- Caps
  - Available with 2D barcodes

# TRAX Scan Stations

Scan stations are used to associate sample and analytical information with the bottle's barcode.

Select Sample Type

<input type="checkbox"/>	H2O2
<input checked="" type="checkbox"/>	NH4OH
<input type="checkbox"/>	DSP
<input type="checkbox"/>	LAL
<input type="checkbox"/>	DHF
<input type="checkbox"/>	SC1
<input type="checkbox"/>	IPA
<input type="checkbox"/>	H2SO4
<input type="checkbox"/>	HF

1.) Select sample type



2.) Scan bottle



3.) Add user input

- Location
- Operator
- Bottle Status
- Chemical
- Comments/notes
- Customizable inputs

Multiple scan stations can be used to track bottle usage both in the fab and the laboratory.

# Fluorocapper

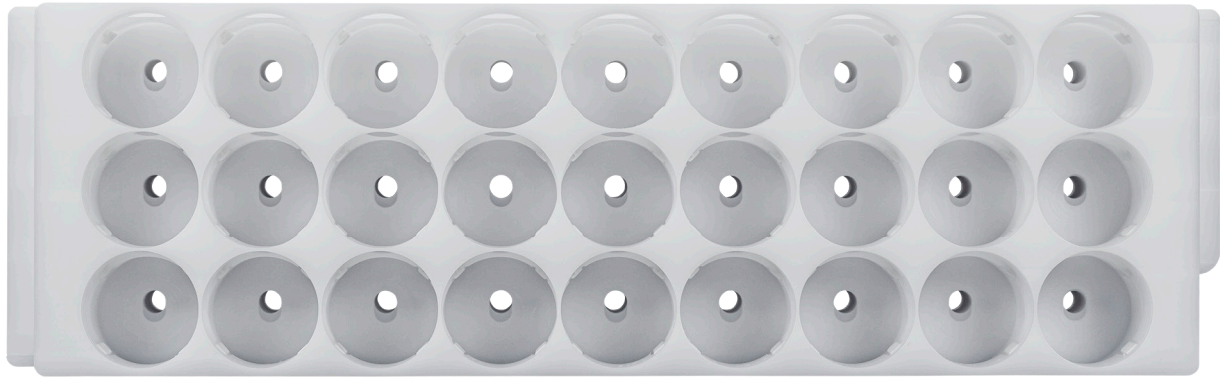
## Automated capping and recapping of bottles and vials

- More stringent control over contamination
- Reduced exposure of operators to dangerous chemicals
- Elimination of sample evaporation
- Elimination of gas-phase reactions of adjacent sample bottles



# Fluorocapper Racks

## Automatic Locking Racks



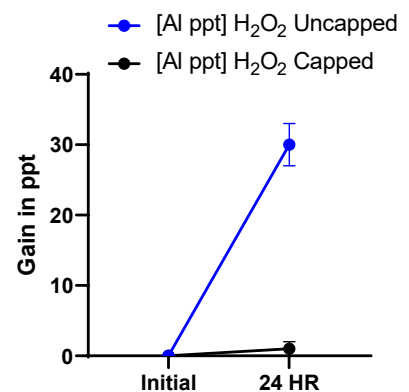
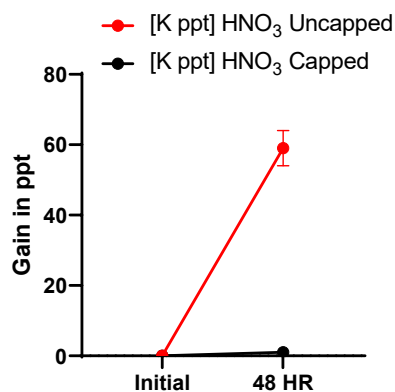
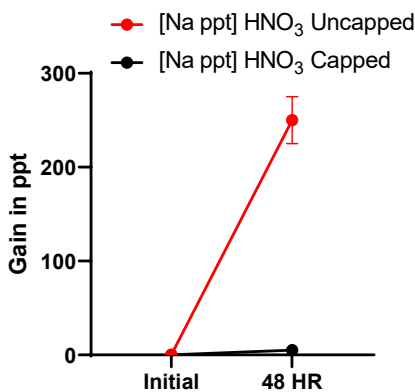
### Fluorocapper racks for 100 mL and 250 mL bottles or 60 mL vials

- Automated capping and recapping of bottles and vials
- Automated locking and unlocking of bottles and vials
- Scanning hole for each bottle or vial
- Reduced exposure of operator to samples



### Fluorocapper reduction of environmental contamination

Accumulation of environmental contamination in uncapped bottles

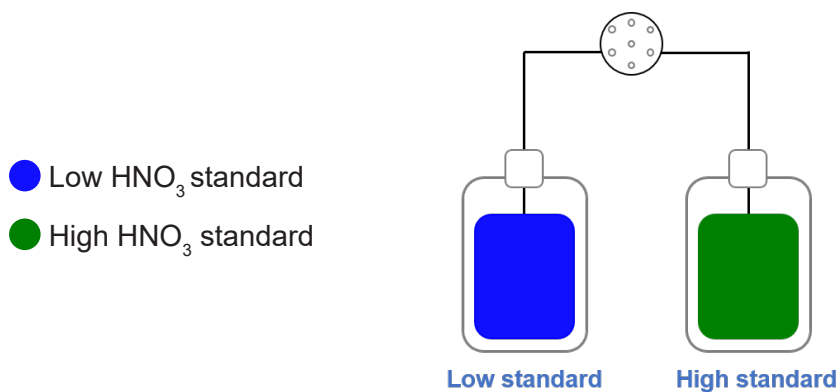


# Multi-standard Selector

## Multi-Standard Features

- Up to four different calibration standards for matrix-matched calibrations without the need for switching or priming standards
- Generate “extended-range” calibrations of 1 curve from multiple bottles
- Multi-elemental calibration from stocks with
  - Different matrixes
  - Different elements
  - Different concentration

## Stand Alone or Extended-Range Calibrations

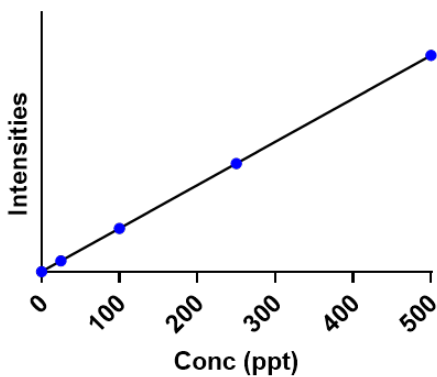


● Cal group 1

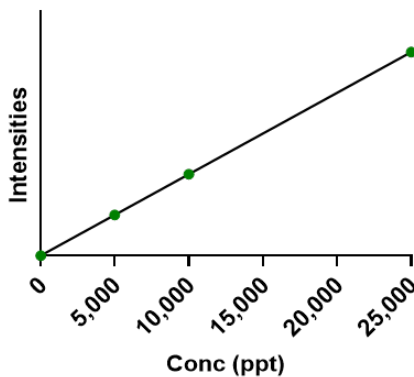
● Cal group 2

● Cal group 3

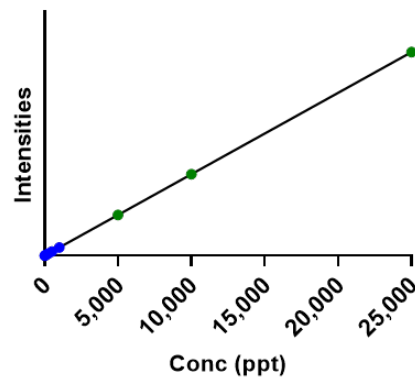
(combines groups 1 and 2)



Low HNO<sub>3</sub> standard



High HNO<sub>3</sub> standard

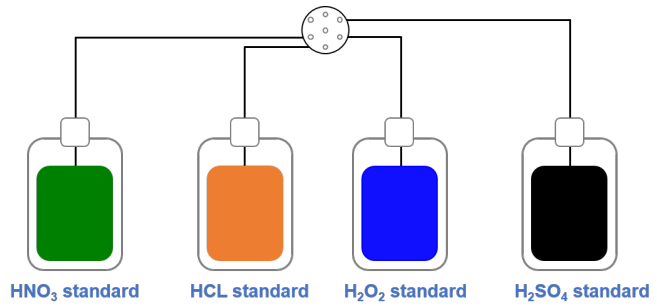


Low and high HNO<sub>3</sub> standard

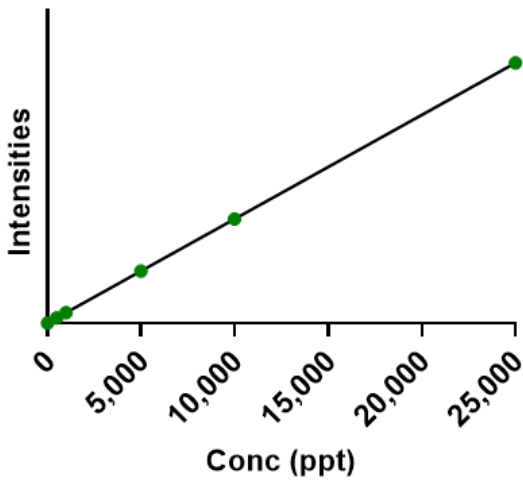


# Up to 4 Different Calibration Standards Consecutively

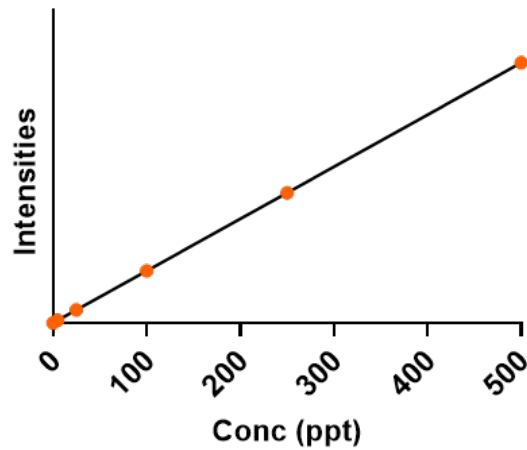
- $\text{HNO}_3$  matrix standard
- $\text{HCL}$  matrix standard
- $\text{H}_2\text{O}_2$  matrix standard
- $\text{H}_2\text{SO}_4$  matrix standard



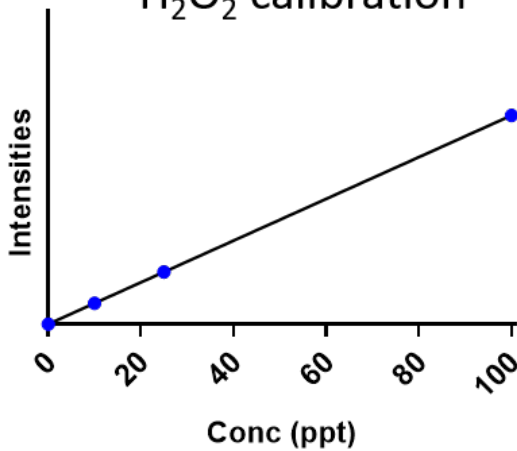
### $\text{HNO}_3$ calibration



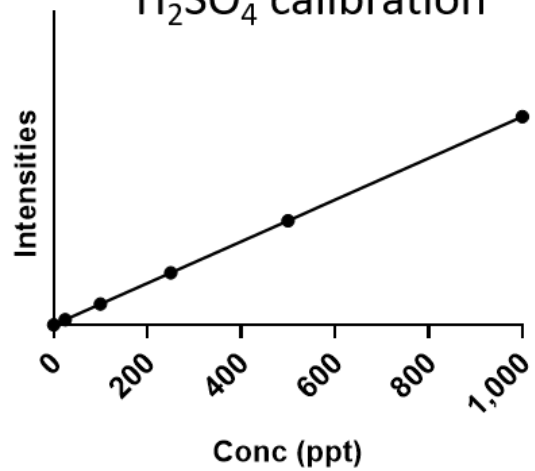
### $\text{HCL}$ calibration



### $\text{H}_2\text{O}_2$ calibration



### $\text{H}_2\text{SO}_4$ calibration



# sampleTRAX SF Analytical Station

## Status Indicator Light

Alerts user to system problems (leaks, empty reagents, etc...)

## Integrated Computer Monitor with Swivel Arm

-Convenient, protected location for instrument computer  
-Touch screen

## Storage Drawers

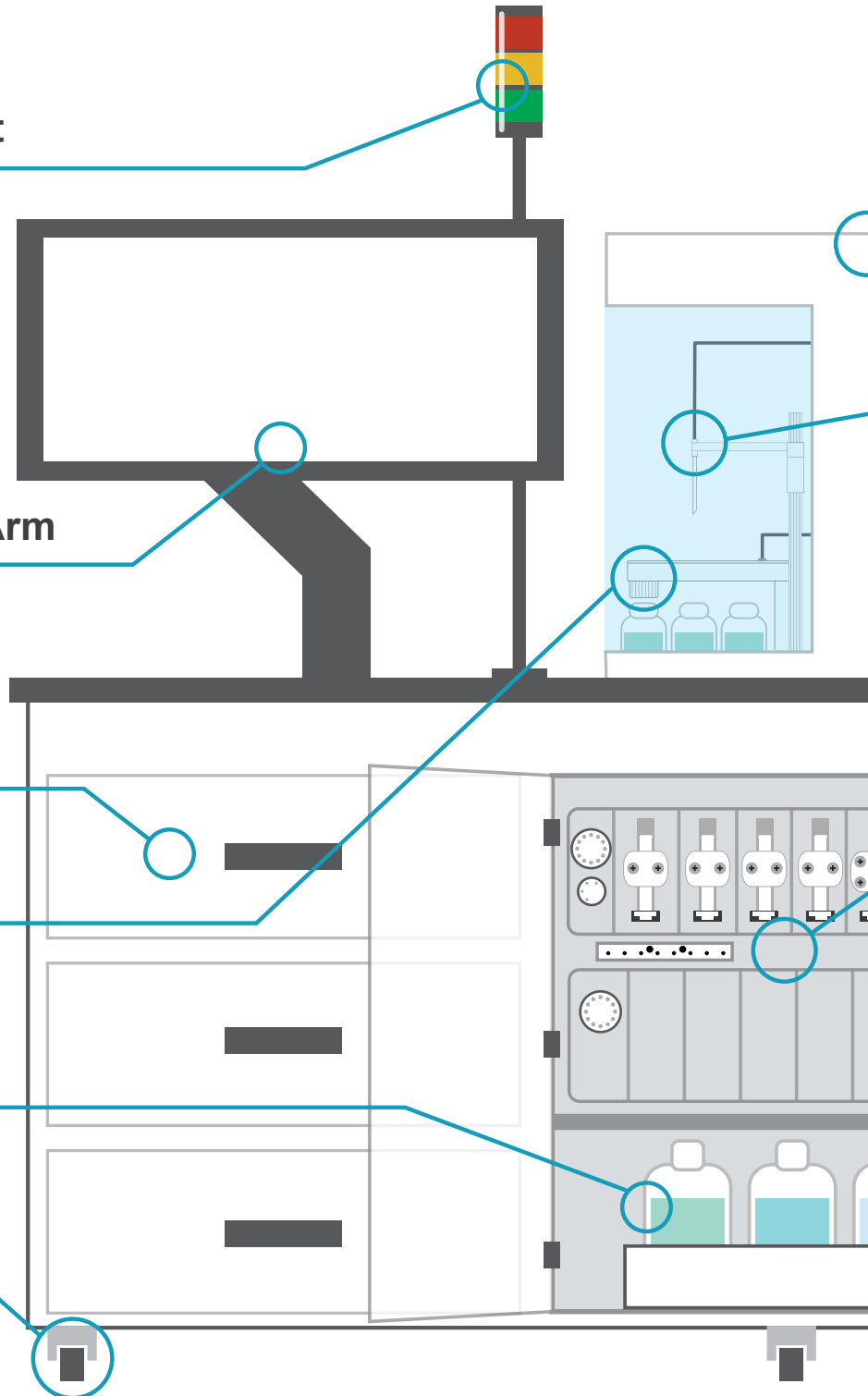
## Fluorocapper

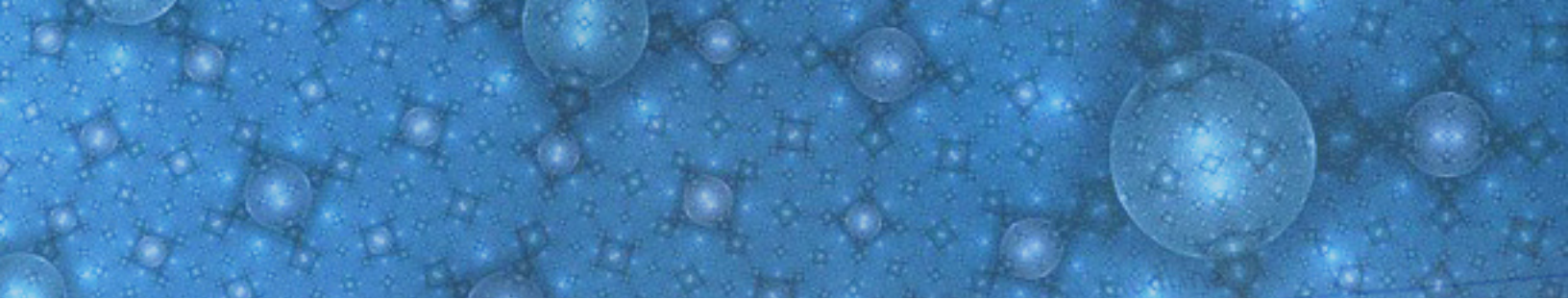
## High Purity PFA Reservoirs

With integrated level sensors

## Wheels

Allows for flexible positioning





## Ultra-clean Enclosure Exhausted with Air Shower

With exhaust vents and inert-gas air shower

### ICP or ICPMS

### sampleTRAX SF Autosampler

With barcode scanning and PFA probe  
and Fluoronetics rail

ICP or ICPMS

### Inert, Acid-Resistant HDPE Countertop

Elemental  
Scientific

### Integrated prepFAST S System

With ultra high purity syringes and valves

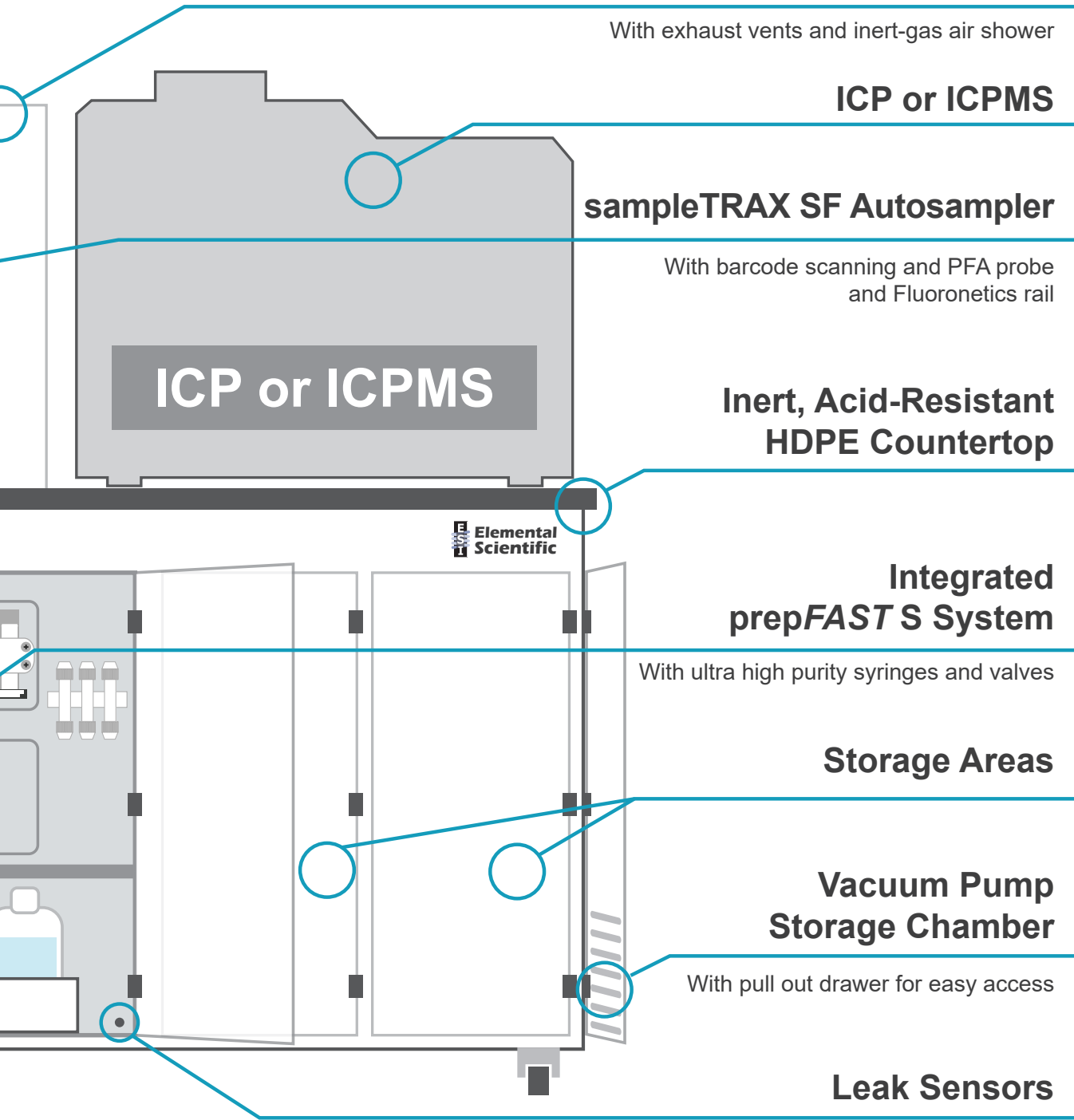
### Storage Areas

### Vacuum Pump Storage Chamber

With pull out drawer for easy access

### Leak Sensors

Detects leaks and alerts user

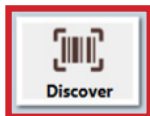


# Automated Grouping and Wash

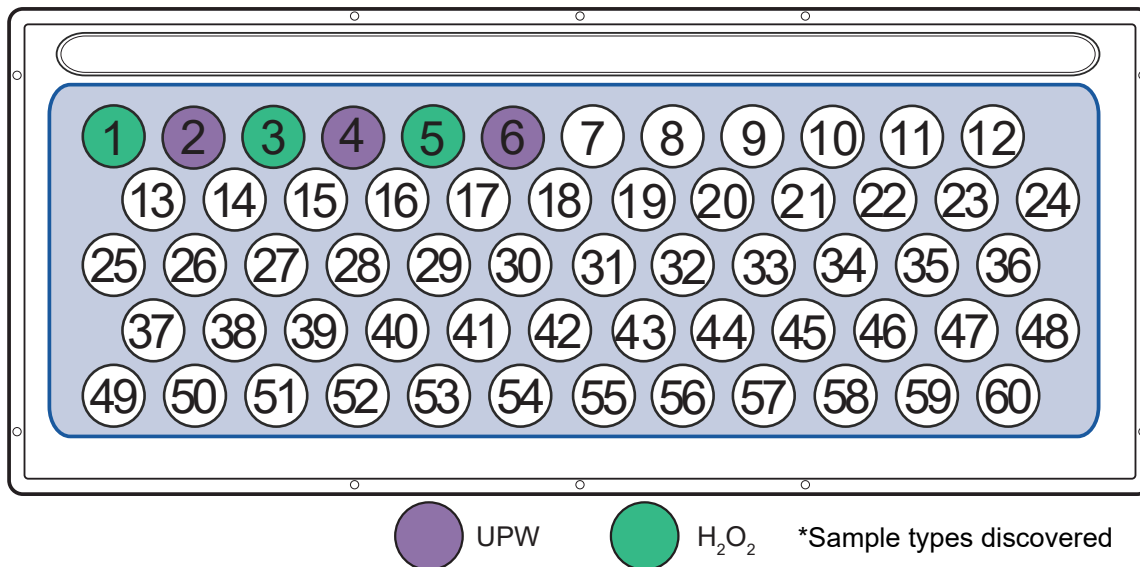
**sampleTRAX SF Analytical Station simplifies and performs the most demanding sample analysis in 3 easy steps.**

1. Discover and group samples
2. Create a sequence, a) MSA, b) Addition Cal, c) External Cal.
3. Run samples, acquire data and calculate results

## 1) Discover Samples



sampleTRAX SF discovers sample location and analytical information.



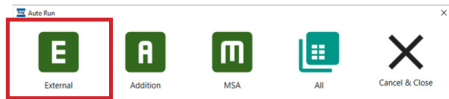
## Group Samples

Based on discovered sample information, the sequence groups samples by type and sorts by analytical order. Chemical specific washes are performed after each group.

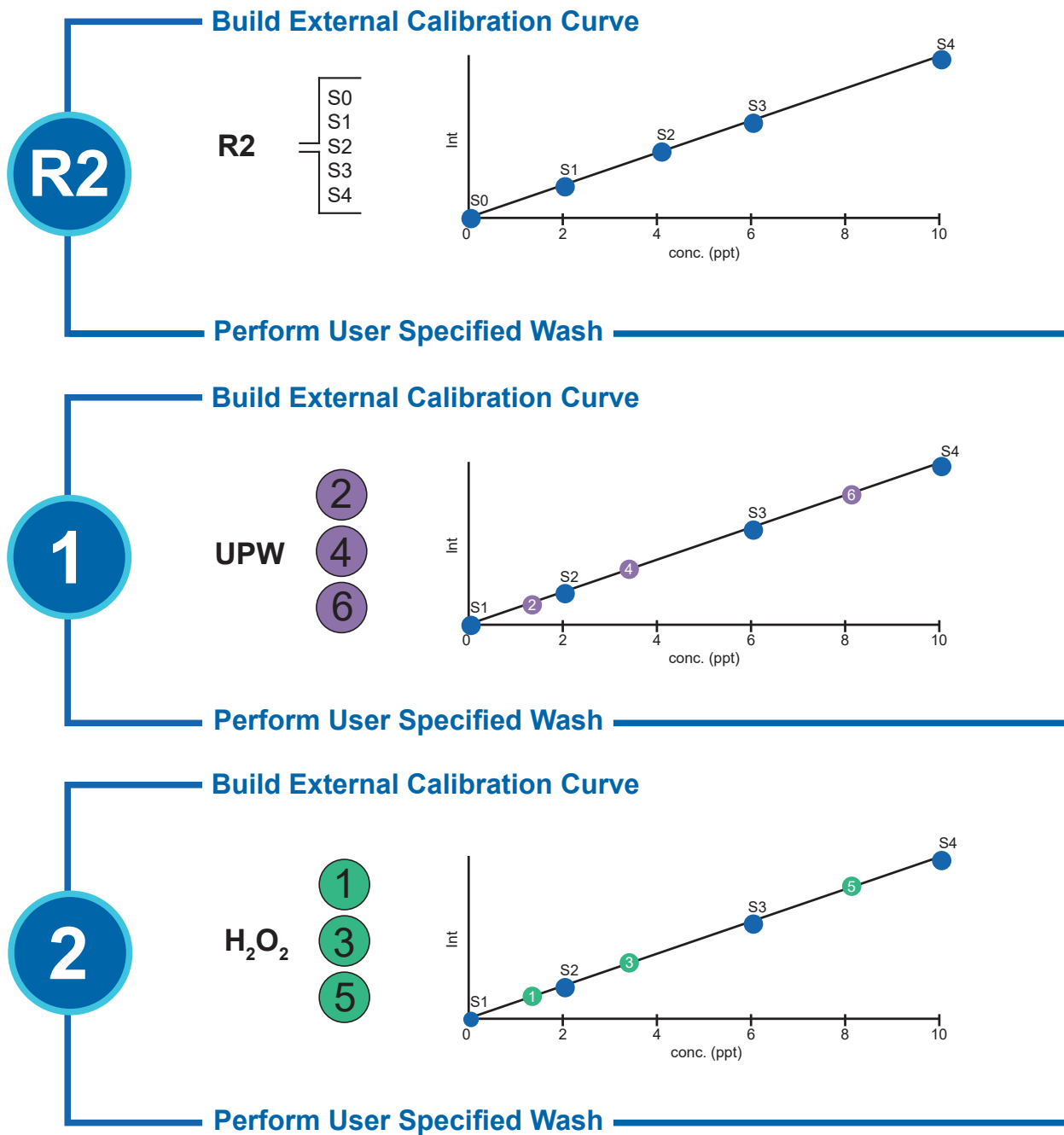
Sample Group Analysis Order	
UPW - Group 1	H <sub>2</sub> O <sub>2</sub> - Group 2
2	1
4	3
6	5

# External Cal Sequence

## 2a) Select Desired Sequence Type



Build External calibration curves according to protocol for each sample and perform chemical specific washes after each sample type.



# Addition Cal Sequence

## 2b) Select Desired Sequence



Build Addition calibration curves according to protocol for each sample and perform chemical specific washes after each sample type.

**1**

**Build UPW Additions Cal Curve**

Group 1

S0
S1
S2
S3
S4

Perform UPW User Specified Wash

**2**

**Build H<sub>2</sub>O<sub>2</sub> Additions Cal Curve**

Group 2

S0
S1
S2
S3
S4

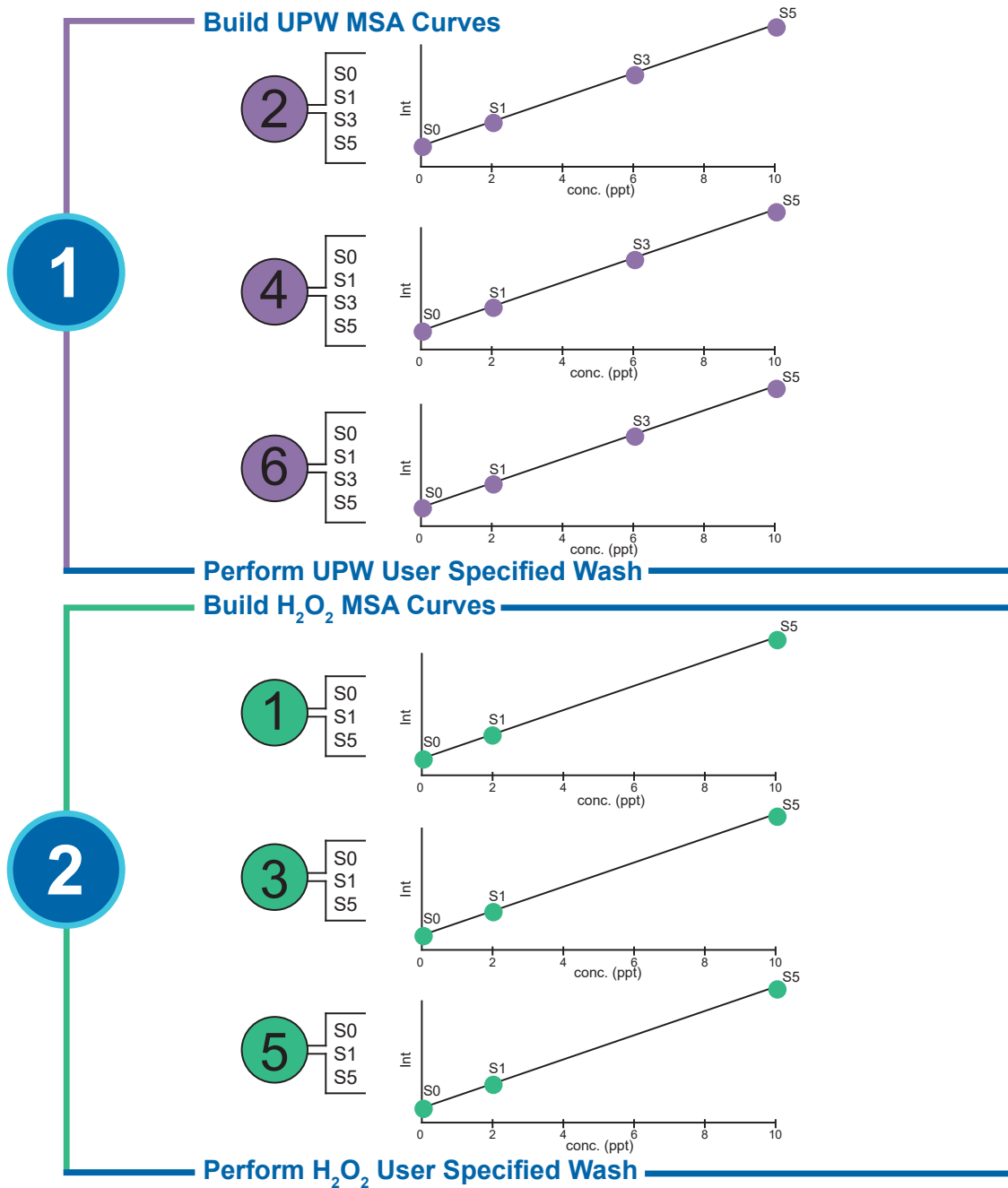
Perform H<sub>2</sub>O<sub>2</sub> User Specified Wash

# MSA Sequence

## 2c) Select Desired Sequence



Build MSA curves according to protocol for each sample and perform chemical specific washes after each sample type.



# Run Samples

## 3) Run samples, acquire data and calculate results for rep

sampleTRAX SF automatically prepares desired calibration curve and samples for analysis

As each chemical is prepared and injected, sampleTRAX SF triggers the ICPMS to acquire data and imports raw intensities.

Raw intensities are:

- Associated with TRAX ID
- Used to calculate concentrations
- Stored in database

The screenshot displays the EST software interface. At the top, the time is 09:55:17 on 06/23/2022. Below this, a status bar indicates '09:46:55.160 Data analysis file opened by Paul Field: Semiconductor - EXTERNAL - 6/16/2022 4:32:33 PM'. The main window shows a table of data points and two calibration curves.

ID	Trax ID	Sample Type	Calibration	Time	Standard
13	ESI00010	External-Test	EXTERNAL_2	6/16/2022 6:00:01 PM	Std-1
14	ESI00010	External-Test	EXTERNAL_2	6/16/2022 6:07:06 PM	Std-2
15	ESI00010	External-Test	EXTERNAL_2	6/16/2022 6:14:12 PM	Std-3

ID	Trax ID	Sample Type	Calibration	Time	Standard
15	ESI00010	External-Test	EXTERNAL_2	6/16/2022 6:14:12 PM	Std-2

**Calibration Curves**  
Viewing: Std-2 (ID: 15)

60Ni (Cool)

$y = 24.845x + 367.343$   
 $R^2 = 0.99614$   
Units = ppt

63Cu (Cool)

$y = 68.062x + 1,176.720$   
 $R^2 = 0.99595$   
Units = ppt




# Reporting to sample TRAX SF database

**TRAX Analysis**

12:33 PM

**User: Paul Field**



TRAX Views

Data Analysis

6/16/2022 3:48:01 PM × Semiconductor - MSA - 6/22/2022 3:07:39 PM ×

Intensities

Concentrations

Final Concentrations

Standard	(No Gas)	60Ni-(Cool)	63Cu-(Cool)	64Zn-(Cool)	74Ge-(HeHe)	75As-(HeHe)	88Sr-(No Gas)
0	0000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
1	0493	45.59172	45.48197	45.99914	48.67735	45.90240	48.80781
2	94754	102.20414	102.25902	102.00043	100.66133	102.04880	100.59609

Standard	(No Gas)	60Ni-(Cool)	63Cu-(Cool)	64Zn-(Cool)	74Ge-(HeHe)	75As-(HeHe)	88Sr-(No Gas)
2	94754	102.20414	102.25902	102.00043	100.66133	102.04880	100.59609
Known Concentration	0.00	100.00	100.00	100.00	100.00	100.00	100.00
Concentration Recovery...	1.95%	102.20%	102.26%	102.00%	100.66%	102.05%	100.60%
Slope	42735	24.84537	68.06236	7.66703	12.81267	6.08552	499.26345
Intercept	-1.06333	367.34333	1,176.72000	212.33333	136.33333	61.66667	5,000.24667
Coefficient R <sup>2</sup>	9927	0.99614	0.99595	0.99681	0.99964	0.99665	0.99971



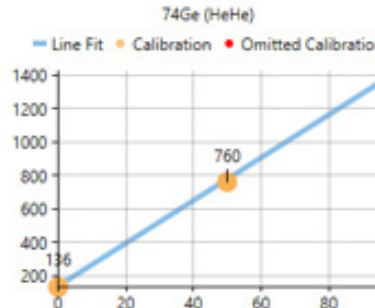
Omitted Calibration 8137



64Zn (Cool)

Line Fit Calibration Omitted Calibration 994

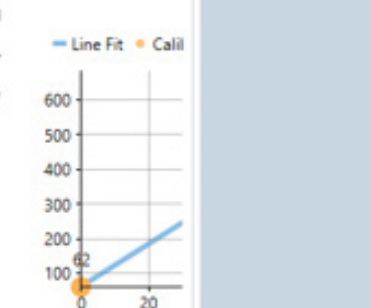
$y = 7.667x + 212.333$   
 $R^2 = 0.99681$   
 Units = ppt



74Ge (HeHe)

Line Fit Calibration Omitted Calibration 426

$y = 12.813x + 136.333$   
 $R^2 = 0.99964$   
 Units = ppt



Line Fit Calibration

$y = 6.086x + 61.667$   
 $R^2 = 0.99665$   
 Units = ppt

Analysis

Details

Process

Devices

FAST

Logs

# sampleTRAX SF (Touch Screen)

## TRAX Actions

Multiple stop options to cease operation of sampleTRAX SF

Barcode scan bottles on the deck to observe in Discover View & Sequence for analysis

Manually sequence samples to be analyzed in a singular run (see types below)

Use previously generated Calibrations for a Sample Type

The screenshot displays the ESI Sample TRAX touch screen interface. On the left, a vertical sidebar contains several control buttons: 'TRAX Stop' with a red octagonal emergency stop icon, 'EMERG STOP' with a red octagonal emergency stop icon, 'STOP' with a red octagonal stop icon, 'TRAX Actions' with a barcode icon, 'Discover' with a barcode icon, 'Sequence' with a green document icon, 'Use Last Cal' with a green document icon, 'Run' with a blue play button icon, and 'Resume Run' with a blue play button icon. The main screen shows the ESI logo, the time '14:49:25 06/15/2023', and the user '14:48:41.510'. Below this, there are tabs for 'FluoroCapper', 'Valves & Pumps', 'prepFAST', 'DeviceStatus', and 'Alerts'. A 'Cap Vacuum' section has 'Enable' and 'Disable' buttons. A 'Stow' button is visible below a 'Connected not Initialized' status message. A sample deck is shown with 50 numbered positions (1-50), with position 25 highlighted in red. The deck is arranged in a 5x10 grid.

# TRAX Views

The image displays the TRAX Views software interface. On the left is a rack control panel with a grid of 60 sample positions (7-60) and a 'Rack Control' section with 'Lock', 'Unlock', and 'Stow' buttons. The status bar shows 'User: Paul Field' and '00:09:36.274 Sequence Stopped: Emergency stop'. On the right is a vertical 'TRAX Views' menu with the following items:

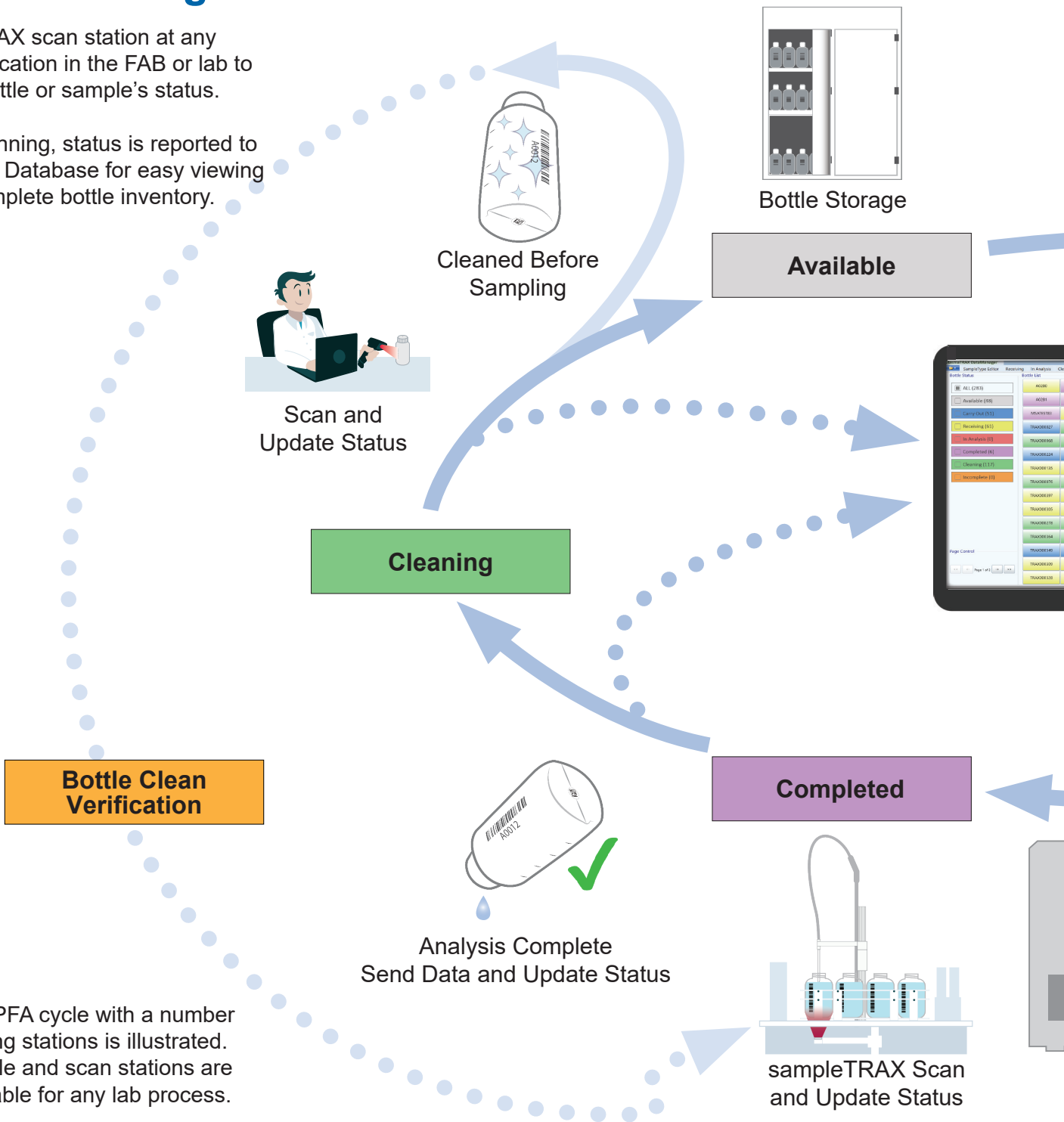
- TRAX Views**: A status indicator with a red, yellow, and green bar.
- ALERT Count: 6**: A red exclamation mark icon, highlighted with a red border. Description: Data report, sample sequence, re-evaluate.
- Analysis**: A purple bar chart icon. Description: Displays samples discovered on-deck.
- Details**: A barcode icon. Description: Run unbarcoded samples.
- Process**: A yellow test tube icon. Description: Fluorocapper & device status, valves/syringes.
- Devices**: A yellow bar chart icon. Description: FAST method status, method running.
- FAST**: A blue rabbit icon. Description: FAST method status, method running.
- Logs**: A blue document icon with an information symbol. Description: Autosampler communication and alerts logs.

# Tracking a Typical Bottle Cycle

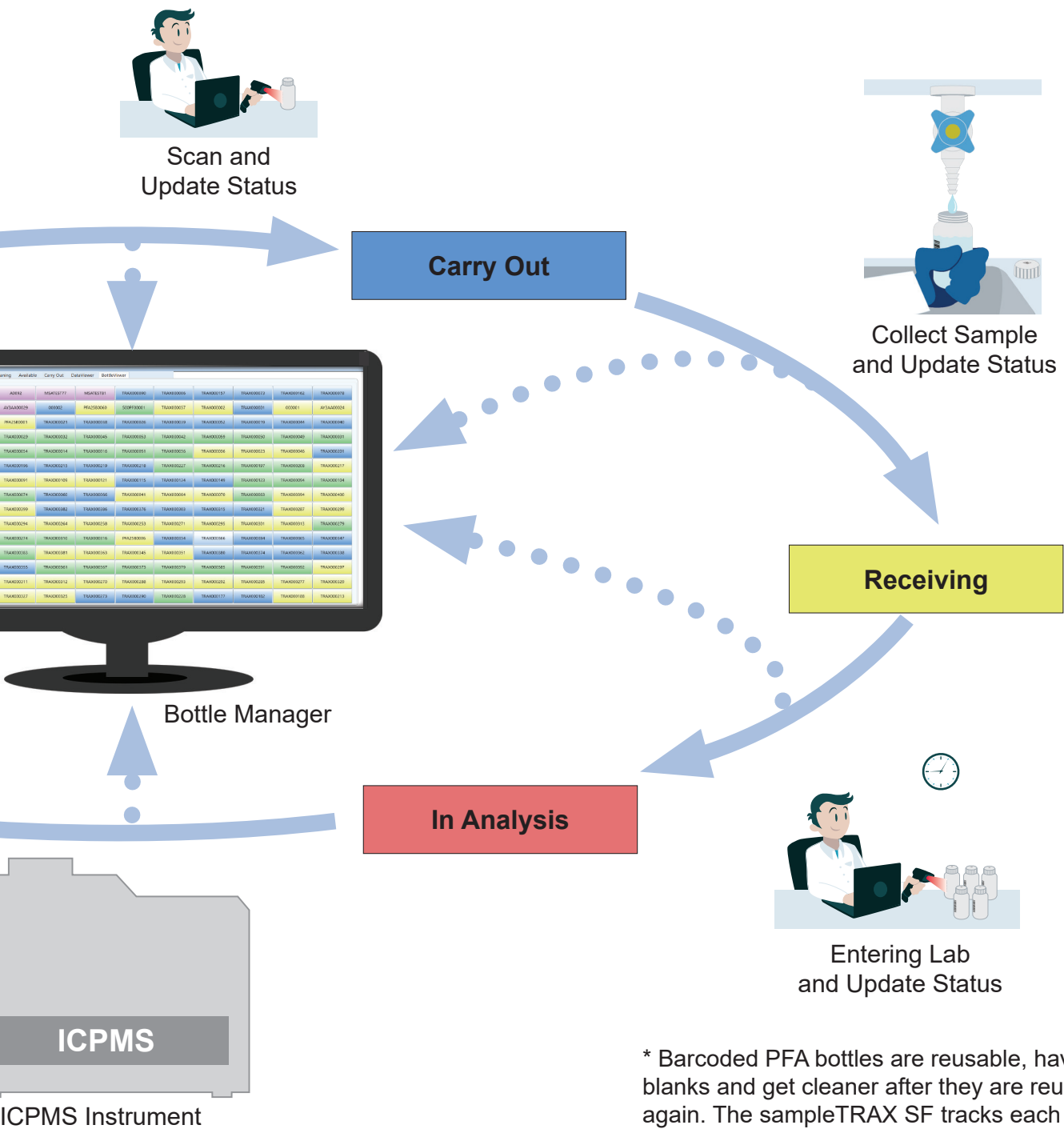
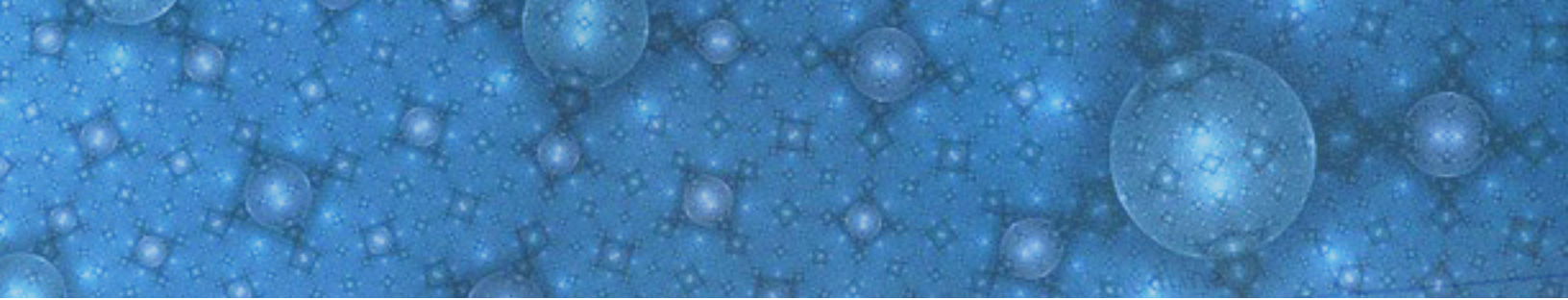
## Bottle Tracking

Add a TRAX scan station at any desired location in the FAB or lab to track a bottle or sample's status.

Upon scanning, status is reported to the TRAX Database for easy viewing of the complete bottle inventory.



\* Typical PFA cycle with a number of scanning stations is illustrated. Bottle cycle and scan stations are customizable for any lab process.



\* Barcoded PFA bottles are reusable, have ultra-low blanks and get cleaner after they are reused again and again. The sampleTRAX SF tracks each bottle, ensures cleanliness and data integrity.

# Bottle Manager: Tracking and History

Scan stations update the database in real time allowing the bottle manager to instantaneously provide a snapshot of every bottle's status.

## Bottle Tracking

Select "ALL" to view the status of the entire bottle inventory as a color-coded grid. Quantity of bottles is indicated with (##) in each of the seven color-coded stages.

## Bottle History

Click on the TRAXID to view its complete history.

- Status
- Sample type
- Purpose
- Concentrations



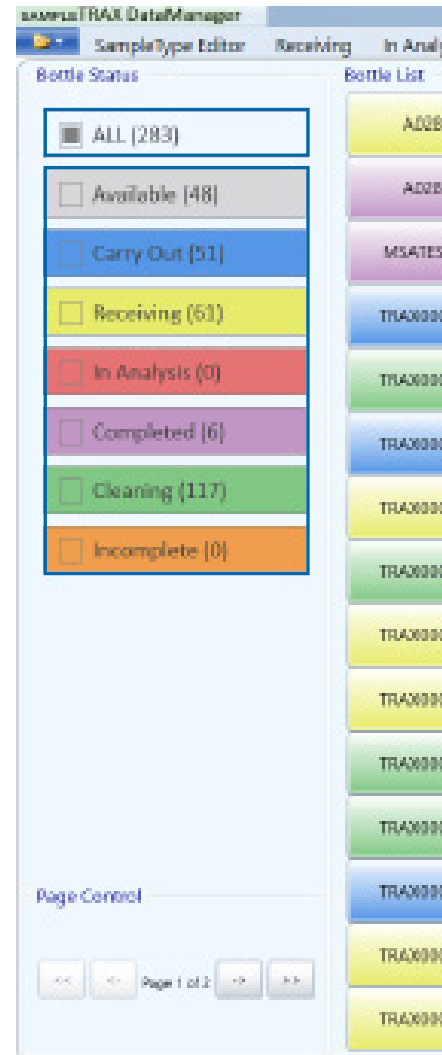
250 mL bottle



100 mL vial



60 mL vial



Clicking a TRAXID opens the bottle history window which shows the complete history of a bottle in the TRAX system including analytical data.

0	A0002	MSATEST32	MSATEST32	TRAX000090	TRAX000006	TRAX000157	TRAX000073	TRAX000162	TRAX000078
1	AY3AA00029	000002	PFA2500060	500PP00001	TRAX000057	TRAX000002	TRAX000001	000001	AY3AA00004
23	PFA2500001	TRAX000021	TRAX000030	TRAX000020	TRAX000030	TRAX000052	TRAX000019	TRAX000044	TRAX000040
27	TRAX000029	TRAX000032	TRAX000043	TRAX000033	TRAX000042	TRAX000059	TRAX000050	TRAX000049	TRAX000031
28	TRAX000054	TRAX000014	TRAX000016	TRAX000031	TRAX000056	TRAX000056	TRAX000023	TRAX000046	TRAX000020
24	TRAX000196	TRAX000215	TRAX000219	TRAX000210	TRAX000227	TRAX000216	TRAX000197	TRAX000200	TRAX000217
125	TRAX000091	TRAX000109	TRAX000121	TRAX000130	TRAX000134	TRAX000149	TRAX000123	TRAX000094	TRAX000104
276	TRAX000074	TRAX000080	TRAX000066	TRAX000041	TRAX000064	TRAX000070	TRAX000063	TRAX000094	TRAX000080
287	TRAX000099	TRAX000102	TRAX000106	TRAX000120	TRAX000103	TRAX000115	TRAX000121	TRAX000107	TRAX000109
105	TRAX000294	TRAX000264	TRAX000250	TRAX000253	TRAX000251	TRAX000295	TRAX000301	TRAX000313	TRAX000275
278	TRAX000274	TRAX000310	TRAX000316	PFA2500006	TRAX000354	TRAX000366	TRAX000364	TRAX000365	TRAX000347
104	TRAX000383	TRAX000381	TRAX000363	TRAX000345	TRAX000351	TRAX000380	TRAX000374	TRAX000362	TRAX000338
145	TRAX000355	TRAX000361	TRAX000367	TRAX000373	TRAX000379	TRAX000385	TRAX000351	TRAX000392	TRAX000297
109	TRAX000311	TRAX000312	TRAX000270	TRAX000288	TRAX000296	TRAX000292	TRAX000285	TRAX000277	TRAX000329
128	TRAX000327	TRAX000325	TRAX000273	TRAX000290	TRAX000228	TRAX000177	TRAX000182	TRAX000188	TRAX000213

Bottle History for MSATEST32

TRAX ID	Status	Sample Type	User	Datetime	Protocol	Purpose	Line	Sampling Point	Comments
MSATEST32	Completed	Validation	ESI\Agilent\CPMS	2019-01-29 11:37:44	Semiconductor				
MSATEST32	In Analysis	Validation	ESI\Agilent\CPMS	2019-01-29 11:03:01	Semiconductor				
MSATEST32	Receiving	Validation	ESI\Agilent\CPMS	2019-01-29 10:59:35	Semiconductor				
MSATEST32	Carry Out		ESI\Agilent\CPMS	2019-01-29 10:56:43					
MSATEST32	Available		ESI\Agilent\CPMS	2019-01-29 10:53:07					
MSATEST32	Cleaning		ESI\Agilent\CPMS	2019-01-29 10:46:37					
MSATEST32	Completed	Validation	ESI\Agilent\CPMS	2019-01-29 09:42:04	Semiconductor				
MSATEST32	In Analysis	Validation	ESI\Agilent\CPMS	2019-01-29 09:07:18	Semiconductor				
MSATEST32	Completed	Validation	ESI\Agilent\CPMS	2019-01-28 18:25:44	Semiconductor				
MSATEST32	In Analysis	Validation	ESI\Agilent\CPMS	2019-01-28 17:50:13	Semiconductor				
MSATEST32	In Analysis	Validation	ESI\Agilent\CPMS	2019-01-28 17:47:11	Semiconductor				
MSATEST32	Receiving	Validation	ESI\Agilent\CPMS	2019-01-28 17:37:20	Semiconductor				

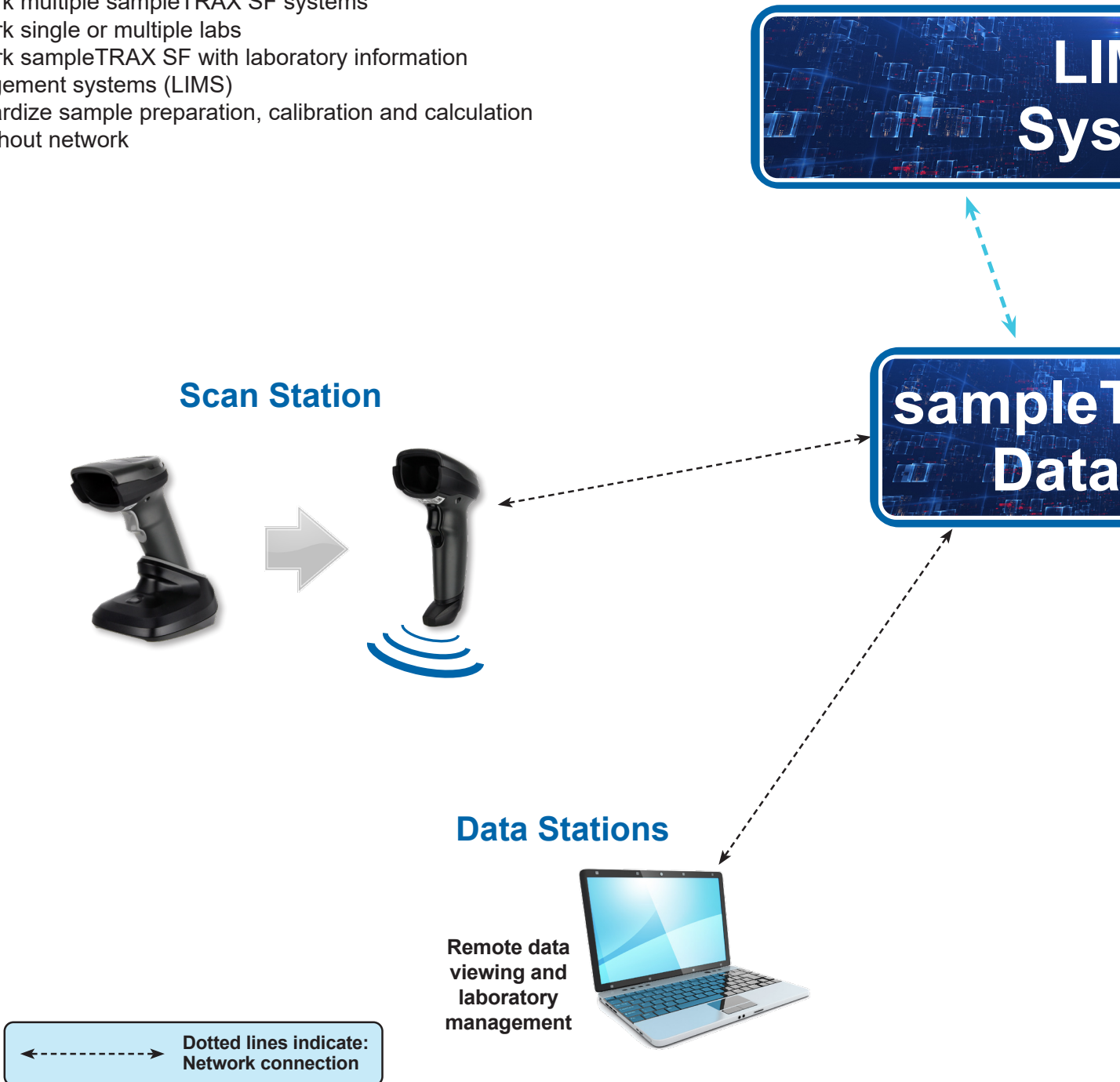
TraxId	SampleType	Device	DateTime	Standard	Na	Mg	N	K	Ti	V	Cr	Fe	Ni	Co
MSATEST32	Validation	2	1/28/2019 5:56:42 PM	std-0	0.184	0.001	0.002	0.004	0.002	0.001	0.056	0.002	0	0
MSATEST32	Validation	2	1/29/2019 9:13:03 AM	std-0	0.139	0.108	0.124	0.042	0.108	0.016	0.212	0.113	0.041	0.111

Close

# Flexible, Customizable sampleTRAX SF M

## Automate the whole lab by incorporating multiple scanning

- Network multiple sampleTRAX SF systems
- Network single or multiple labs
- Network sampleTRAX SF with laboratory information management systems (LIMS)
- Standardize sample preparation, calibration and calculation throughout network



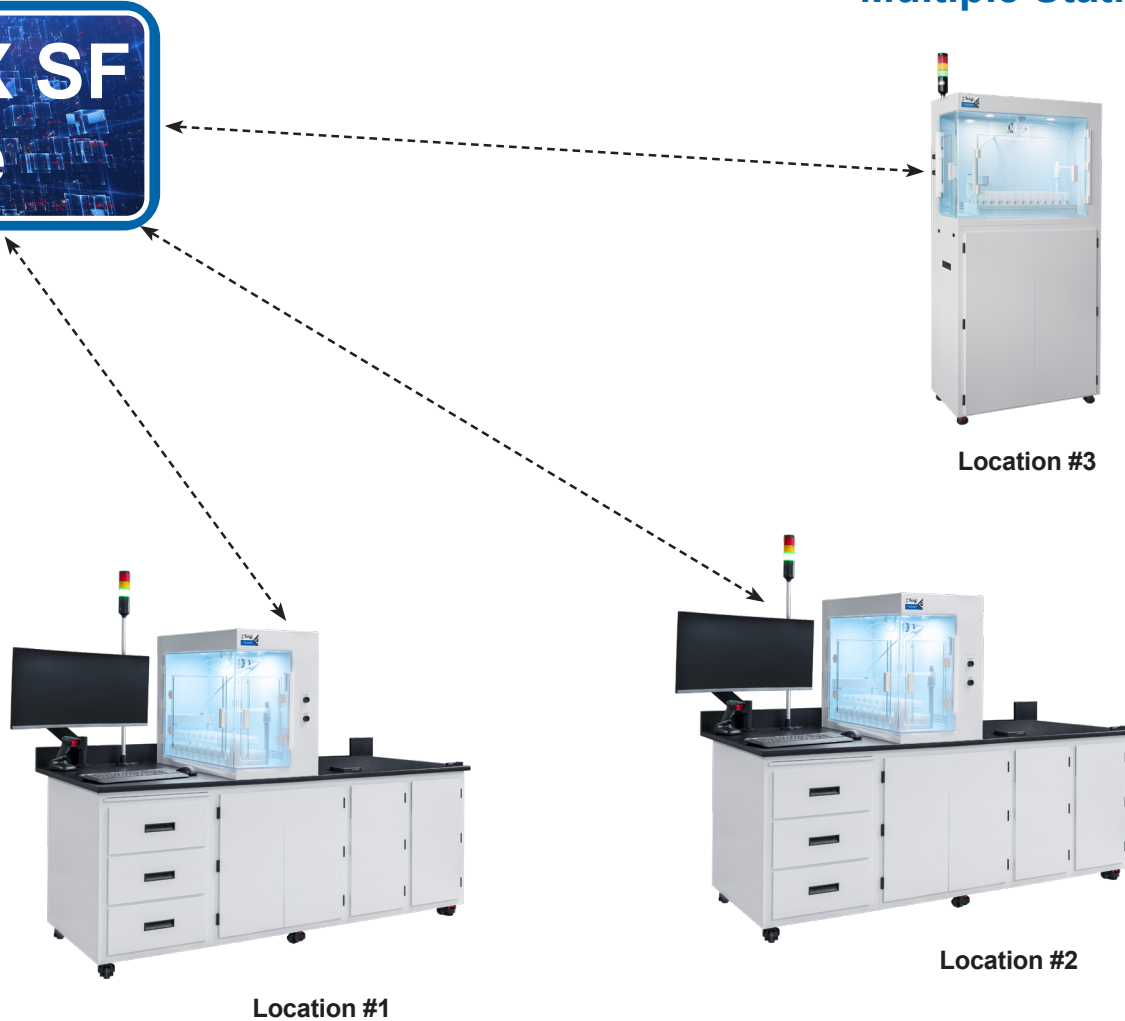


# Networking

## g and analytical stations



### Multiple Stations



# Full System at a Glance

## Features and Benefits

### Sample Identification

- Barcode scanning accesses information including:
  - Sample type
  - Sample information (Line, sampling point, name, etc.)
  - Method of standardization and analysis
  - QC protocol

### Ultra Pure

- Ultra-clean
- <1 ppt semiconductor metals
- Automated matrix matched MSA or external calibration
- Analytical stations for ICPMS instruments

### Laboratory Automation

- Bottle tracking
- Bottle history (cleaning, sample, chemical, analysis, concentration)
- Chemical grouping
- Chemical specific rinse function per chemical
- Customized network, bottle cycle

## How It Works

### sampleTRAX SF Analytical station automatically:

1. Scans bottles
2. Groups samples by chemical type
3. Analyzes grouped chemicals in a user-defined order
4. Performs wash method specific to each chemical type after each group is analyzed
5. Generates and reports data

**Examples of Semiconductor Chemicals  
Analyzed at the ppt Level with sampleTRAX SF**

Acids	Bases	Organics	Chemical Mixes
98% H <sub>2</sub> SO <sub>4</sub>	22% NH <sub>4</sub> OH	IPA	SC-1
89% H <sub>3</sub> PO <sub>4</sub>	2.38% TMAH	PGMEA/PGME	SC-2
70% HNO <sub>3</sub>	25% TMAH	Photoresist	BOE
49% HF	KOH	NMP	DSP
35% HCl		Butyl Acetate	
30% H <sub>2</sub> O <sub>2</sub>		Cyclohexanone	
SPM			
FPM			
DHF			
Etchant			
Others			

All semiconductor pure chemicals can be analyzed using sampleTRAX SF. This table contains only a partial list of common chemicals.

# Racks and Vials

## Barcoded Bottles and Vials for Fluorocapper

sampleTRAX SF Automatic Bottle Opening System with Fluorometric Sampling

sampleTRAX dual-axis Fluorocapper system

Compatible with 60 mL vials, 100 mL bottles and 250 mL bottles



Shown with Locking Rack TRX-LR-60-60



TXV3-250  
250 mL bottle



TXV3-100  
100 mL vial



TXV3-60  
60 mL vial

### Locking Racks

Vial/Bottle P/N	Volume	OD	Position	Locking Rack P/N
TXV3-60	60 mL	30 mm	60	TRX-LR-60-60
TXV3-100	100 mL	48 mm	27	TRX-LR-27-100
TXV3-250	250 mL	62 mm	27	TRX-LR-27-250



**Elemental Scientific**

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

© Elemental Scientific | +1 402-991-7800 | [sales@icpms.com](mailto:sales@icpms.com) | 7277 World Communications Drive | Omaha, NE 68122

B-20240-5

