



Elemental Scientific

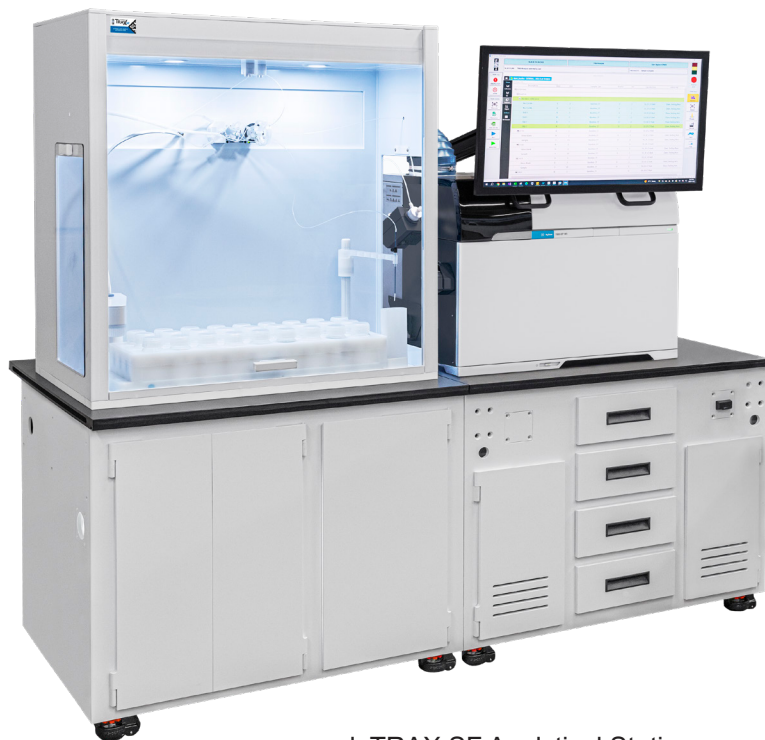
SampleTRAX SF

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



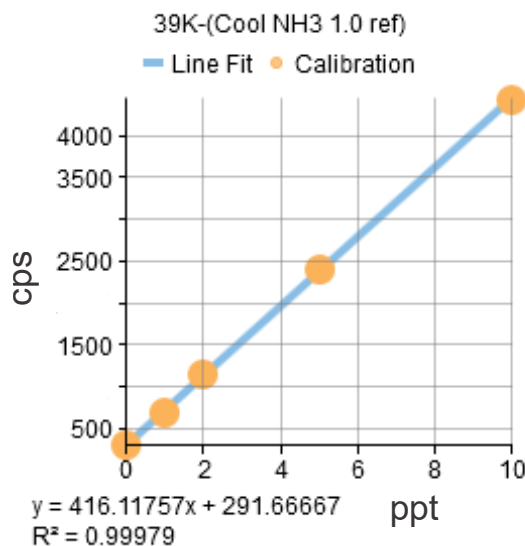
An integrated barcode reader scans the bottom of a PFA bottle to identify sample information before analysis.

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

☐	H2O2
☒	NH4OH
☐	DSP
☐	LAL
☐	DHF
☐	SC1
☐	IPA
☐	H2SO4
☐	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

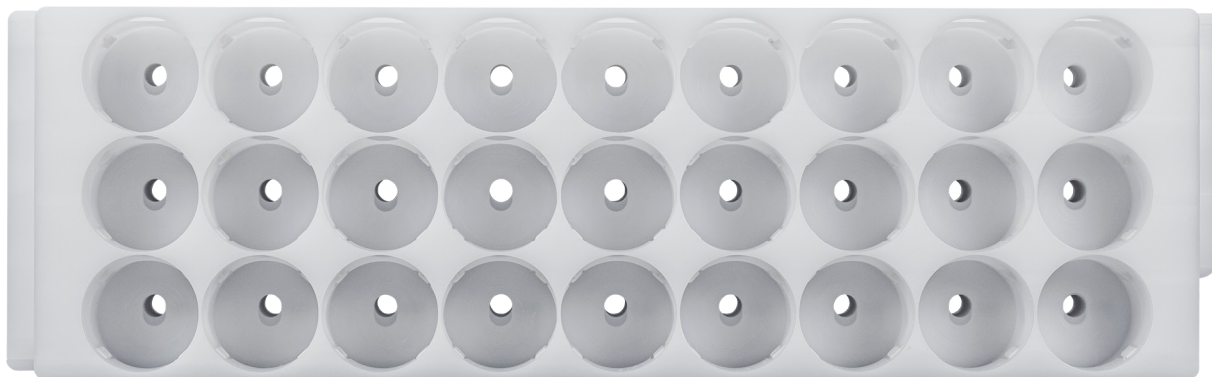
Automated capping and recapping of bottles and vials

- 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



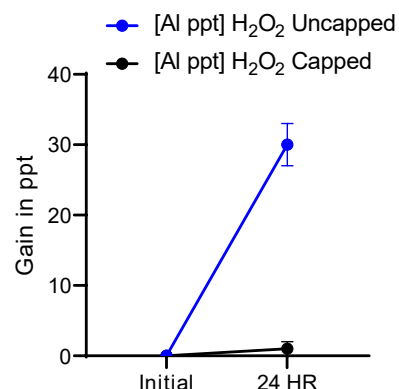
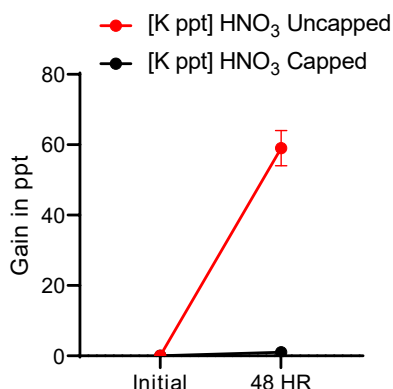
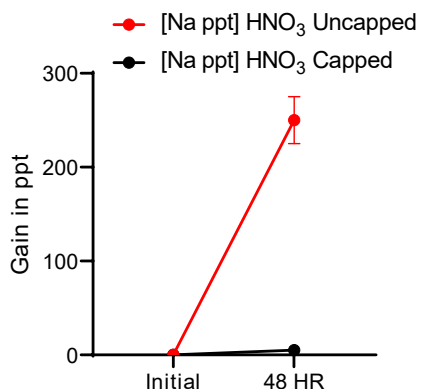
Fluorocapper racks for 100 mL and 250 mL bottles or 60 mL vials

- 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

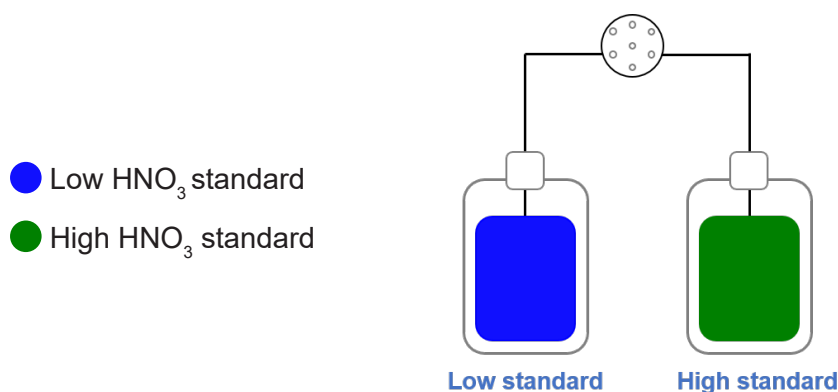


Multi-standard Selector

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

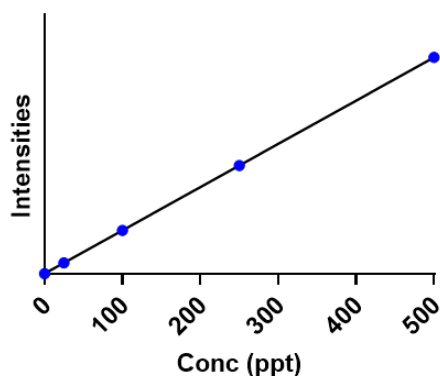


● Cal group 1

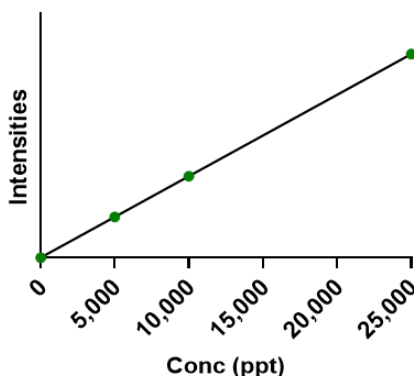
● Cal group 2

● Cal group 3

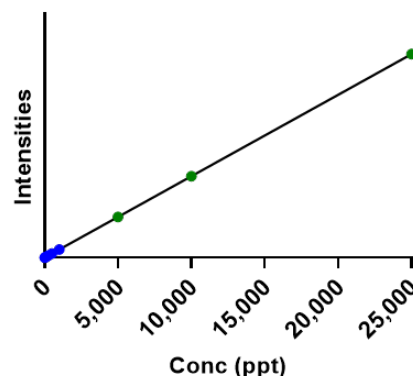
(combines groups 1 and 2)



Low HNO₃ standard



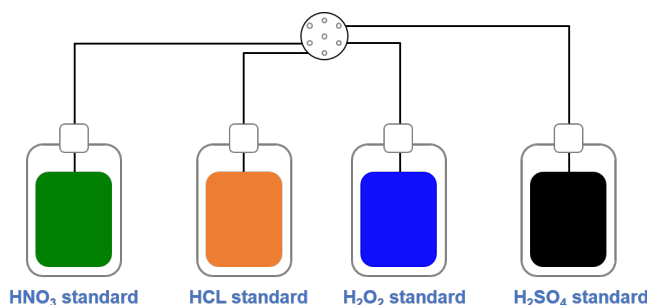
High HNO₃ standard



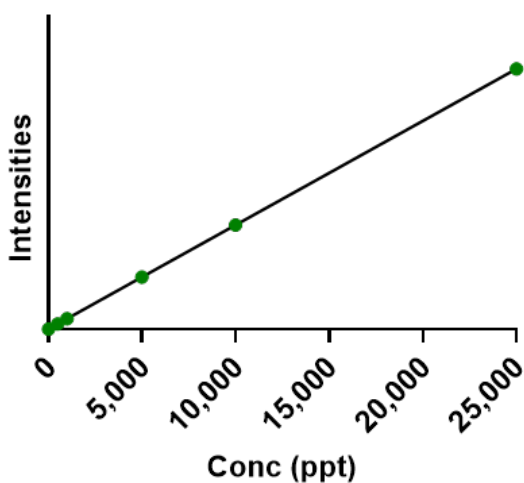
Low and high HNO₃ standard

Up to 4 Different Calibration Standards Consecutively

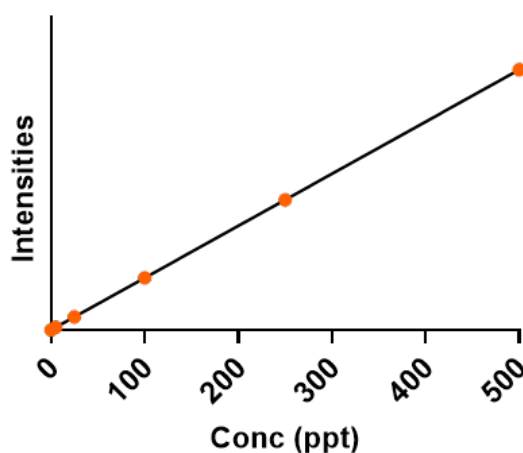
- HNO_3 matrix standard
- HCL matrix standard
- H_2O_2 matrix standard
- H_2SO_4 matrix standard



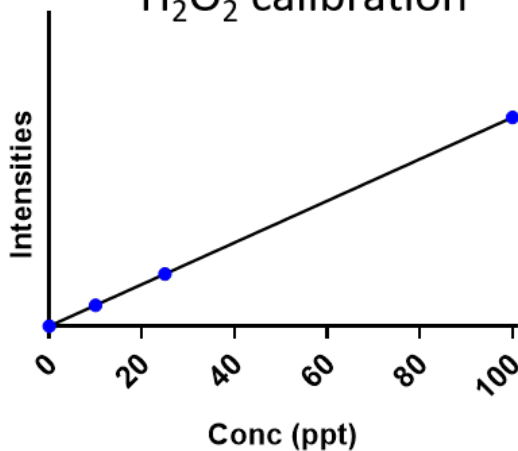
HNO_3 calibration



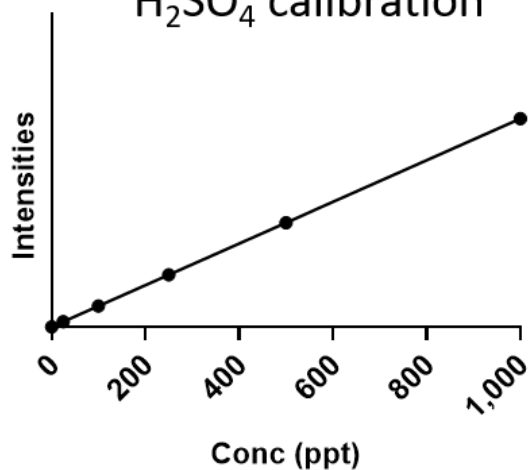
HCL calibration



H_2O_2 calibration



H_2SO_4 calibration



sampleTRAX SF Analytical Station

Status Indicator Light

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

ULPAClean 10 Filter *(Optional)*

Removes 99.9995% of airborne particles
from enclosure (0.1 μm or larger)

Ultra-clean Enclosure Exhausted with Air Shower

With exhaust vents and
inert-gas air shower

sampleTRAX SF Autosampler

With barcode scanning and
PFA probe and Fluoronetics rail

Fluorocapper

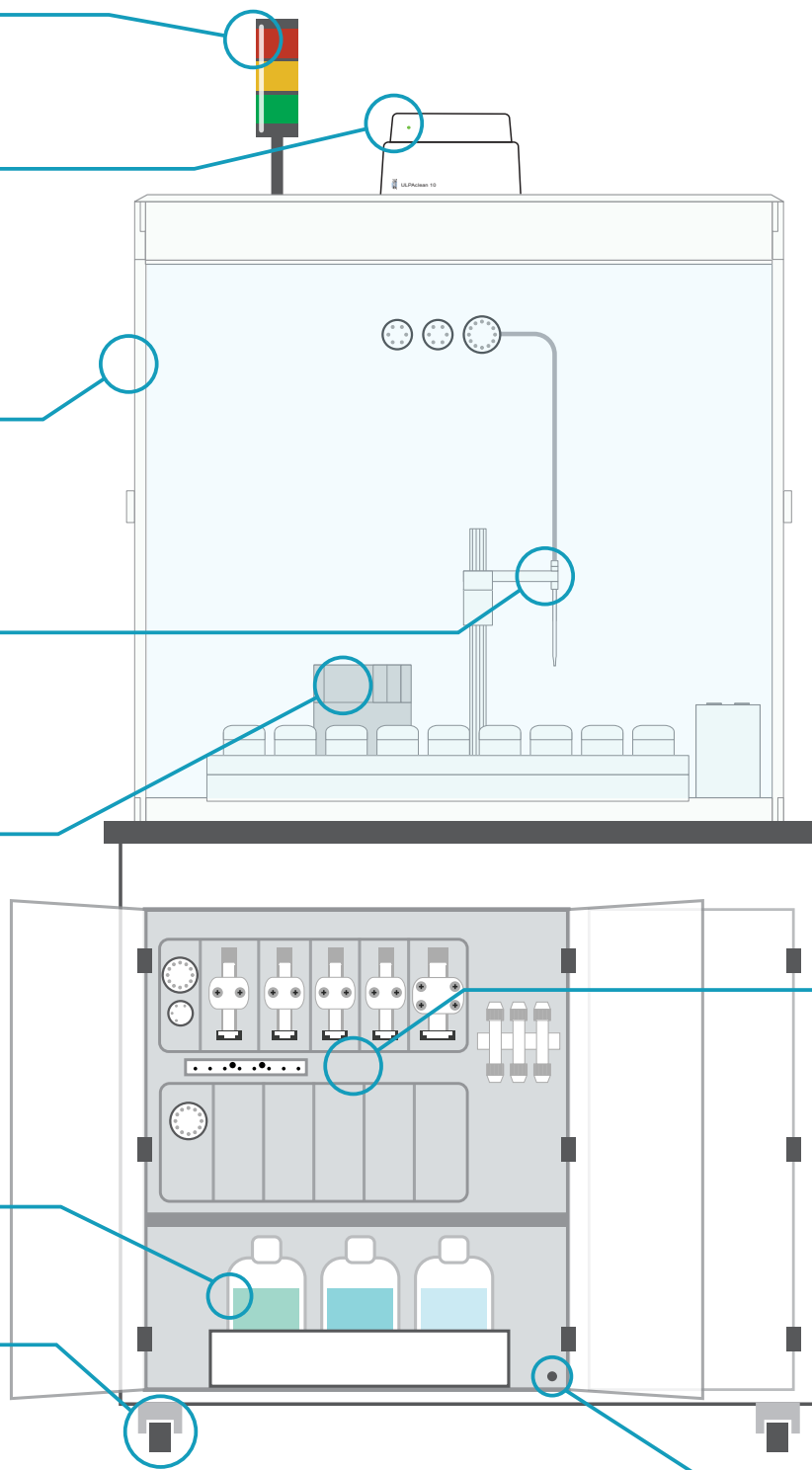
Automatic bottle uncapping
for optimal results

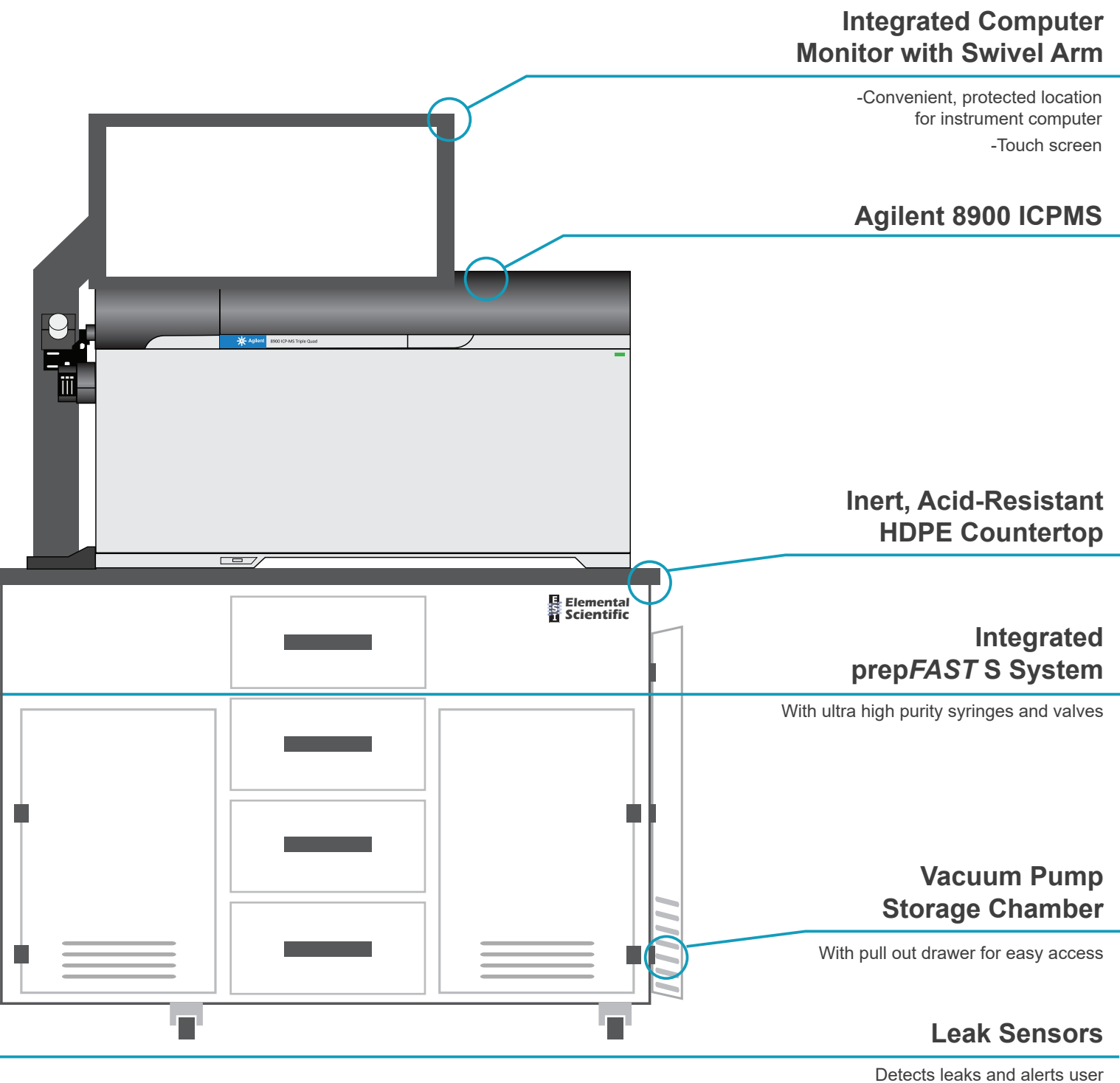
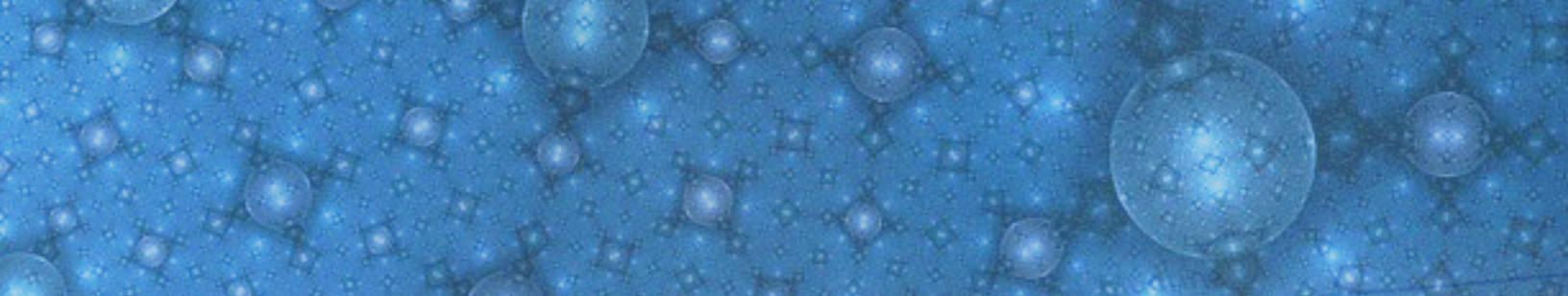
High Purity PFA Reservoirs

With integrated level sensors

Wheels

Allows for flexible positioning



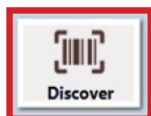


Automated Grouping and Wash

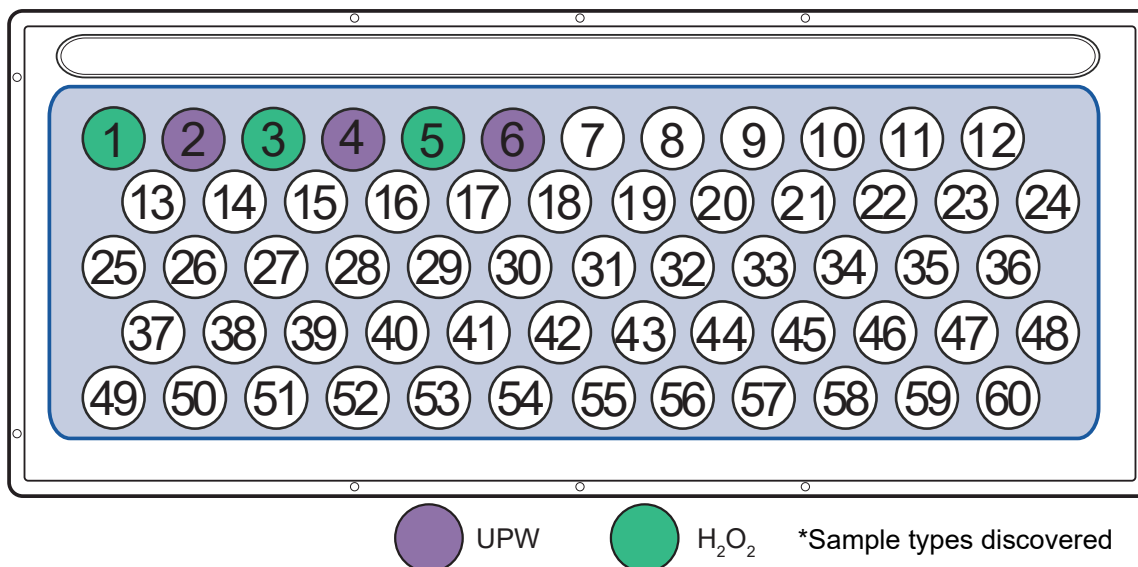
sampleTRAX SF Analytical Station simplifies and performs the most demanding sample analysis in 3 easy steps.

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.

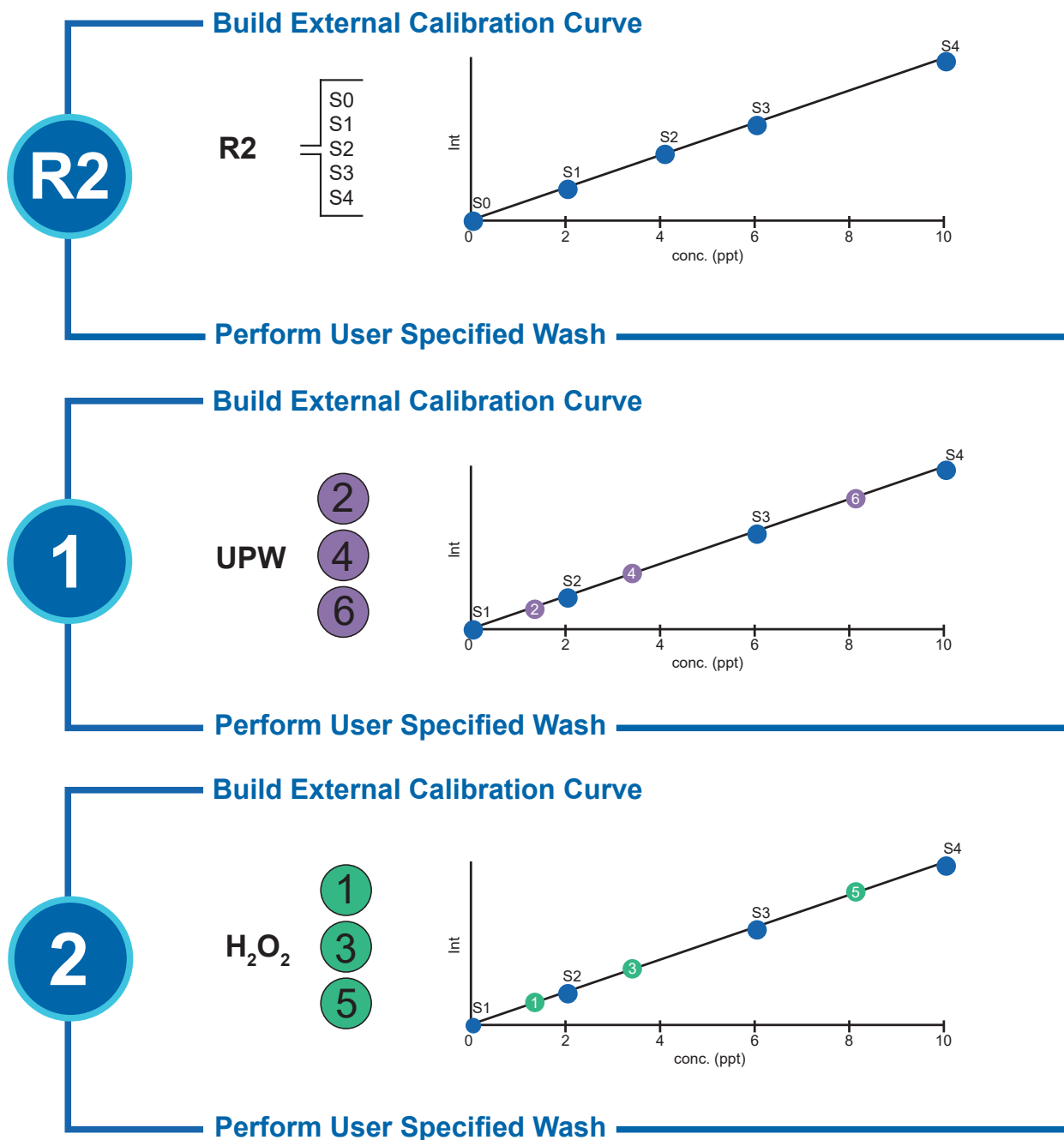
Sample Group Analysis Order	
UPW - Group 1	H ₂ O ₂ - Group 2
2	1
4	3
6	5

External Cal Sequence

2a) Select Desired Sequence Type

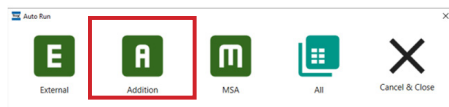


Build External calibration curves according to protocol for each sample and perform chemical specific washes after each sample type.

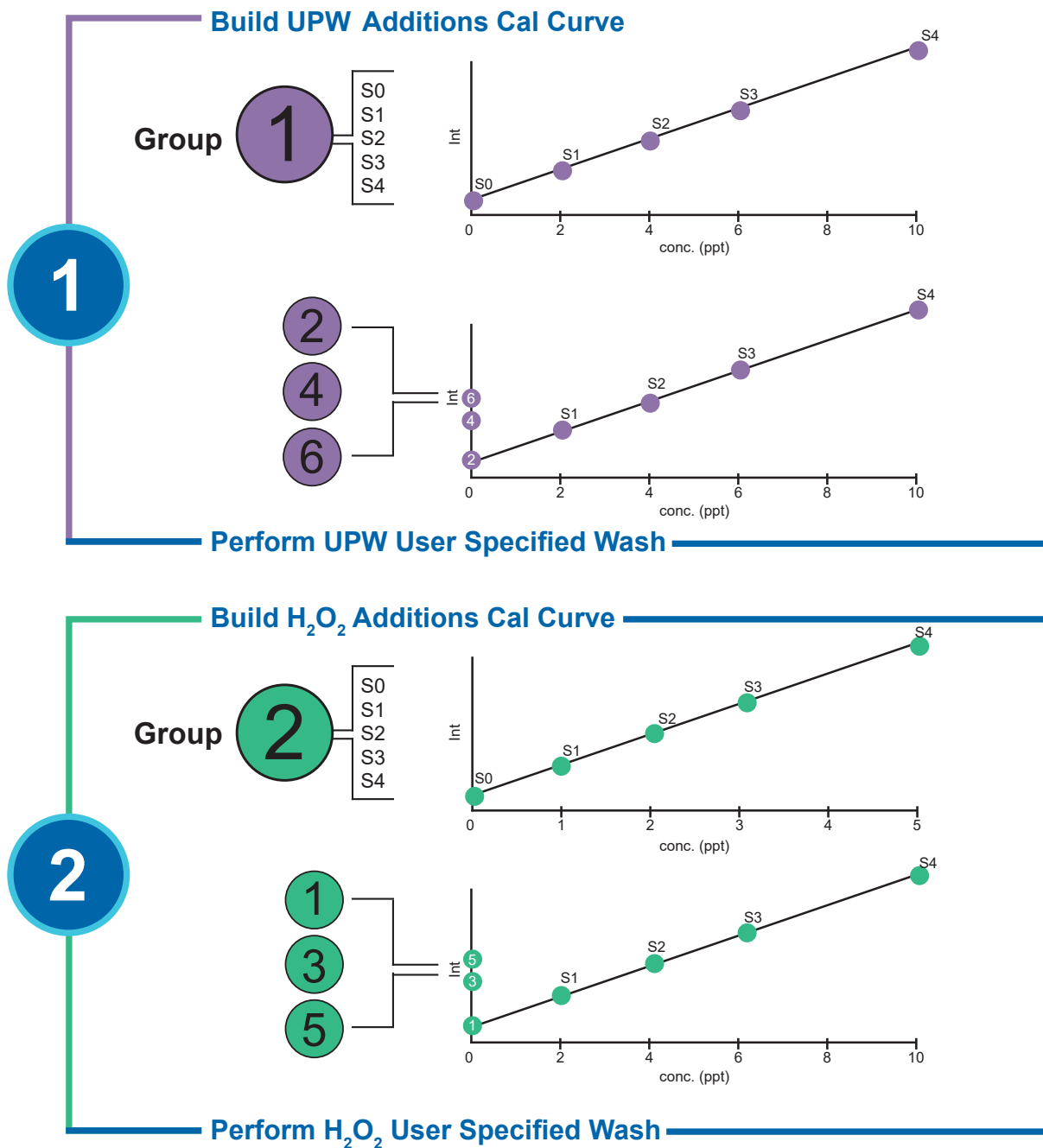


Addition Cal Sequence

2b) Select Desired Sequence



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

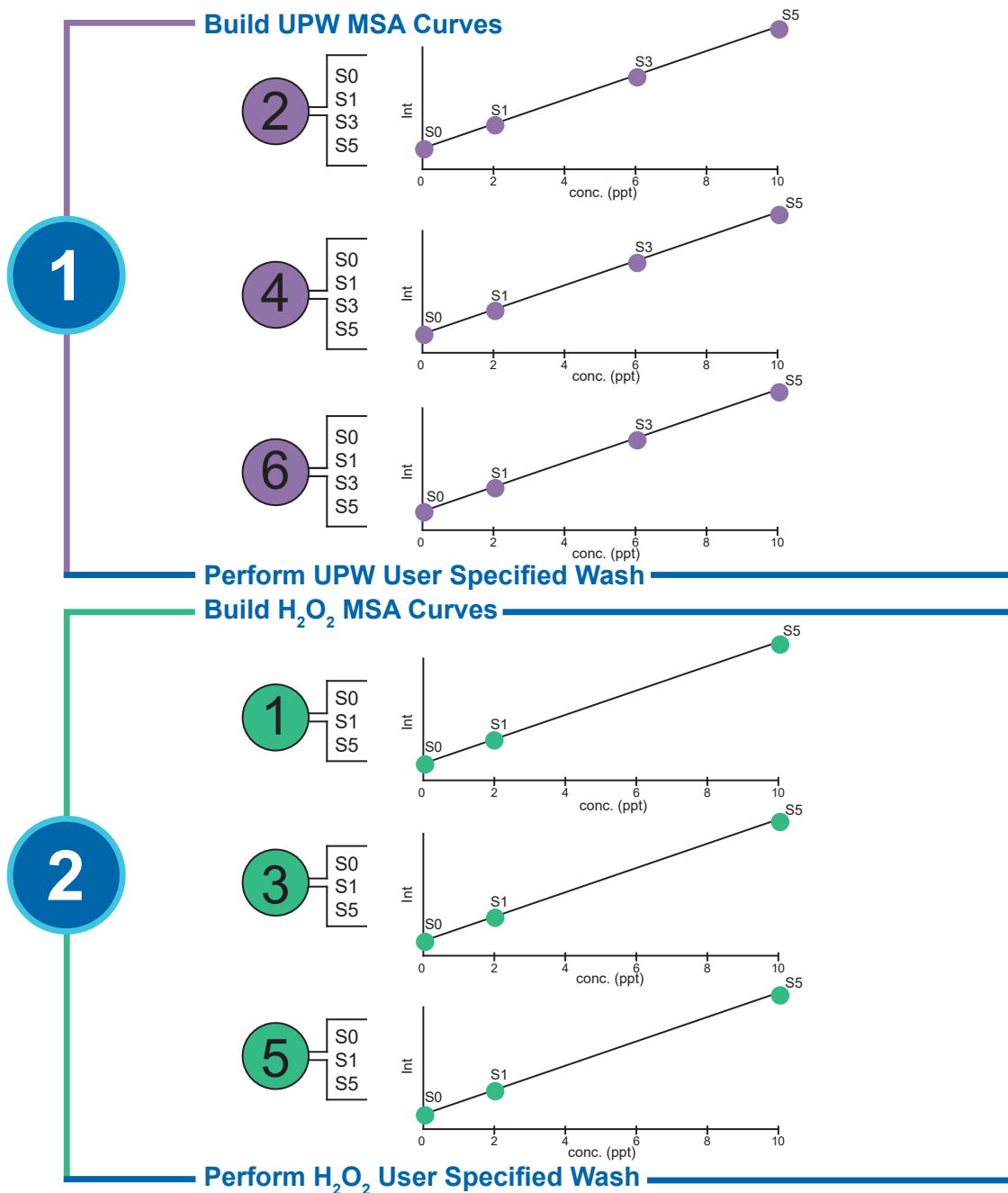


MSA Sequence

2c) Select Desired Sequence



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



Run Samples

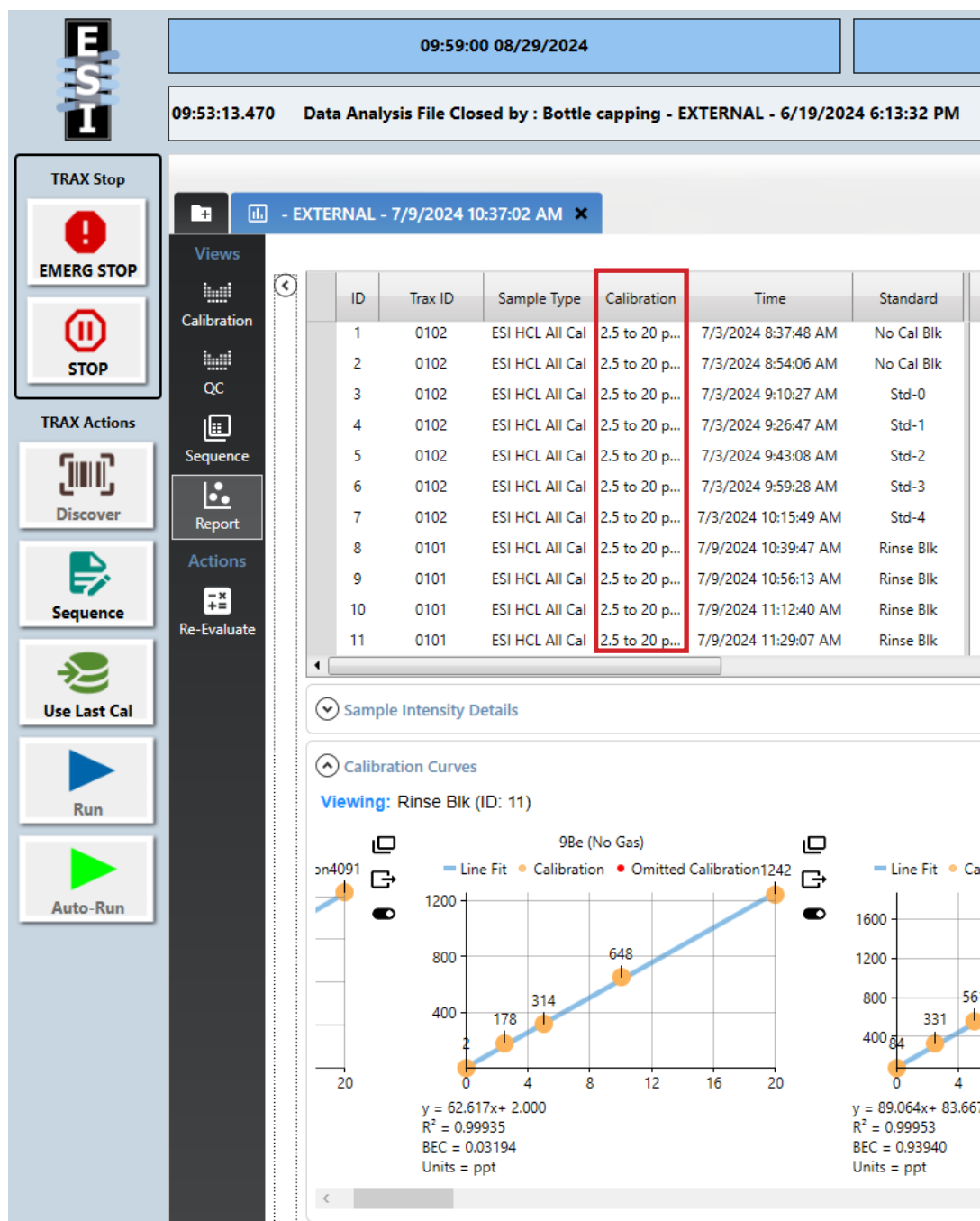
3) Run samples, acquire data and calculate results for rep

sampleTRAX SF automatically prepares desired calibration curve and samples for analysis

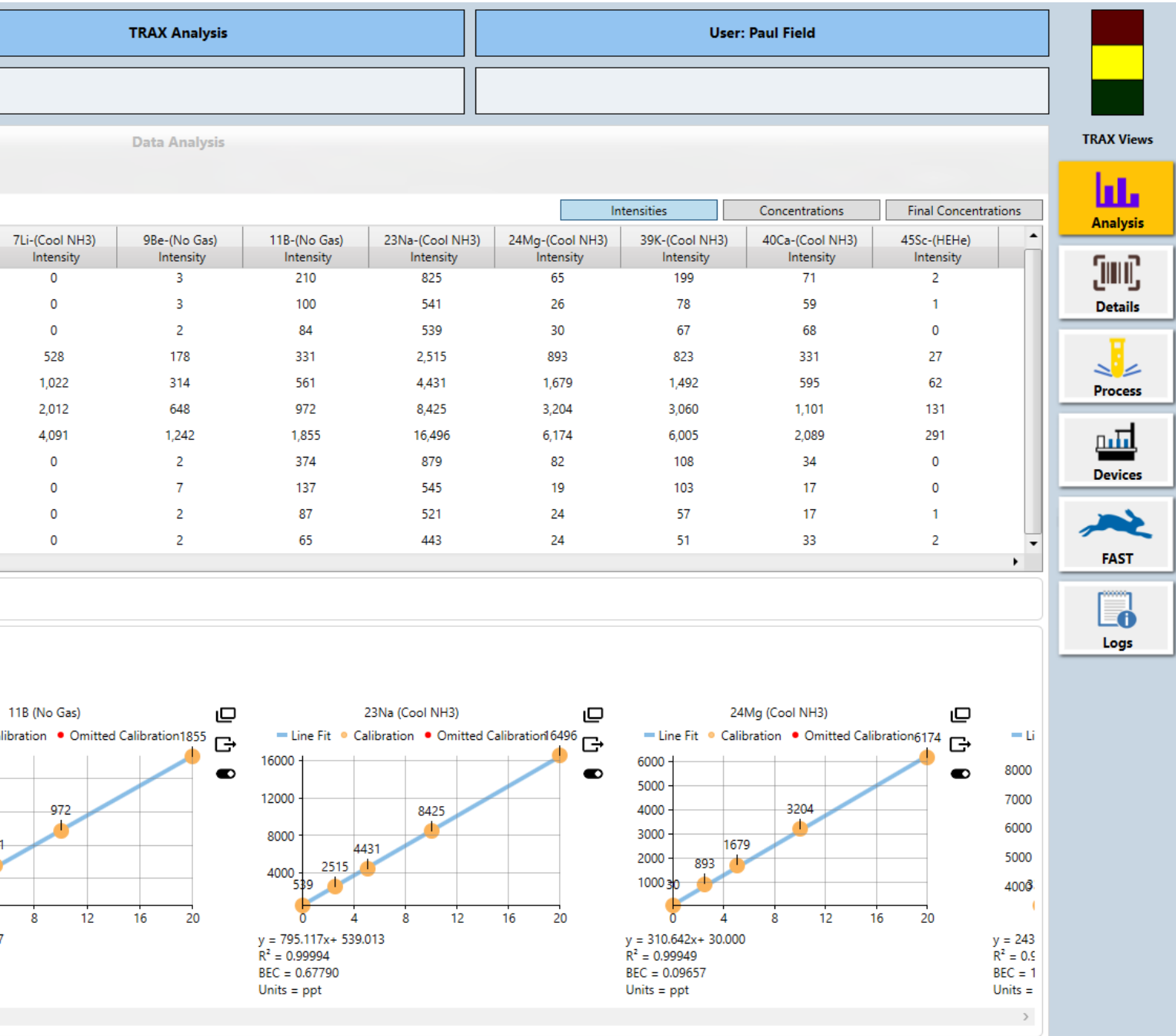
As each chemical is prepared and injected, sampleTRAX SF triggers the ICPMS to acquire data and imports raw intensities.

Raw intensities are:

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



Porting to sampleTRAX SF database



TRAX Views



Analysis



Details



Process



Devices



FAST



Logs

sampleTRAX SF (Touch Screen)

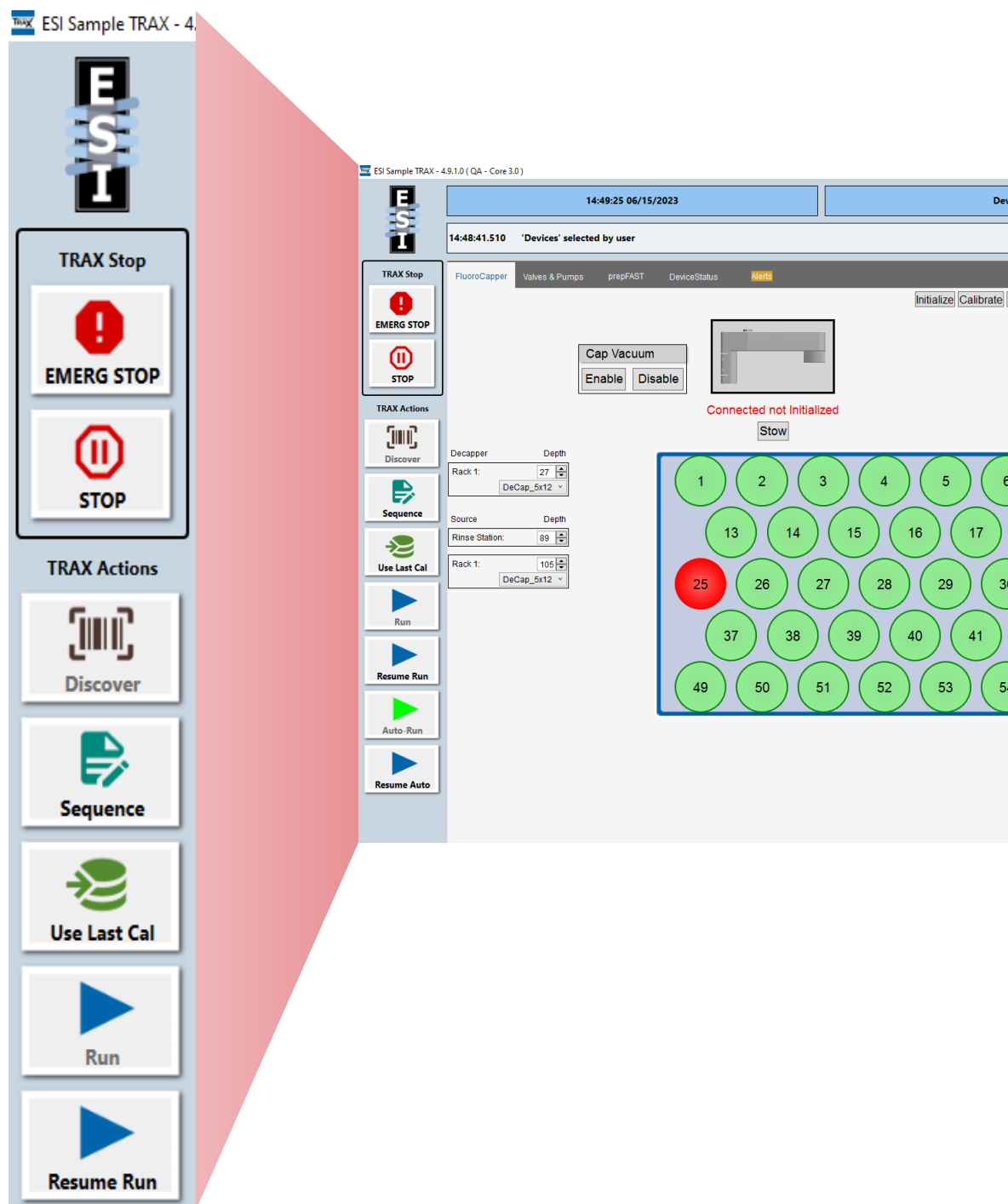
TRAX Actions

Multiple stop options
to cease operation of
sampleTRAX SF

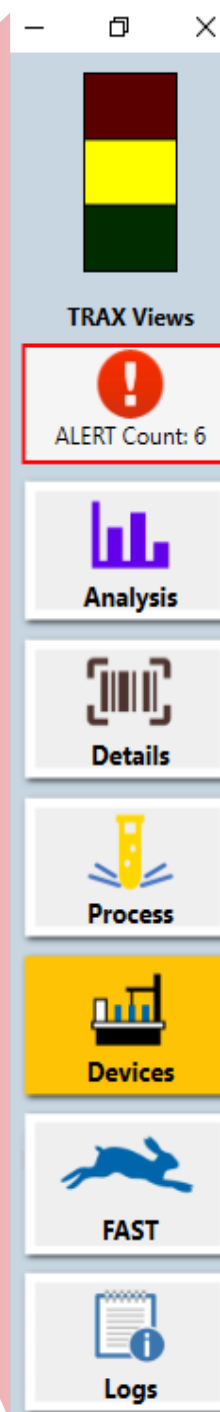
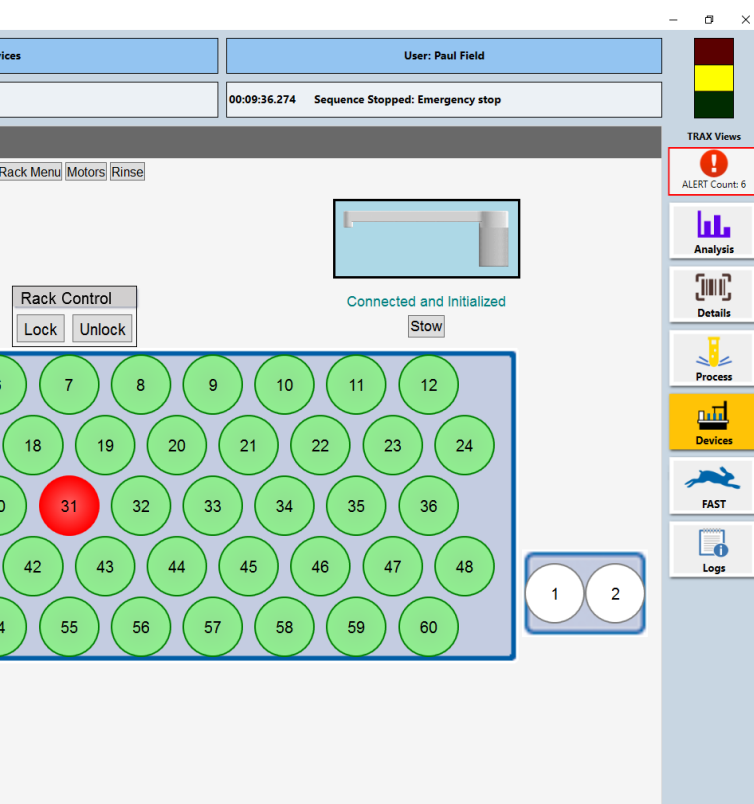
Barcode scan bottles on the
deck to observe in Discover
View & Sequence for analysis

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

Use previously
generated Calibrations
for a Sample Type



TRAX Views



Data report, sample sequence, re-evaluate

Displays samples discovered on-deck

Run unbarcoded samples

Fluorocapper & device status, valves/syringes

FAST method status, method running

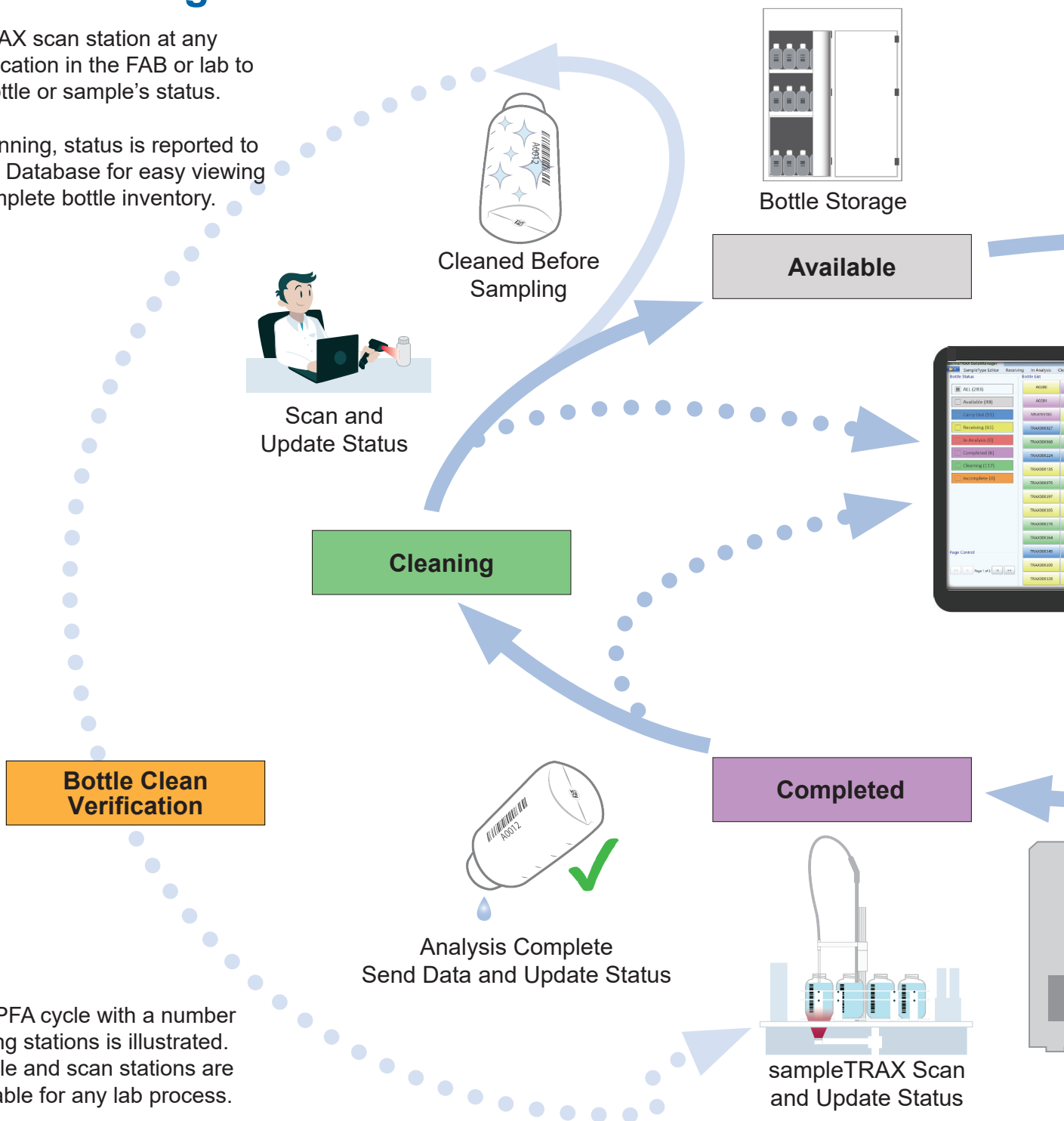
Autosampler communication and alerts logs

Tracking a Typical Bottle Cycle

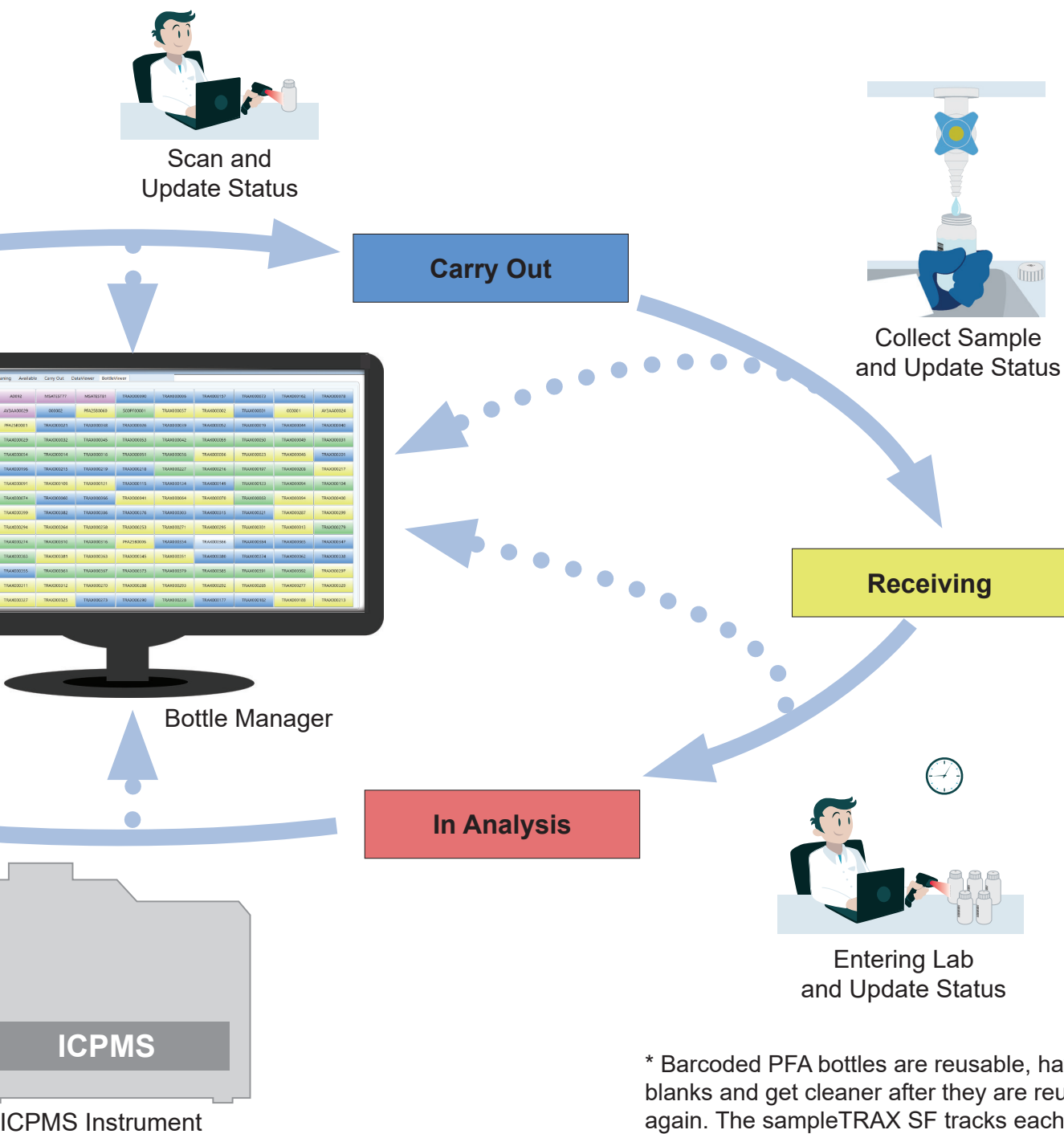
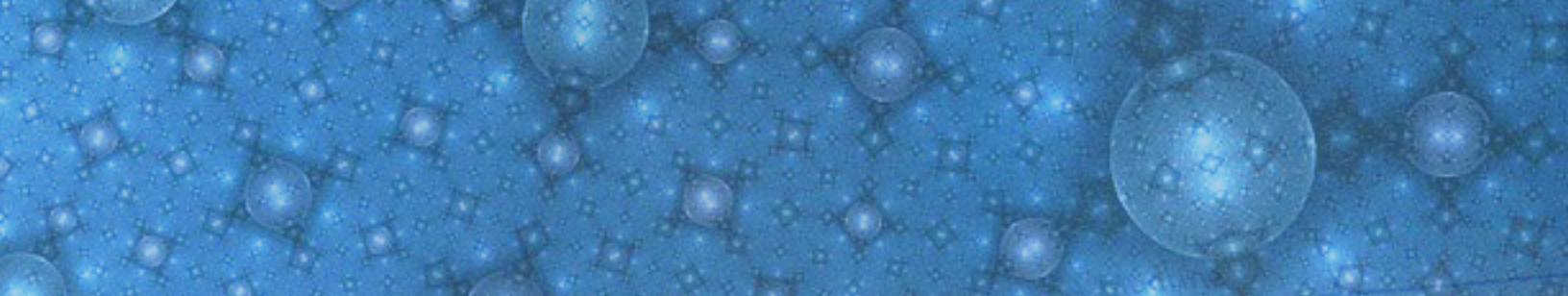
Bottle Tracking

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.



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



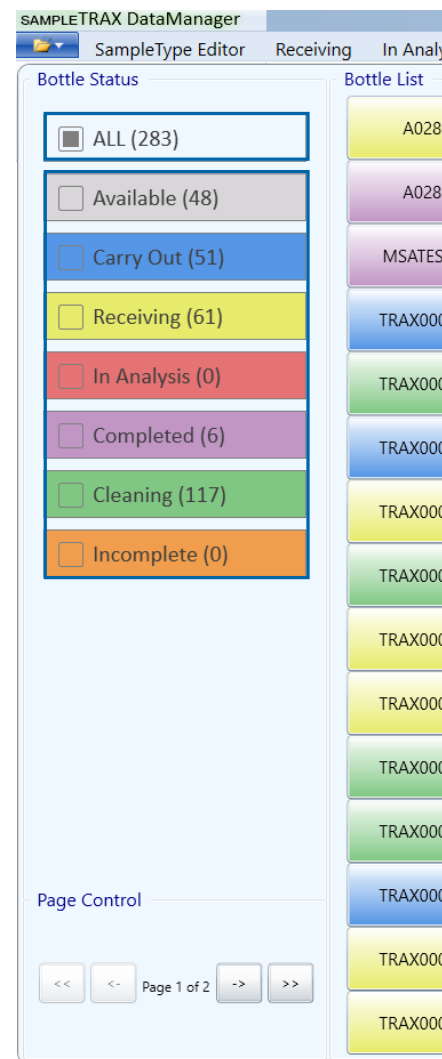
250 mL bottle



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	A0092	MSATEST32	MSATEST81	TRAX000090	TRAX000006	TRAX000157	TRAX000073	TRAX000162	TRAX000078
1	AY3AA00029	000002	PFA25B0060	500PF00001	TRAX000057	TRAX000002	TRAX000001	000001	AY3AA00024
T83	PFA25B0001	TRAX000021	TRAX000038	TRAX000026	TRAX000039	TRAX000052	TRAX000019	TRAX000044	TRAX000040
0027	TRAX000029	TRAX000032	TRAX000045	TRAX000053	TRAX000042	TRAX000059	TRAX000050	TRAX000049	TRAX000031
0068	TRAX000054	TRAX000014	TRAX000016	TRAX000051	TRAX000056	TRAX000036	TRAX000023	TRAX000046	TRAX000201
0224	TRAX000196	TRAX000215	TRAX000219	TRAX000218	TRAX000227	TRAX000216	TRAX000197	TRAX000208	TRAX000217
0135	TRAX000091	TRAX000109	TRAX000121	TRAX000115	TRAX000134	TRAX000149	TRAX000123	TRAX000094	TRAX000104
0076	TRAX000074	TRAX000060	TRAX000066	TRAX000041	TRAX000064	TRAX000070	TRAX000063	TRAX000394	TRAX000400
0397	TRAX000399	TRAX000382	TRAX000386	TRAX000376	TRAX000303	TRAX000315	TRAX000321	TRAX000287	TRAX000299
0305	TRAX000294	TRAX000264	TRAX000258	TRAX000253	TRAX000271	TRAX000295	TRAX000301	TRAX000313	TRAX000279
0278	TRAX000274	TRAX000310	TRAX000316	PFA25B0006	TRAX000354	TRAX000366	TRAX000384	TRAX000365	TRAX000347
0364	TRAX000383	TRAX000381	TRAX000363	TRAX000345	TRAX000351	TRAX000380	TRAX000374	TRAX000362	TRAX000338
0349	TRAX000355	TRAX000361	TRAX000367	TRAX000373	TRAX000379	TRAX000385	TRAX000391	TRAX000392	TRAX000297
0309	TRAX000311	TRAX000312	TRAX000270	TRAX000288	TRAX000293	TRAX000292	TRAX000285	TRAX000277	TRAX000329
0328	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				

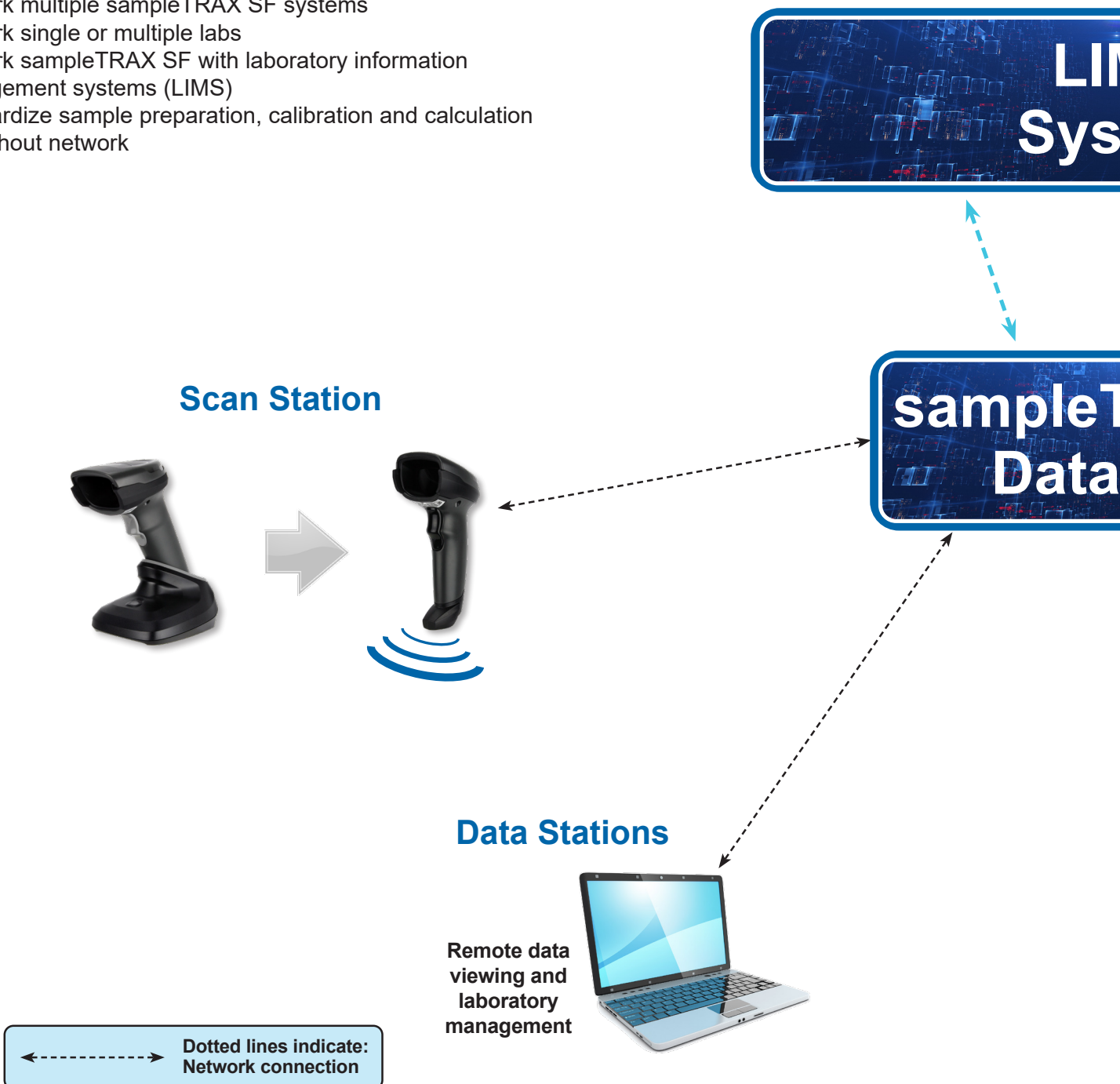
Traxid	SampleType	Device	DateTime	Standard	Na	Mg	N	K	Ti	V	Cr	Fe	Ni	Co
MSATEST32	Validation	2	1/28/2019 5:56:42 PM	std-0	0.184	0.001	0.002	0.004	0.002	0.001	0.056	0.002	0	0
MSATEST32	Validation	2	1/29/2019 9:13:03 AM	std-0	0.139	0.108	0.124	0.042	0.108	0.016	0.212	0.113	0.041	0.111

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

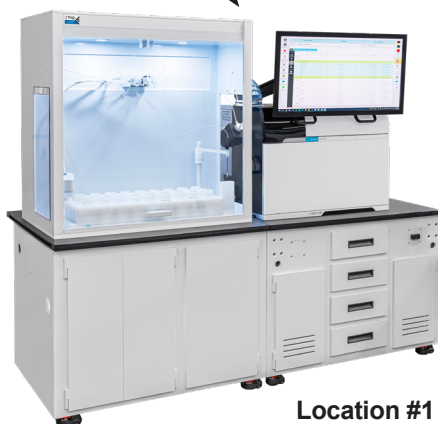


TRAX SF
base

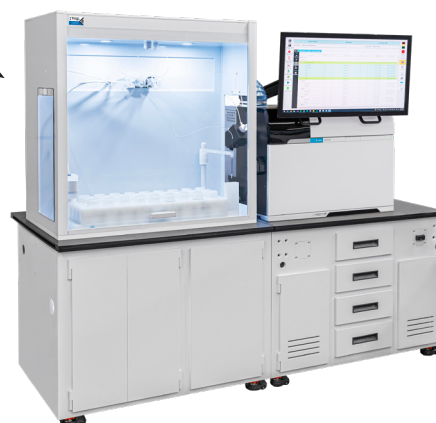
Multiple Stations



Location #3



Location #1



Location #2

Full System at a Glance

Features and Benefits

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- Automated matrix matched MSA or external calibration
- Analytical stations for ICPMS instruments

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

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

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