



**ThermoFisher**  
SCIENTIFIC

## Enhanced sensitivity in GC-MS/MS technology

**Thermo Scientific TSQ 9000 Triple Quadrupole GC-MS/MS System, Unstoppable Routine Analysis**

PO10610

The world leader in serving science

# Pressures on routine laboratories

- Lower detection requirements and varying sample types
- Deliver more results in less time, without compromising quality
- Remove complexity, for maximum analyst productivity
- Meet today's requirements, while being ready for tomorrow

## Requirements

- Highly sensitive and selective GC-MS/MS
- Highest uptime and stripping out cost of result production
- Ease of use, from method development to routine analysis
- Ability to scale their technology with their needs

# TSQ 9000 triple quadrupole GC-MS/MS system

Ultimate **sensitivity** with Advanced Electron Ionization source

Incredible **uptime** with inherent robustness and NeverVent™ technology

Routine **ease of use** from method development to daily operation

True **scalability** for growing laboratory requirements

# UNSTOPPABLE



# *Reaching into the attogram range*

**UNSTOPPABLE**

ag  
10<sup>-18</sup>

Introducing Advanced Electron Ionization (AEI) source

# Inheriting from the Thermo Scientific™ ExtractaBrite™ ion source

- Highly inert material
- Independent dual heater
- Proprietary RF lenses
- Dual filament design

## Adding innovative design for superior sensitivity and robustness

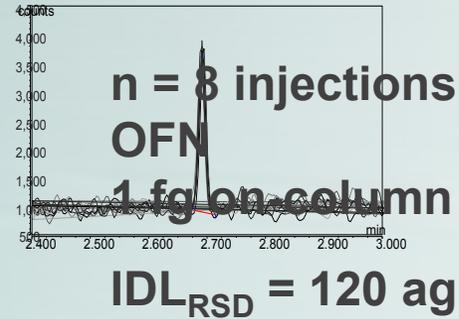
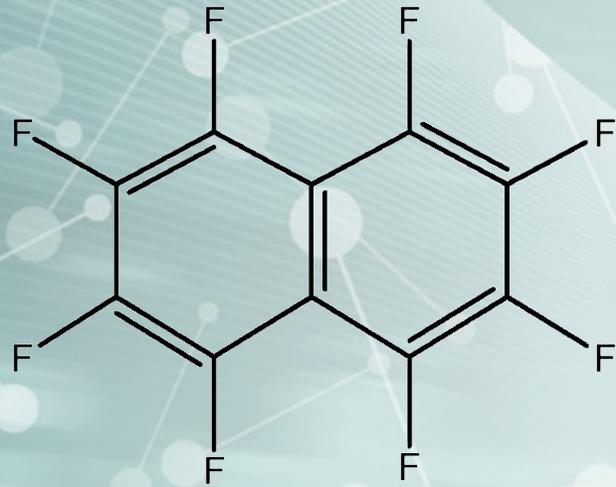
- Highly efficient ionization
- Tightly focused ion beam
- Detection into the attogram range



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10<sup>-18</sup>

# AEI Sensitivity Octafluoronaphthalene (OFN)

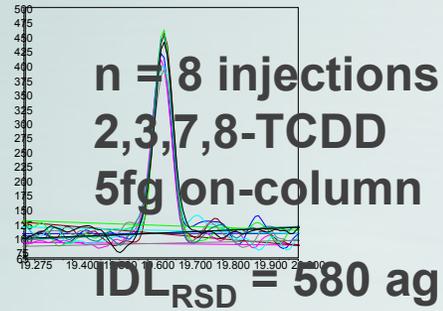
IDL performance of the Thermo Scientific™ TSQ™ 9000 (AEI) GC/MS-MS system for OFN using repeated injections of 1 fg on-column



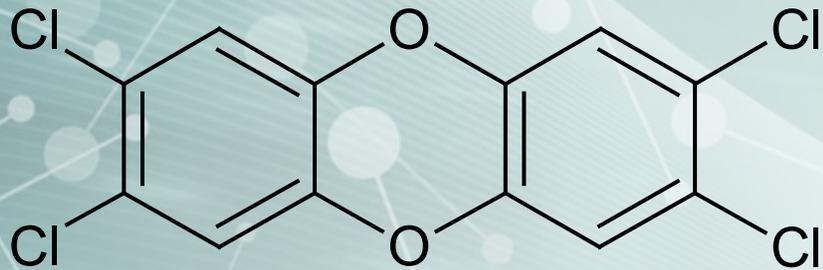
\*IDL <0.4 fg verified at installation under pre-defined conditions

# AEI Sensitivity 2,3,7,8-Tetrachlorodibenzo-p-dioxin

**IDL performance of the TSQ 9000  
(AEI) system for 2,3,7,8-TCDD using  
repeated injections of 5 fg on-column**



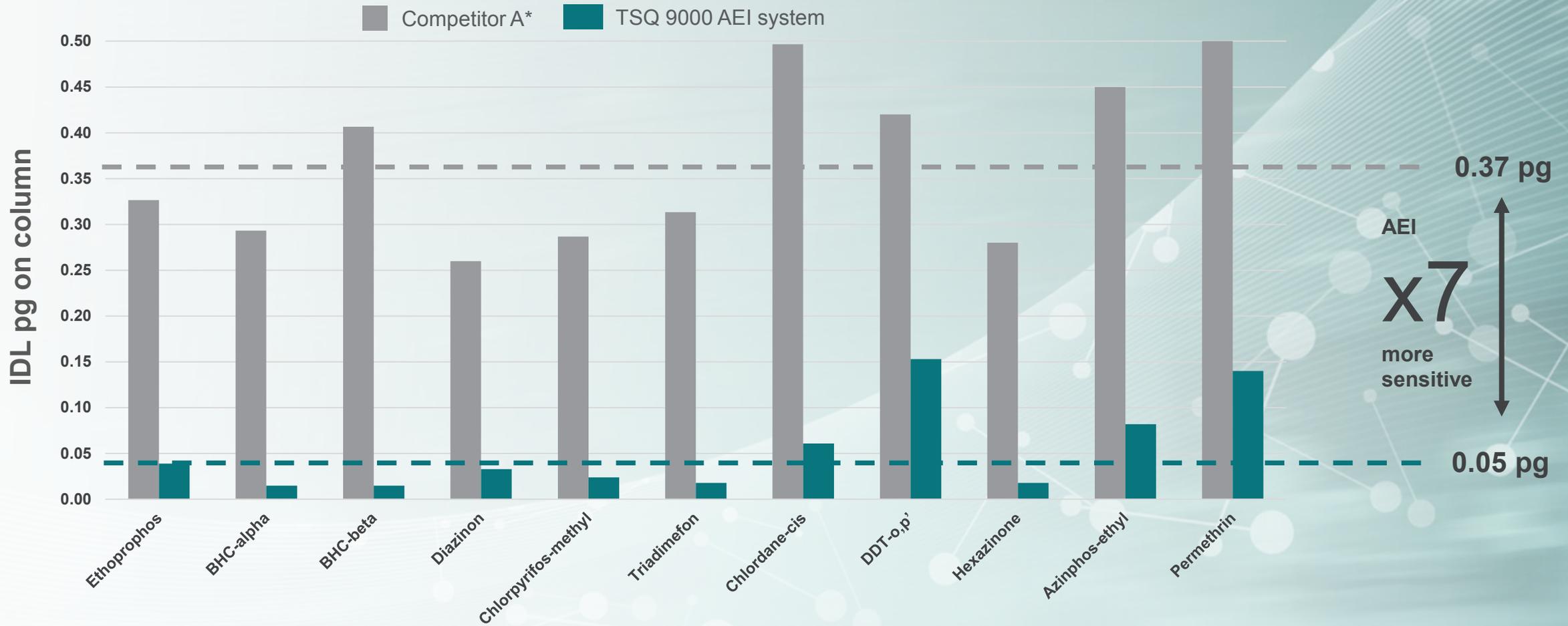
2378-TCDD



\*IDL is a demonstration of maximum performance calculated using only a single compound and not taking into account full confirmatory method criteria for regulated dioxin analysis

# Comparing AEI for pesticides

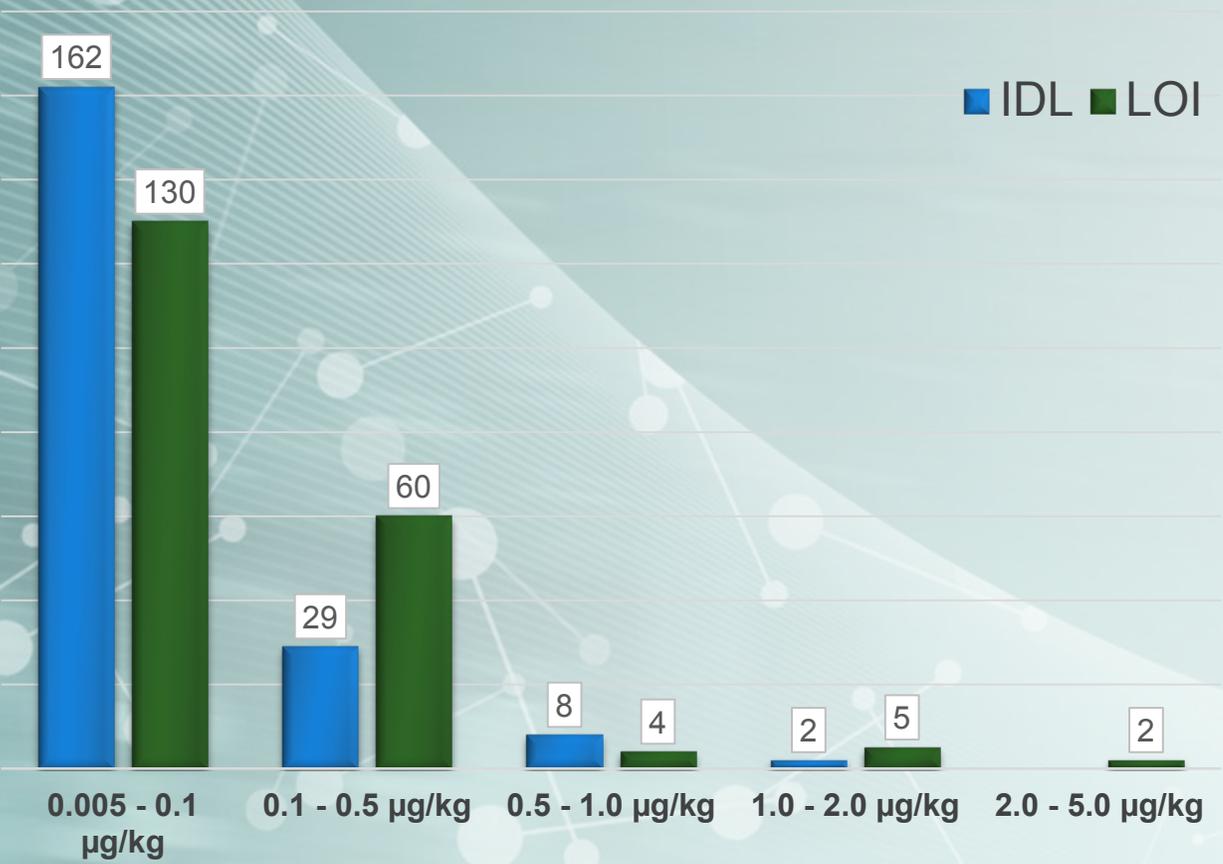
## Instrument detection limit (IDL) for QuEChERS food extracts



\*Competitor A published IDL data averaged from different food matrices

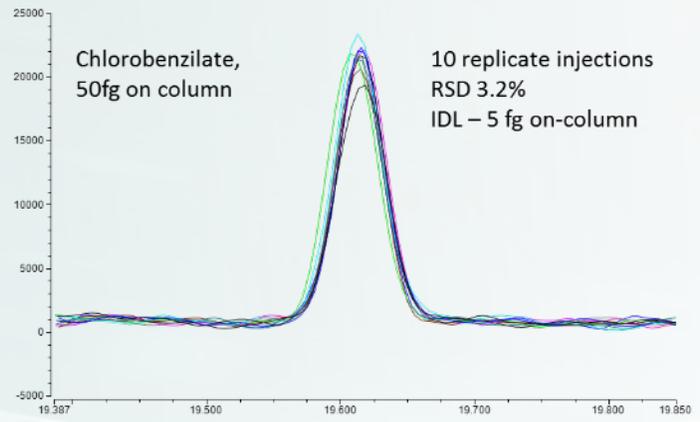
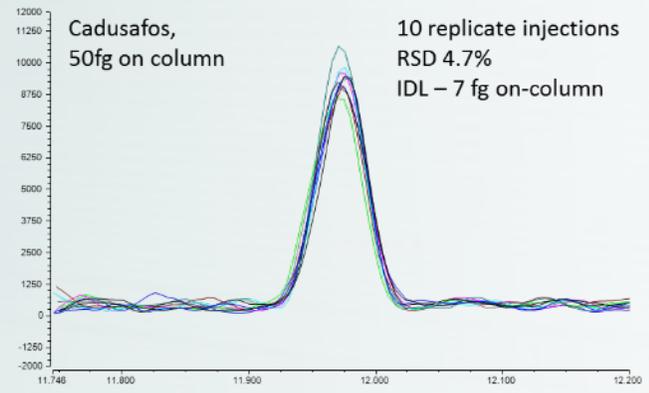
# AEI Pesticides in baby food - Limit of detection and identification

Number of compounds satisfying SANTE requirements  
(211 pesticides studied)



>60% identified <0.1 µg/kg – 100 x lower than default maximum residue limit (MRL)

>90% identified <0.5 µg/kg – 20 x lower than default maximum residue limit (MRL)

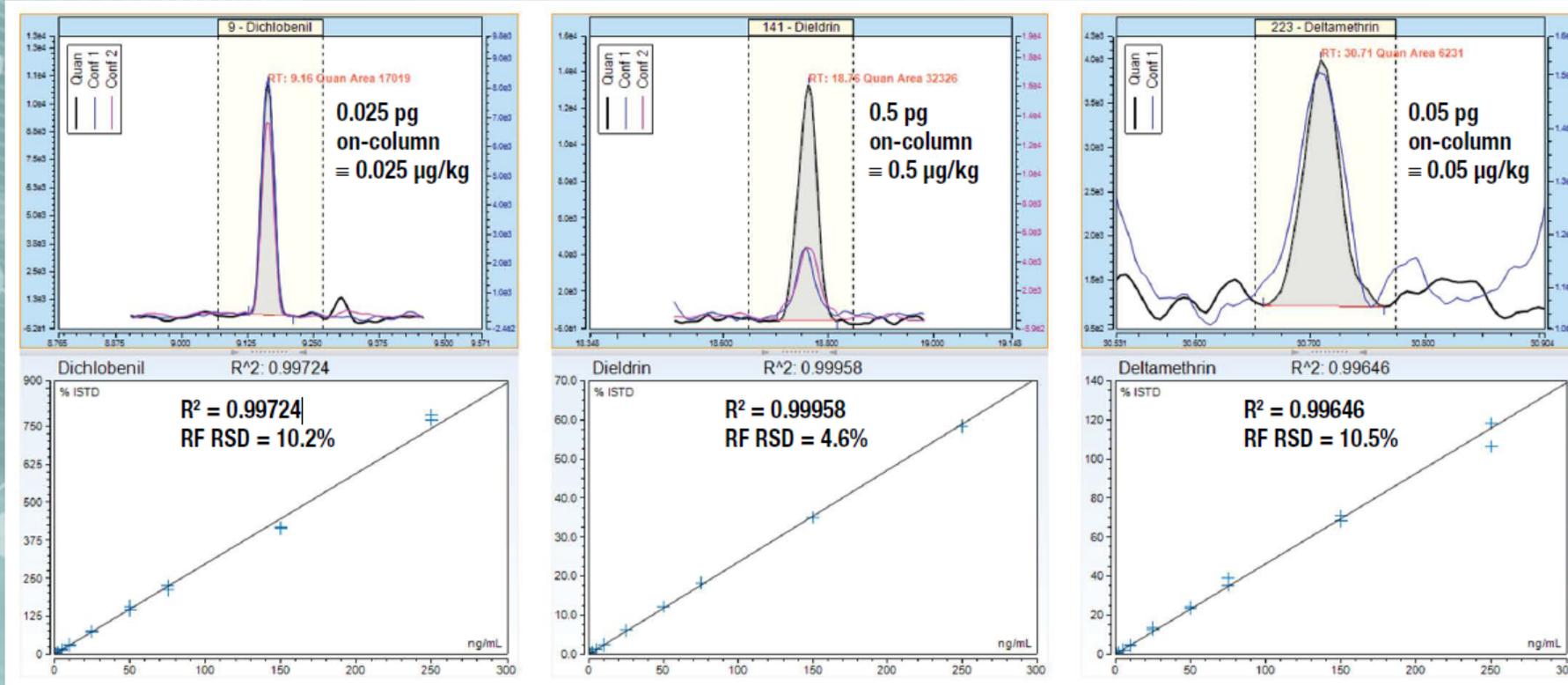


# AEI Pesticides in baby food

Dichlobenil – MRL 10 µg/kg

Dieldrin– MRL 3 µg/kg

Deltamethrin– MRL 10 µg/kg

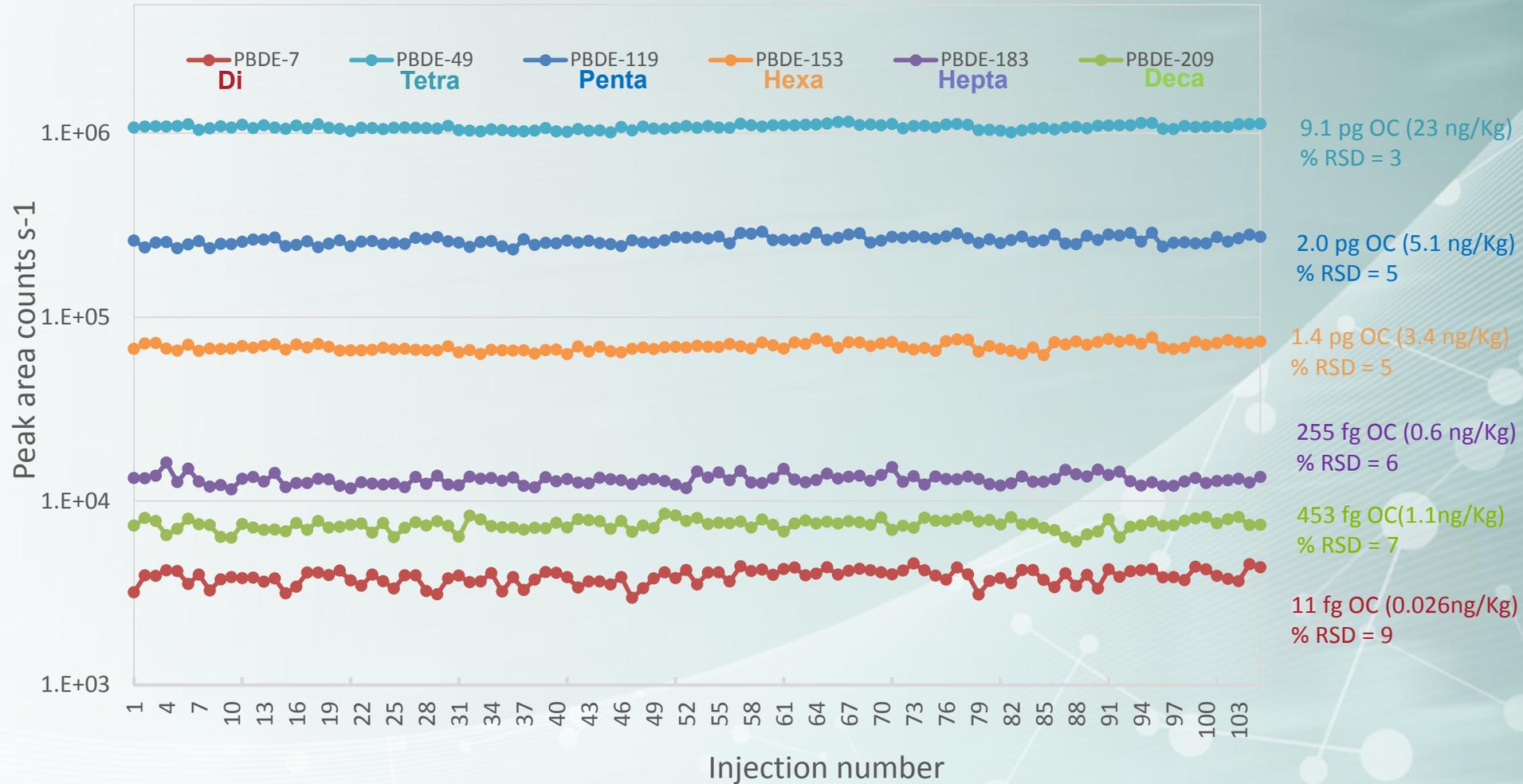


Lowest detectable matrix matched standard which meets SANTE identification requirements

Calibration curves  
0.025 to 250fg on column  
Duplicate injection at 14 levels

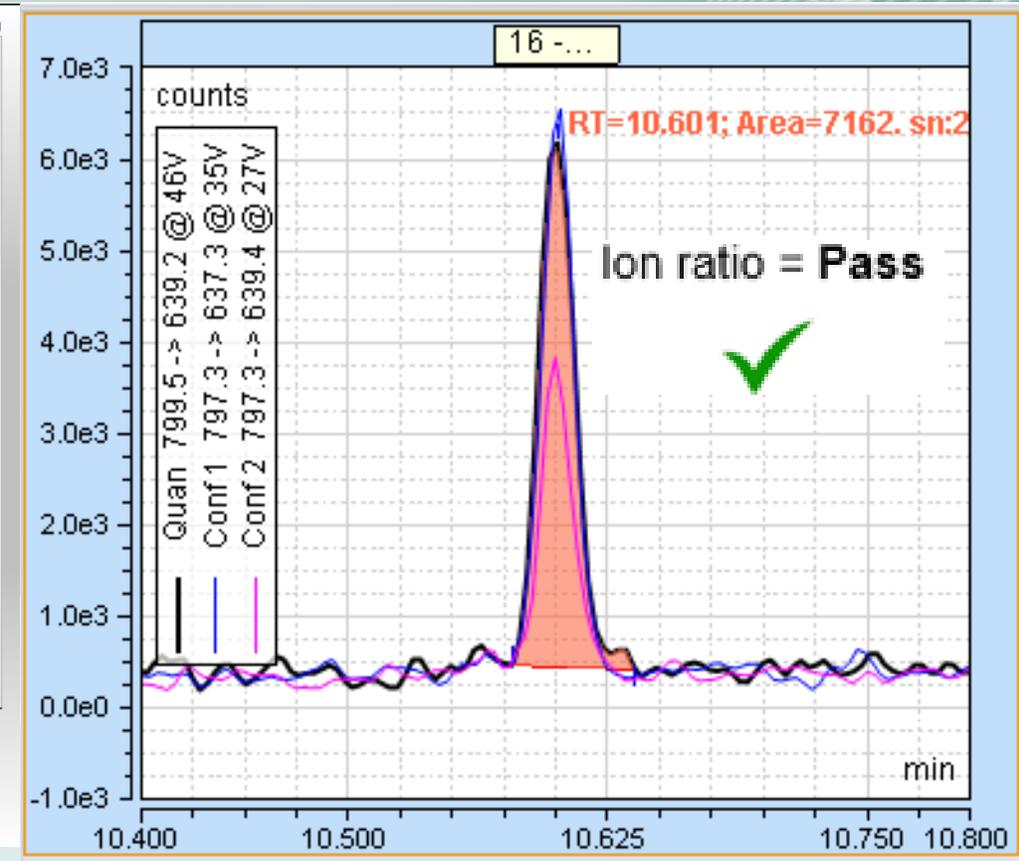
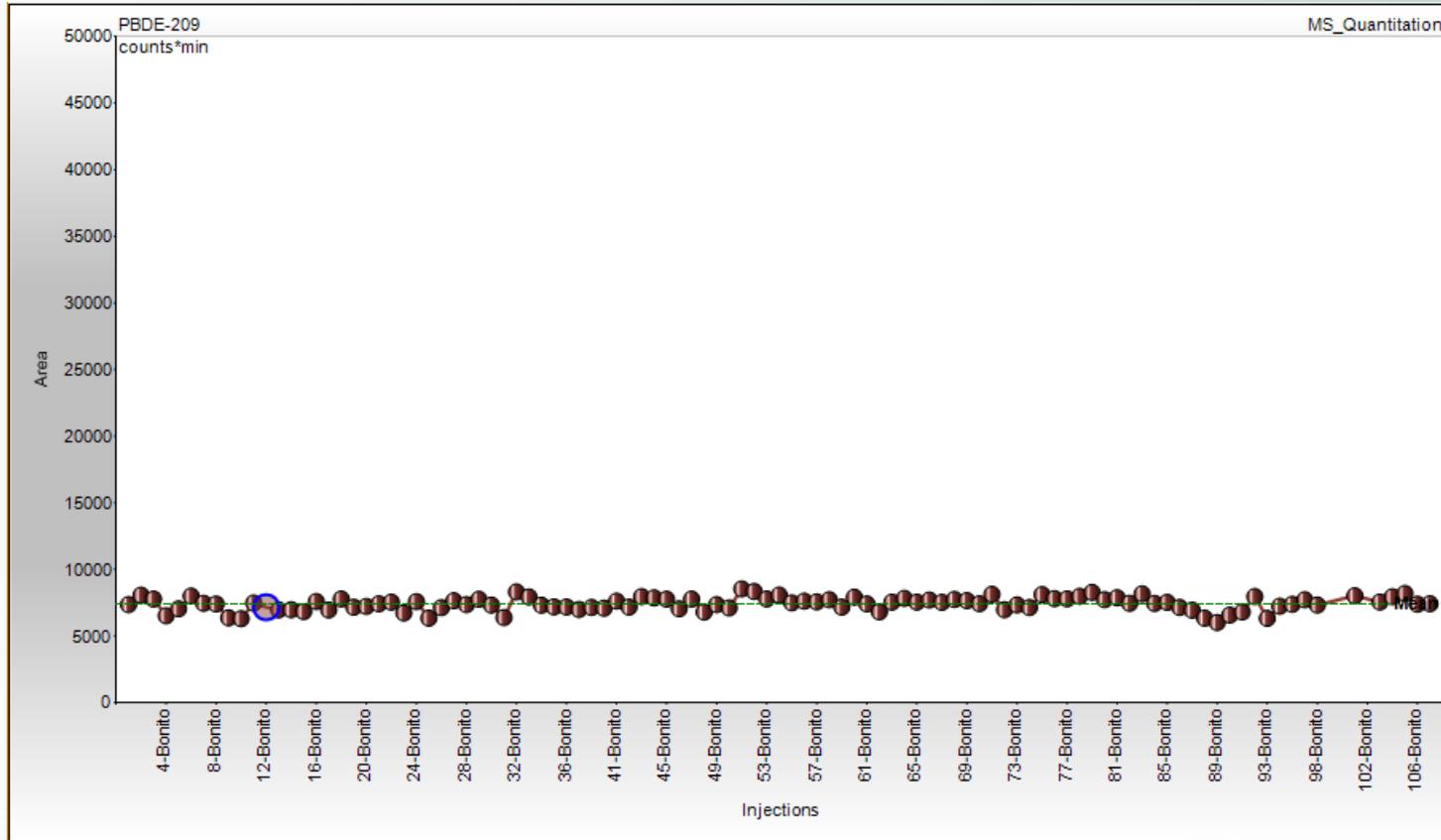
Low level detection and identification and quantitative linearity

# Repeatability of AEI for PBDEs



Peak area repeatability: n=106 unspiked extracted fish matrix injections

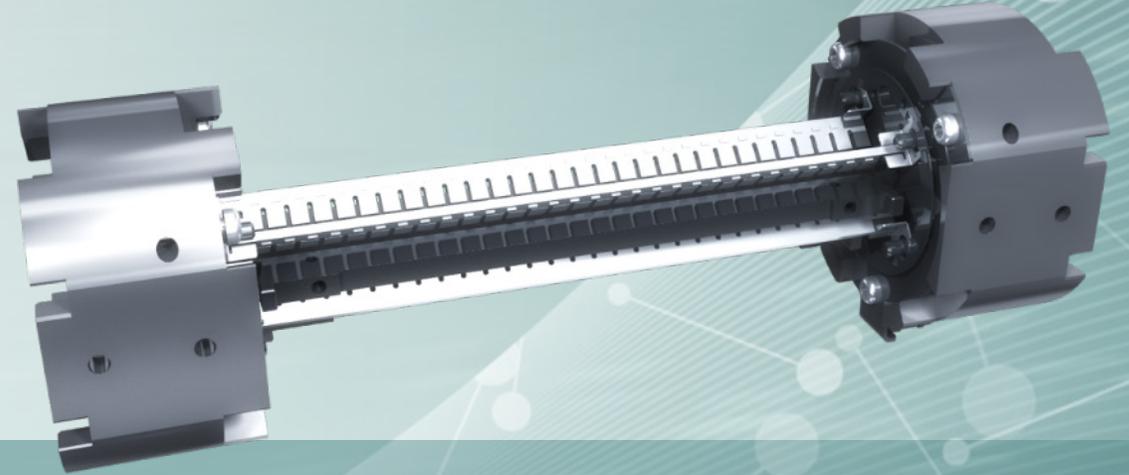
# Repeatability of AEI for PBDEs



BDE-209 (Deca) 106 matrix injections of unspiked matrix  
1.1ng/kg (~450fg OC) was found in sample based on cal Peak area % RSD = 5%

## Enhanced velocity optics

- Rapid SRM transition speeds (800 SRM/s)
- Maintain sensitivity at higher acquisition speeds

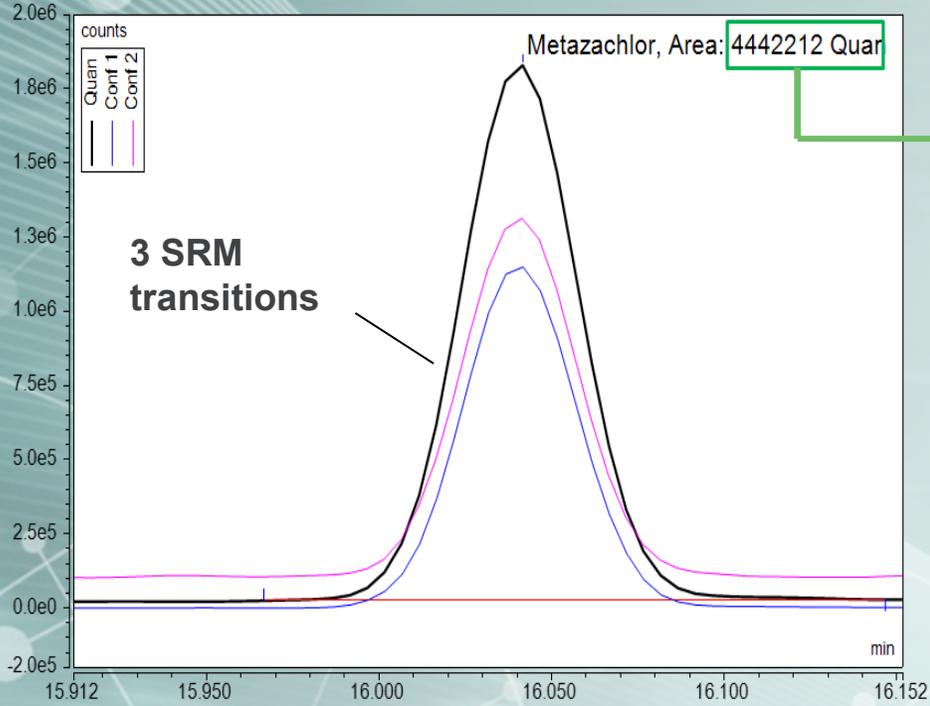


## Faster and more efficient methods

- Increase method scope: consolidate more compounds and matrices
- Increase throughput: compress GC methods for faster runtimes
- Increase resistance to matrix effects: more transitions, less interference risk

# EvoCell - Increase resistance to matrix effects

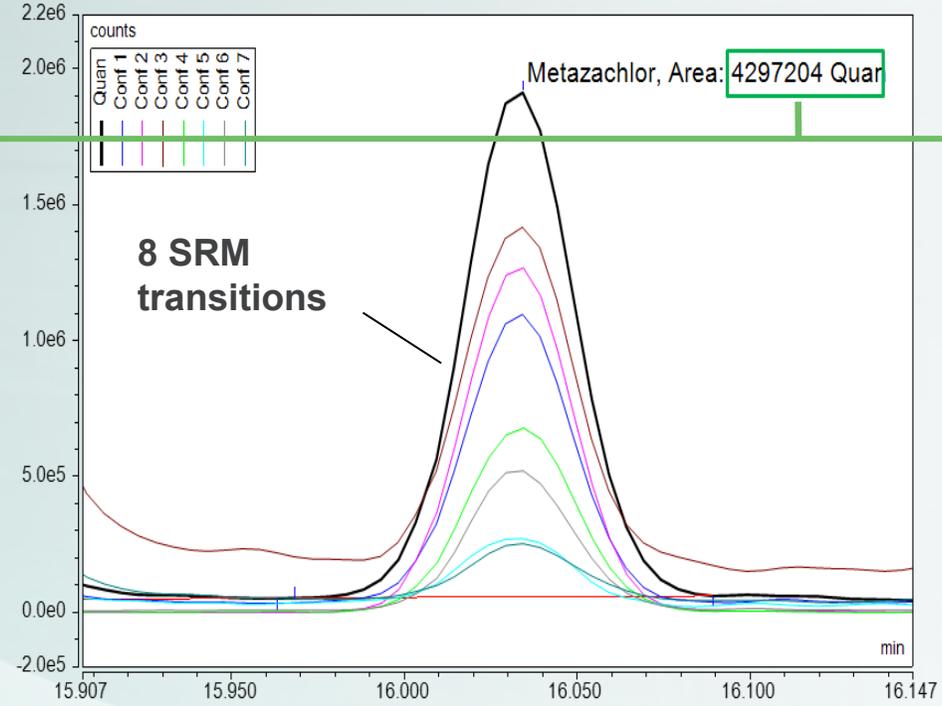
Typical multi-residue method  
Less transitions/compound



39 transitions at peak apex  
8 ms dwell time

Lower probability of selective transitions  
being available in varying matrices

Matrix resistant multi-residue method  
More transitions/compound



102 transitions at peak apex  
4 ms dwell time

Higher probability of selective transitions  
being available in varying matrices

Response  
maintained  
despite > 2.5 x  
more transitions

# The impact of TSQ 9000 AEI system sensitivity for routine analysis

Ultra robust



Remain in result production for longer

Highest sensitivity

Take less sample

Reduce / remove pre-concentration

Dilute extracts

Inject less / split injection

Measure more comfortably current compounds

Address toughest detection limit challenges

Reduced

Source cleaning

Reduced

Sample prep time & cost

Matrix pressure on system

GC inlet & column maintenance

Source cleaning

Reduced

Manual peak reintegration

Reanalysis for quality issues

Increased



Uptime



Result production



On time delivery



Quality



Margins



Analytical scope



Confidence

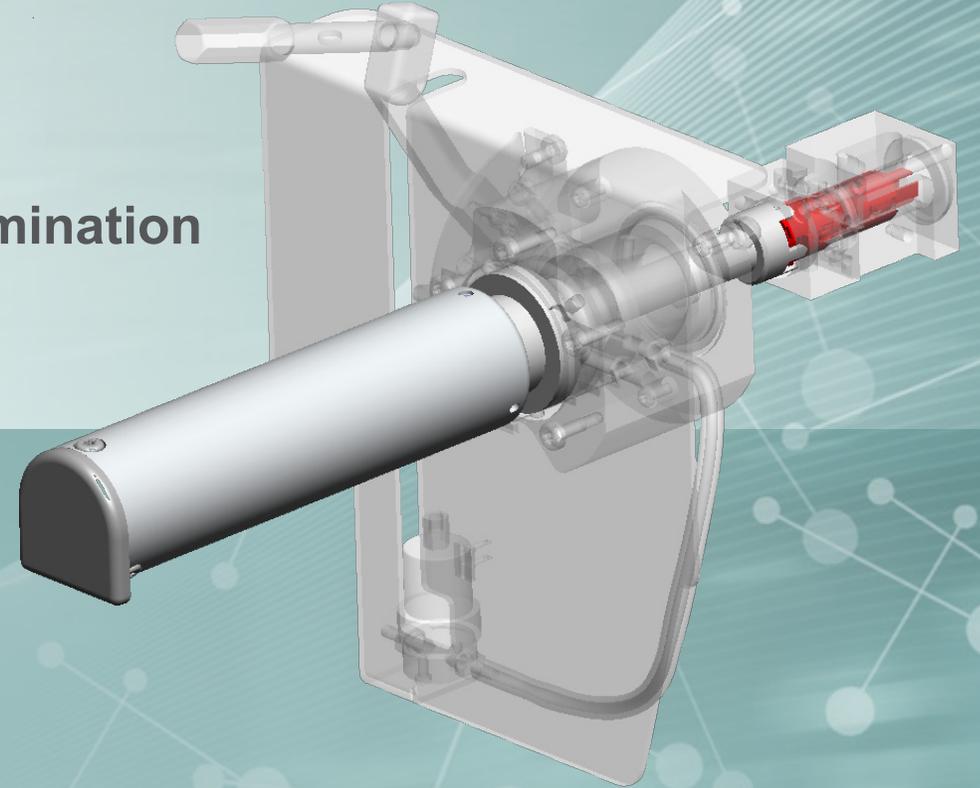
*Unprecedented  
levels of uptime*

**UNSTOPPABLE**



## Ion source robustness built-in

- Highly inert material with independent dual heaters
- Proprietary RF lenses keep matrix burn contained
- AEI source with tight ion beam reduces lens contamination



## NeverVent Technology

- Unique Vacuum Probe Interlock (VPI) design
- Vent free GC column exchange
- Vent free ExtractaBrite ion source exchange

# Two sources of robustness

Feature	Benefit	ExtractaBrite ion source	Advanced Electron Ionization (AEI) source
Highly inert material	Low reactivity reduces surface contamination	✓	✓
RF lenses	Contains matrix contamination, keeps it far away from quadrupoles	✓	✓
Dual heater design	Better heating reduces surface contamination	✓	✓
Vent free exchange	Offline source maintenance	✓	
Advanced ion beam focusing	Reduces lens contamination, extends required maintenance intervals		✓



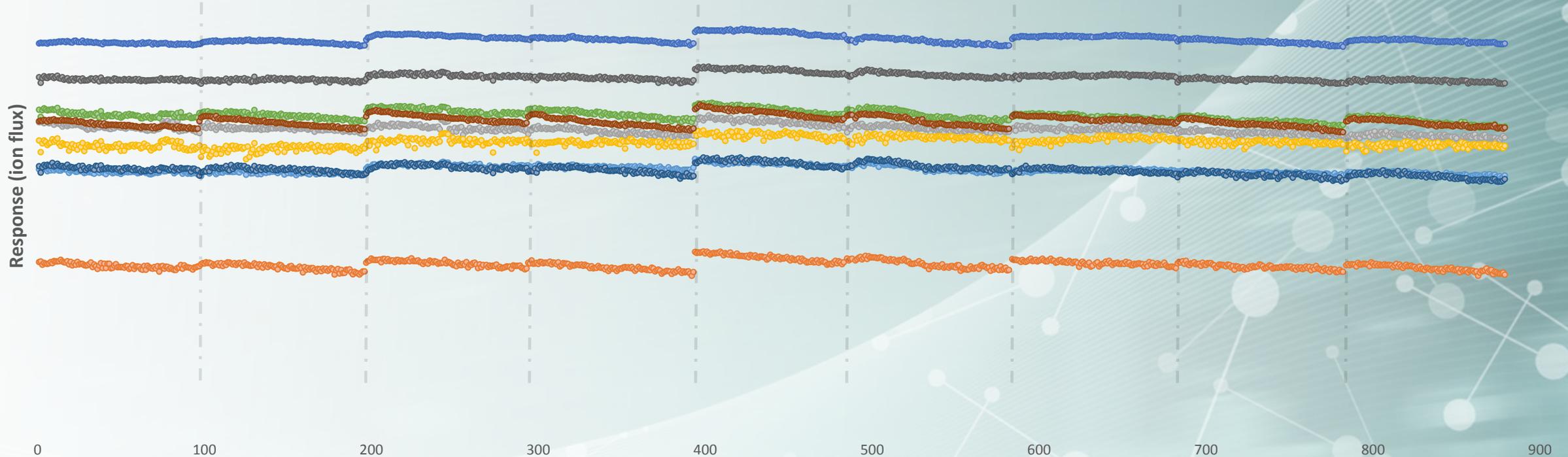
# AEI robustness ~900 Acetonitrile QuEChERS injections

150 pesticides  
monitored at 10 ppb  
in **carrot and  
potato baby food**

Liner change  
and SmartTune  
every ~100  
injections

No AEI source  
cleaning

→ <20% RSD for >90% of  
pesticides monitored

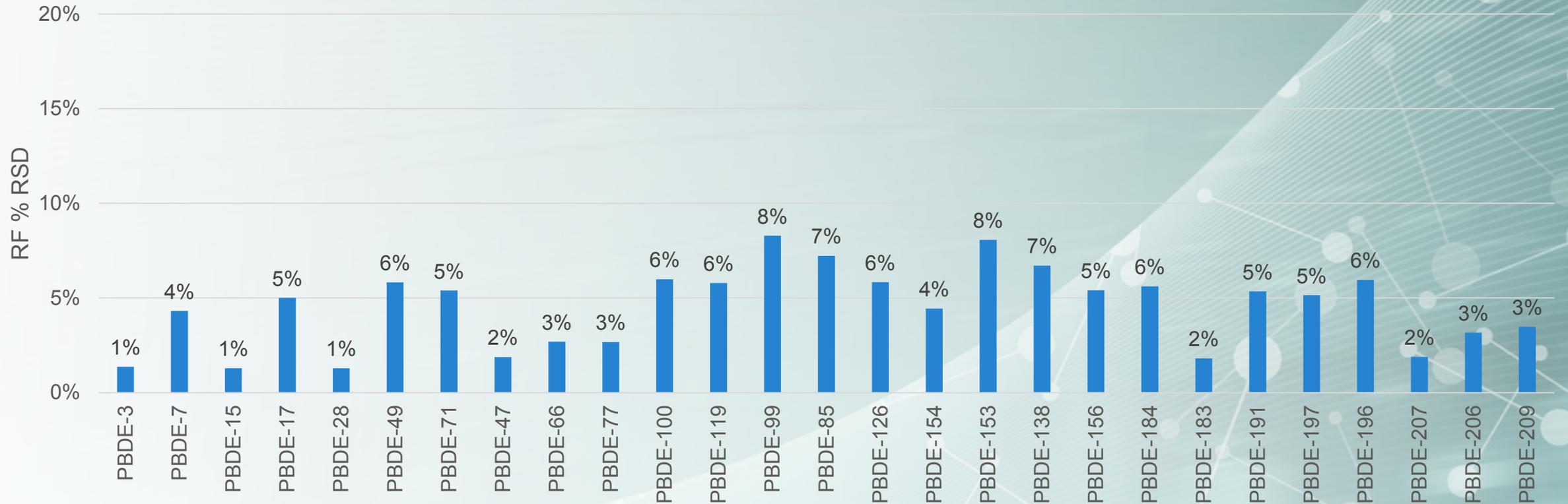


- Tefluthrin 6.7% RSD
- Endosulfan II 8.0% RSD
- Chloroneb 8.5% RSD
- Cadusafos 9.3% RSD

- Isodrin 7.0% RSD
- Resmethrin II 8.1% RSD
- Bifenthrin 7.0% RSD
- Diazinon 8.8% RSD

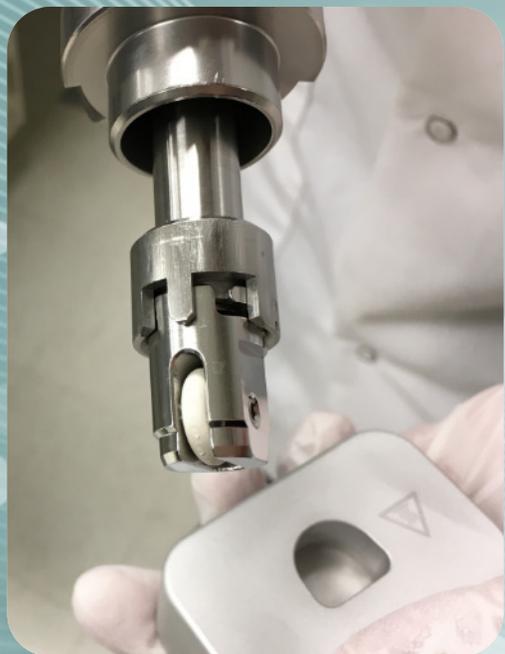
# AEI robustness ~320 injection PBDE sequence

Average RF % RSD over 320 matrix injections



n=18 QC3 injections interspersed throughout a batch containing 320 injections of calibration standards, solvent blanks, samples and robustness testing (Bonito fish matrix)

# NeverVent – A rapid return to result production



## V-Lock source plug

Allows vent free GC column exchange

No complicated fluidics / extra connections



## ExtractaBrite ion source

Vent free ion source exchange

Operate with spare source and clean offline

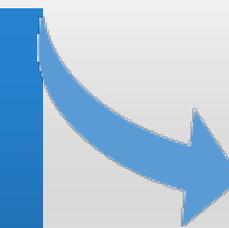


## Column Replacement (including conditioning)



4.5 hours

Standard GCMS



87%  
Time  
Saving

35 min.

NeverVent

## Ion Source Maintenance



4 hours

Standard GCMS



98%  
Time  
Saving

5 min.

NeverVent

An instant connection to productivity

# Thermo Scientific™ TRACE™ 1300 Series GC Systems

- Proprietary Thermo Scientific™ Instant Connect injector and detector modules
- Fully user-exchangeable:
  - No service engineers
  - No special tools
  - No special training



## Maximum uptime

- Eliminate maintenance downtime
- Swap modules for continuous result production
- Dedicate injectors for special applications
- Rapid troubleshooting



*Routine ease  
of use*

**UNSTOPPABLE**



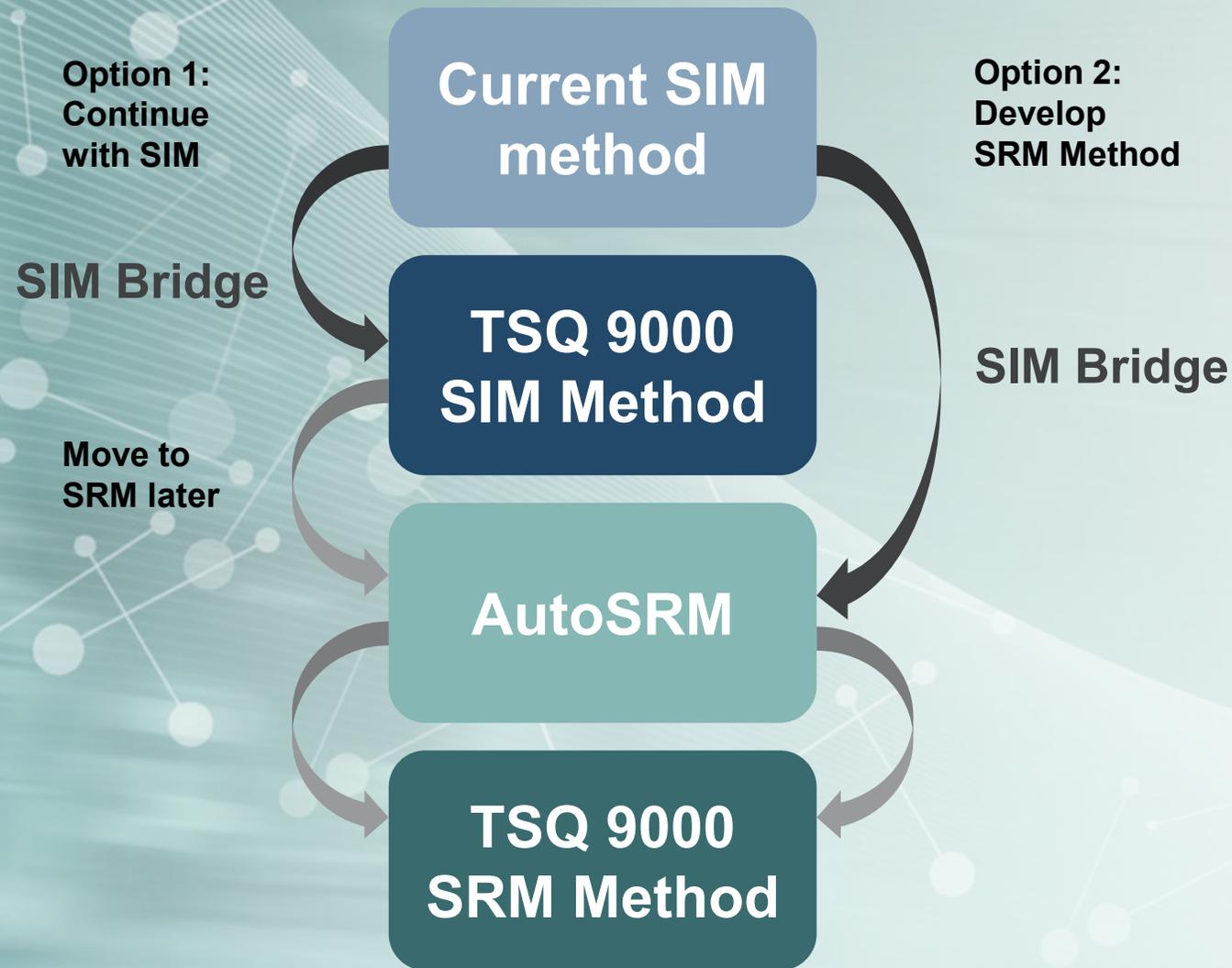
## MS/MS simplicity from start to finish

- Full suite of easy-to-use tools
- Move from other technology or provider
- Method development and management
- Day-to-day system operation

## Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) software

- Intelligent Functionality – it does everything you need!
- Operational Simplicity™ – everything is fast and easy!
- Future-proofed, scalable and flexible architecture
- Multi-technique (GC, LC, IC, MS) and multi-vendor platform

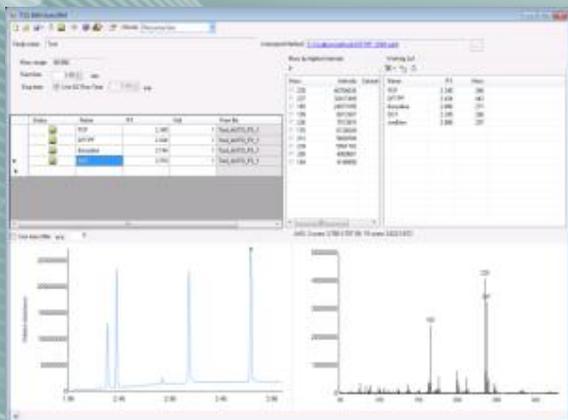




## SIM Bridge

- Simple tool to migrate from single quadrupole to triple quadrupole
- SIM methods exported from other sources to be translated to the TSQ 9000 GC-MS/MS system method
- SIM methods can be immediately run on the TSQ 9000 system or through AutoSRM to translate the SIM information into a powerful SRM method

## 1) Precursor ion selection



## 2) Product ion selection



## 3) Collision energy optimization

# AutoSRM

- A triple quadrupole method development expert integrated into your system
- Provides full method development independence
- Fully optimized SRM transitions *for your system*, even for less experienced users
- Saves huge amount of time and effort

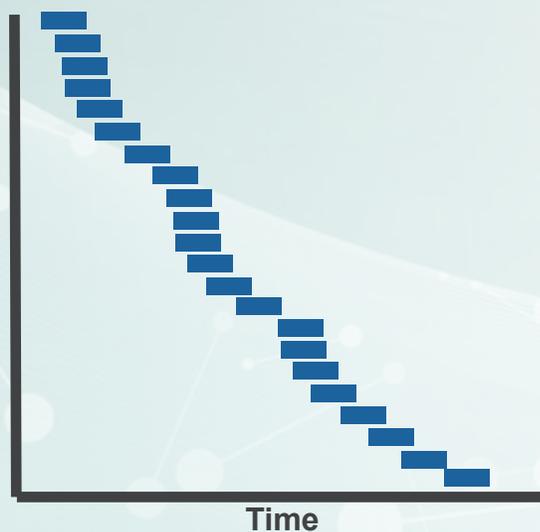
## Timed-SRM

- Reduces complexity in high capacity methods
- Automatically optimizes target compounds for maximum sensitivity
- Simply enter RT for compounds and windows automatically set
- Easy method updates with new GC column or GC column trimming



### Segmented SRM (classic approach)

- Inefficient monitoring of SRM transitions
- Complicated to set time windows
- Susceptible to matrix RT shift

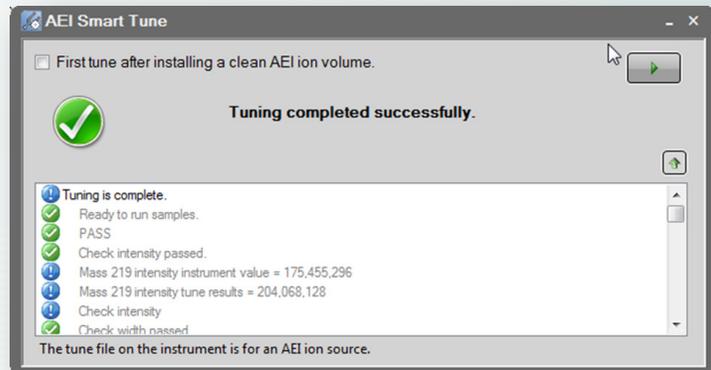
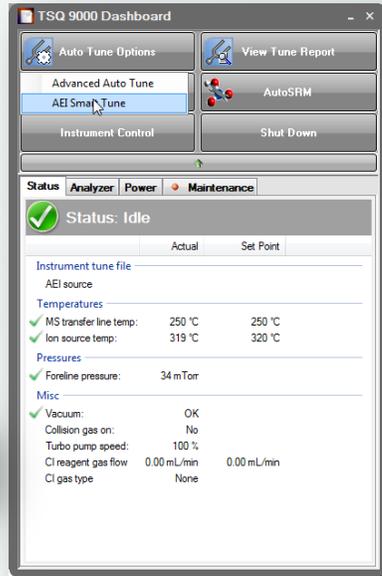


### Timed SRM

- Optimized monitoring of SRM transitions
- Automated window definition
- Resistant to matrix RT shift

## SmartTune

- New simplified tuning tool for ISQ and TSQ instruments
- Ensures your system is performing at the level you require
- Efficiently checks and tunes the system
- Intelligently eliminates any unnecessary steps in the process, resulting in faster tuning operations
- Advises on necessary corrective actions
- User customizable targets to facilitate consistency in performance



## Chromeleon CDS software

- **Control your entire chromatography lab. It is fully scalable from a single workstation to an enterprise-wide installation**
- **Control more than 350 modules from Thermo Fisher Scientific™ and many other vendors**
- **Quantitative mass spectrometry workflows for all separation techniques and MS variants, all using the same intuitive user interface**
- **Boost laboratory efficiency with operational simplicity and intelligent functionality**



## Operational simplicity and intelligent functionality

- Reduce errors in sequence setup using Thermo Scientific™ eWorkflows™
- Achieve more “right first time” analyses using Intelligent Run Control
- Experience faster data processing, reviewing and reporting with dynamic updating and smart tools built in
- Customizable reporting templates for common workflows e.g. WADA testing laboratories



***Scalable in a  
changing  
laboratory  
environment***

***UNSTOPPABLE***



# Unstoppable scalability

## Perfect for today, ready for tomorrow

- Grows with laboratory requirements
- From base to advanced configurations
- Full field upgrade path

Ultra high performance  
and robustness  
TSQ 9000 AEI



High-throughput solution  
TSQ 9000 NeverVent EI & CI



High-throughput solution  
TSQ 9000 NeverVent EI



Affordable performance  
300L/s ExtractaBrite



Most accessible entry from SQ>TQ

240L/s ExtractaBrite



# UNSTOPPABLE

ROUTINE ANALYSIS



**Sensitivity**  
**Uptime**  
**Ease of use**  
**Scalability**