Rise Above the Risk. Don’t Let the Helium Crisis Shut Your Lab Down or Drive Your Costs

Massimo Santoro

GC and MS Marketing Manager

Agenda

- Existing Ways to Tackle the Helium Supply Shortage
- The Helium Waster: Split/Splitless Injector
- Introducing the Instant Connect Helium Saver SSL Injector
- Analytical Validation
- Conclusions and Q&A

Helium Shortage Affects Laboratory Productivity

- **The helium supply chain crisis has negative implications on research and laboratory operations world-wide**
- **Helium rationing, delayed deliveries and price increases still cause difficulty in production planning and uncertainty in instrument productive uptime**
- **Although the GC & GC-MS segment consumes less than one percent of the global helium supply usage per year, the shortages and delivery interruptions have wide-spread consequences for many industries utilizing varied analytical techniques**

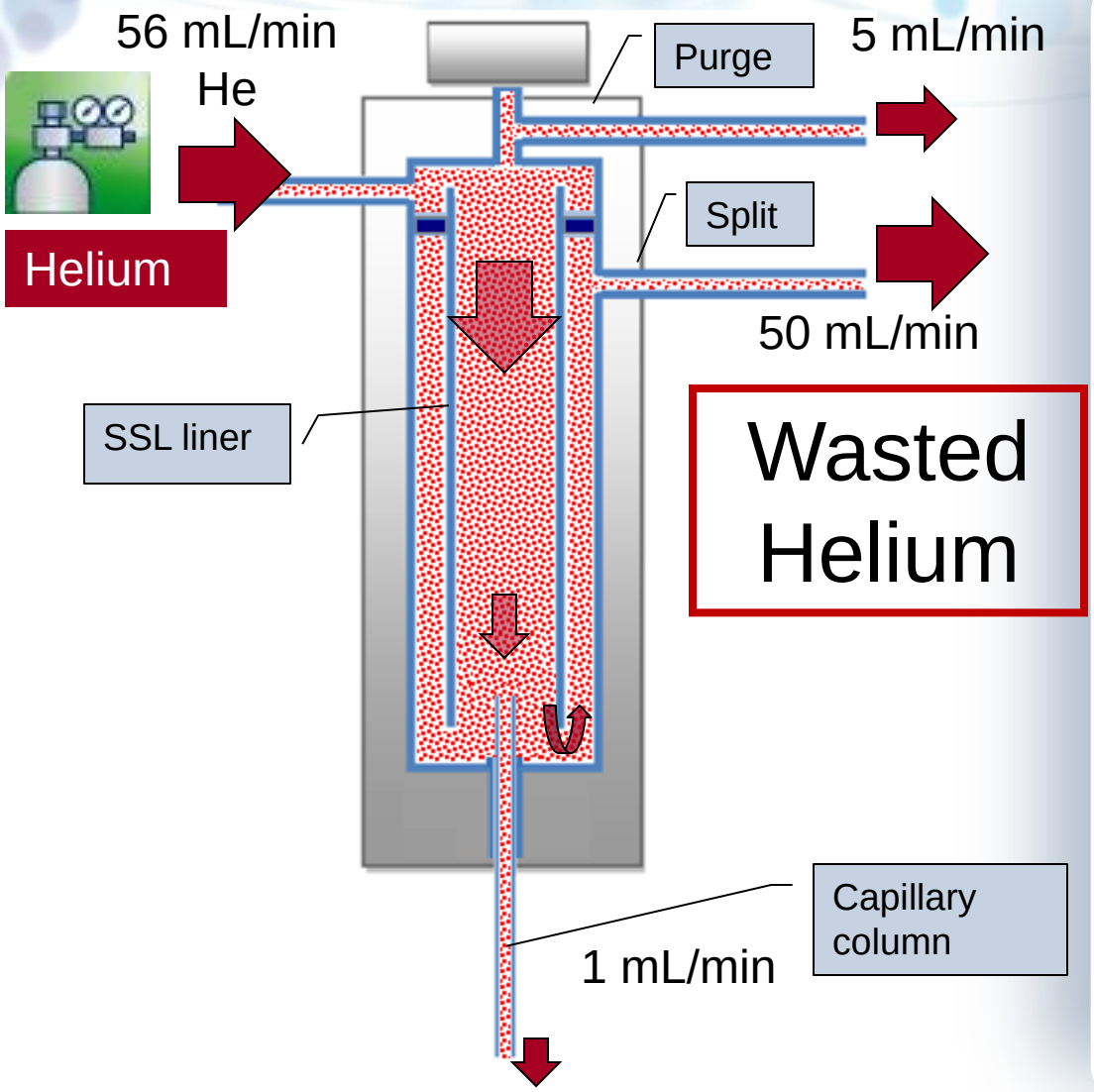
Existing Ways to Tackle the Helium Supply Shortage

- Reduce the split ratio (and amount injected) during the split time of the split injection
- Migrate to H_2 carrier gas
- Switch over to nitrogen when the GC or GC-MS is not running

Limitations of the Existing Approaches

- Reduce the split ratio (and amount injected) during the split time of the split injection
  - Not applicable to splitless
  - Accuracy may be affected with smaller-volume injections
- Migrate to H_2 carrier gas
  - Safety concerns
  - Method translation/optimization
  - Reduced sensitivity
- Switch over to nitrogen when the GC or GC-MS is not running
  - Not for routine laboratories
  - Delay time when switching back to helium

The Helium Waster: Split/Splitless Injector



- Same gas used in the carrier, septum purge and split paths
- Only ~1/10 - 1/50 of the total flow enters the column
- Purge and split flows cannot be reduced beyond a certain limit without introducing contamination into column/detector:
  - Sample matrix accumulated in liner and lines
  - Septa particles
  - Air diffusing from septa
  - Seals outgassing

The Helium Saver

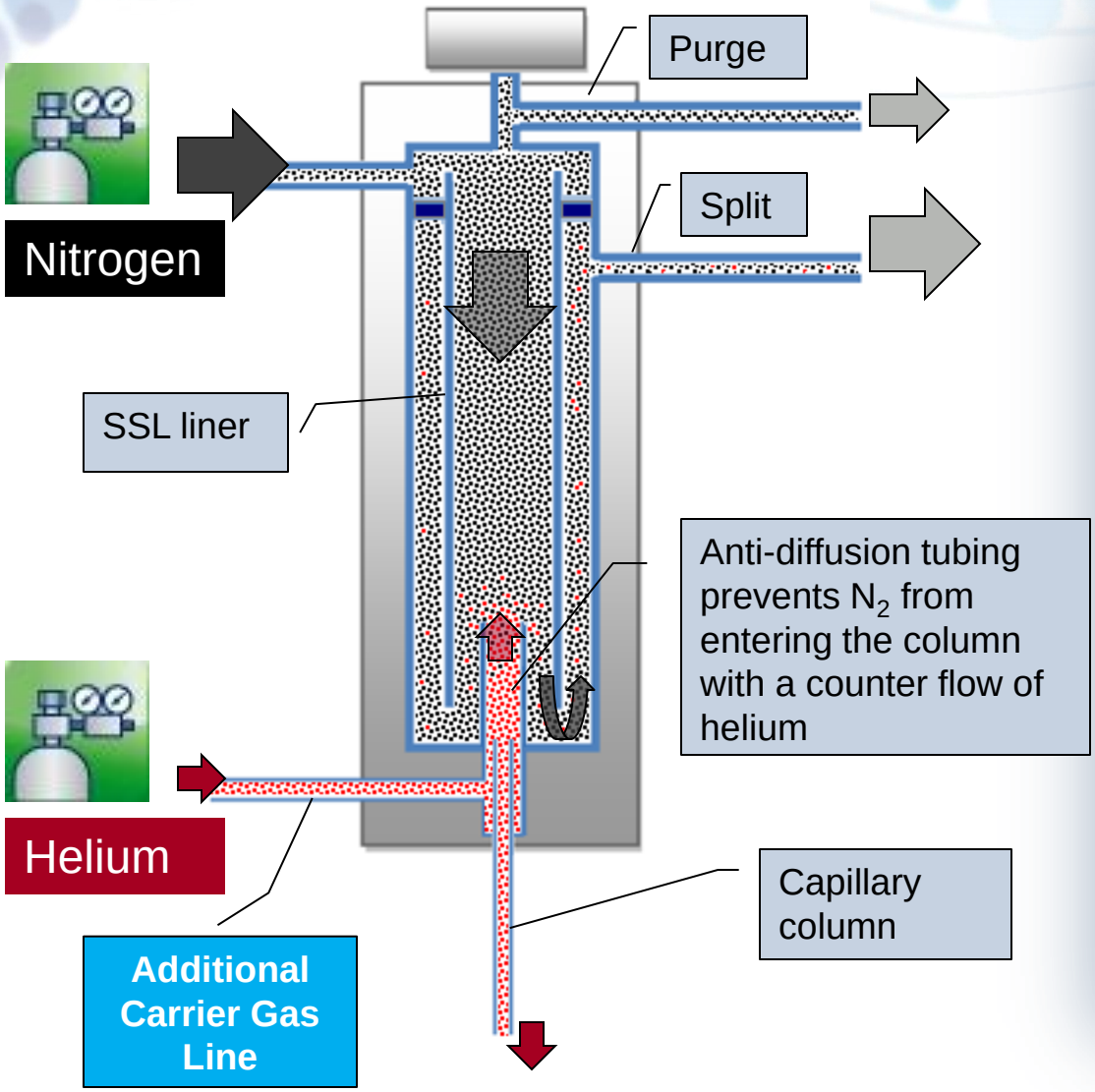
The **revolutionary** Thermo Scientific™ Instant Connect Helium Saver Module for chromatographers seeking freedom from the helium supply crisis, offers a GC & GC-MS instrument **lifetime helium carrier gas solution** while **keeping existing methodology**. Unlike others, the Helium Saver is a module that is **always ready** and works **while your instrument is running,** as well as when it is idle, providing **up to 14 years** of GC & GC-MS operation from a *single helium cylinder*.

- **Maintain your Methods**
- **Prolong your Supply**
- **Save your Budget**

www.thermoscientific.com/heliumsaver

ThermoFisher SCIENTIFIC

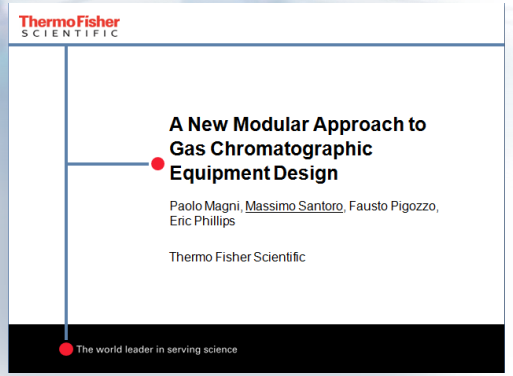
Instant Connect Helium Saver Module

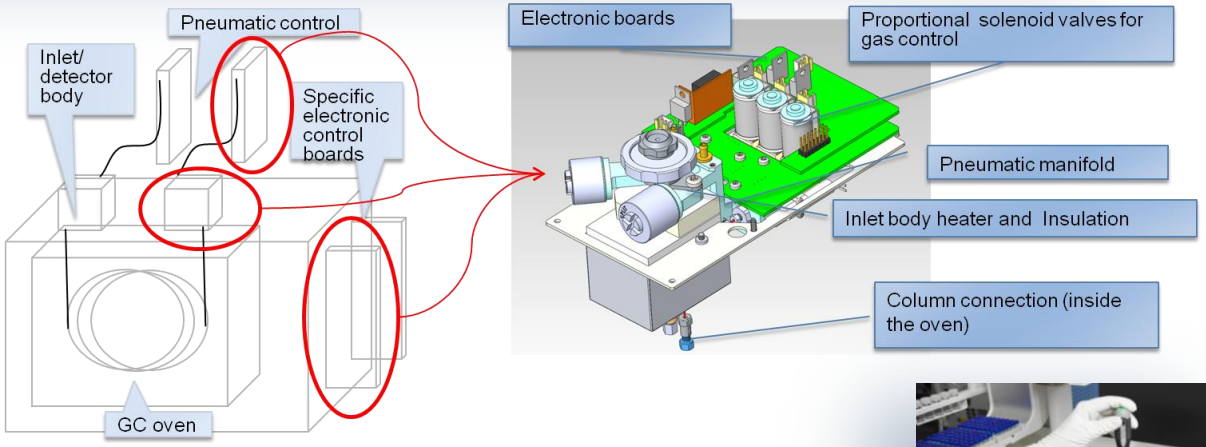


- Inlet is supplied with 2 different gases
  - **Nitrogen** is used for septum purge and split flows
  - **Helium** only feeds the analytical column; its consumption is drastically reduced
- **Nitrogen** column head pressure settings regulate **Helium** flow
- Available as user-installable Instant Connect module

Benefits of Instant Connect Modularity

- Presented at Pittcon 2012, Instant Connect user-installable modules incorporate
  - Injector (or detector) body and heater
  - Gas control valves
  - Electronics for temperature and gas control for signal amplifier and A/D conversion



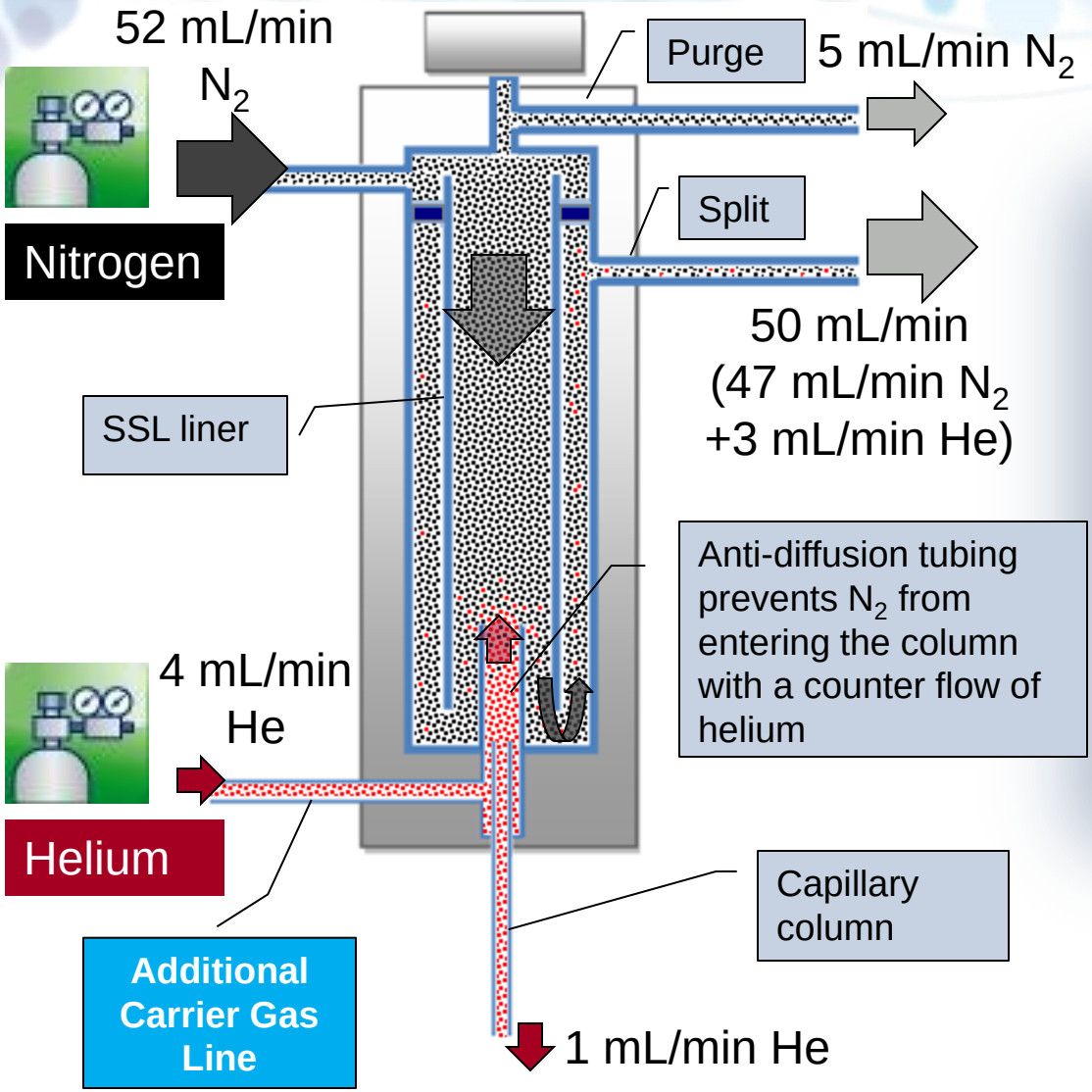


ThermoFisher SCIENTIFIC

Tailor Instrument Configuration with GC Modularity

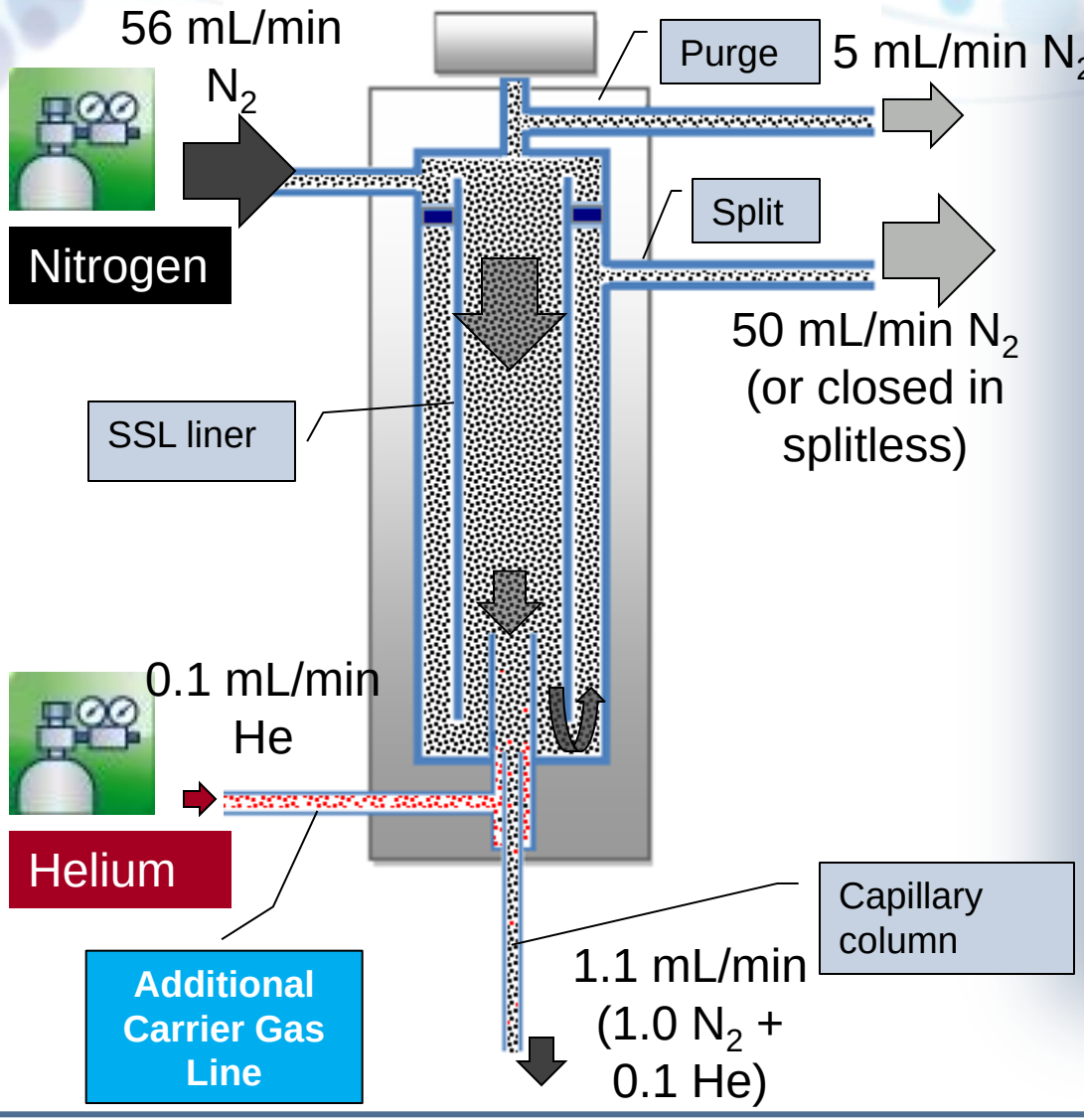
- **Thermo Scientific™ TRACE™ 1300 Series GC**
  - **Instant Connect modules are user-installable in less than two minutes**
- **Instant Connect injector and detector modularity**
  - **Tailor GC configuration to the application**
  - **Adopt a future-proof GC platform**
  - **Ease and scale up investments**
  - **Maximize instrument uptime and Resume operations quickly**
  - **Ensure constant response time**
  - **Reduce capital investments**
  - **Make troubleshooting easy**

How the Helium Saver Module Works: Operation



- During all “non-injection” periods, helium is supplied with a flow slightly higher than the column flow
- Helium consumption is only 1/15 – 1/20 of standard Split/Splitless injector

How the Helium Saver Module Works: Injection



- During injection period, nitrogen flows into the column for sample introduction
- Helium is supplied at 0.1 mL/min to keep the connection swept and avoid dead volumes
- When GC is in stand-by, can be left in this condition with zero consumption of helium
- Separation done in helium

Helium Saver Enables a Cylinder of Helium to Last…

3.5 years **continuously used 24/7/365 for GC-MS analysis**

and up to

14.6 years shutting Helium off or to N_2 on weekends and overnight

For a ***Thermo Scientific™ TRACE 1300 Series GC, ISQ™ Series GC-MS*** and ***TSQ™ 8000 GC-MS/MS*** with the ***Helium Saver Module,***
it means this could be the **last and only** helium cylinder that will be needed for the lifetime of the instrument

Helium Saver Module Example

GC Flow Conditions		EPA 8270 Standard
He carrier gas flow	mL/min	1
He split flow	mL/min	60
Gas saver flow	mL/min	20
Gas saver on	min	3
Purge flow	mL/min	5
Run time	min	25
He volume in cylinder	L	7,300
Runs per Day		57
He cylinder cost	USD	$300
N_2 cylinder cost	USD	$60

- **Example:** U.S. EPA Method 8270 (semi-volatiles analysis with GC-MS)
- **Total Analysis Time:** 25 minutes
- **Around the Clock Analyses per Day:** 57

Helium cylinder life time was extended from 5 months to 3.5 years of continous uninterrupted use

Helium Savings: 7 times

(continuous uninterrupted use)

Monetary Savings: 3 times

		Standard He Consumption	Helium Saver Consumption
Daily He Usage	Liters	46.56	5.76
He Cylinder Life	Days	**157**	**1,267**
Daily N_2 Usage	Liters	0	40.8
N_2 Cylinder Life	Days	0	179
Total Annual Cost		**$688**	**$205**
Total Savings			**$483**

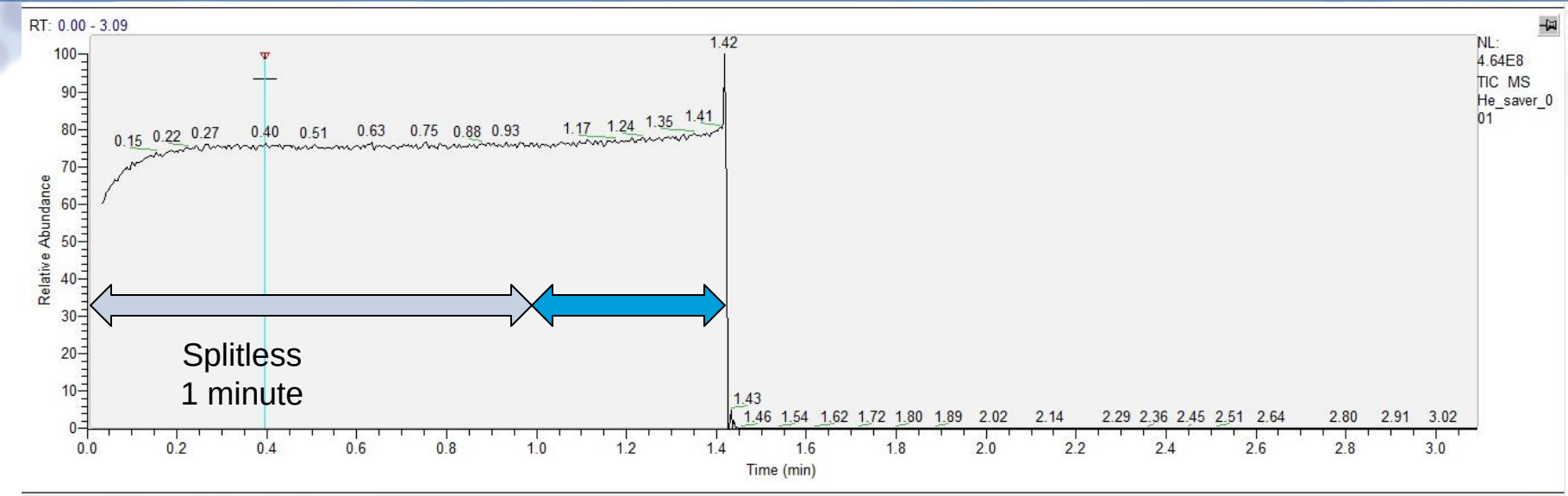
Helium Saver Module vs. Conventional SSL

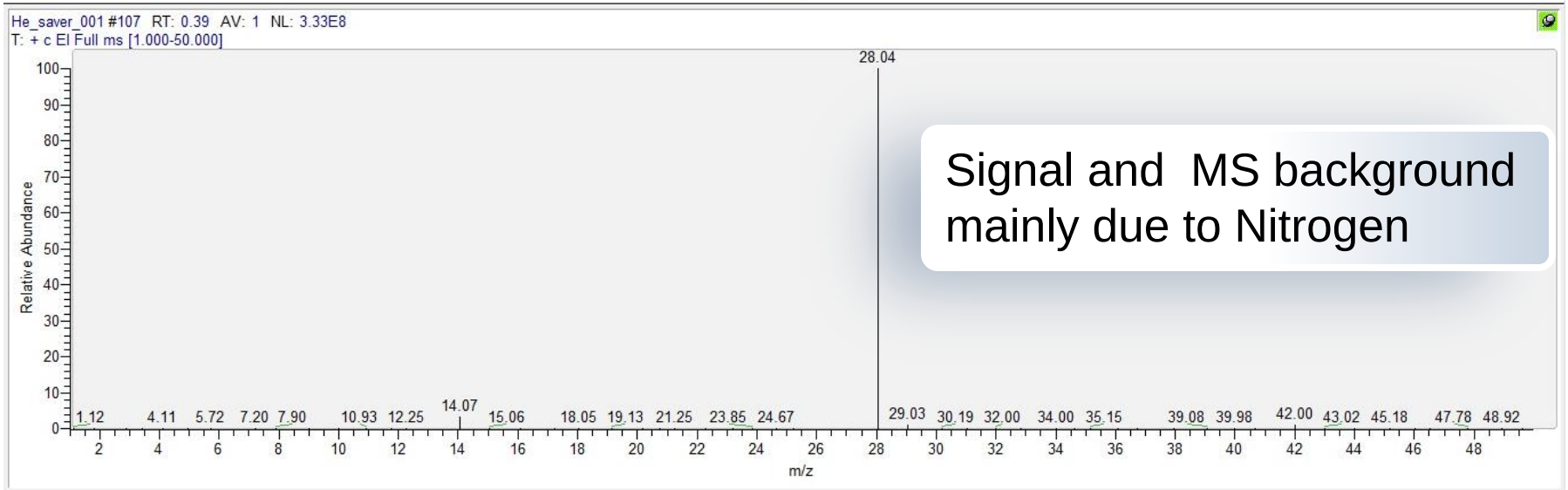
Helium Saver Module	Conventional SSL
Contains the SSL as a sub-system	Industry standard injector
Uses exactly the same methods	Used for > 80% methods
Preserves your methods and saves helium	Wastes most of the helium

Instant Connect Helium Saver Analytical Validation

ThermoFisher SCIENTIFIC

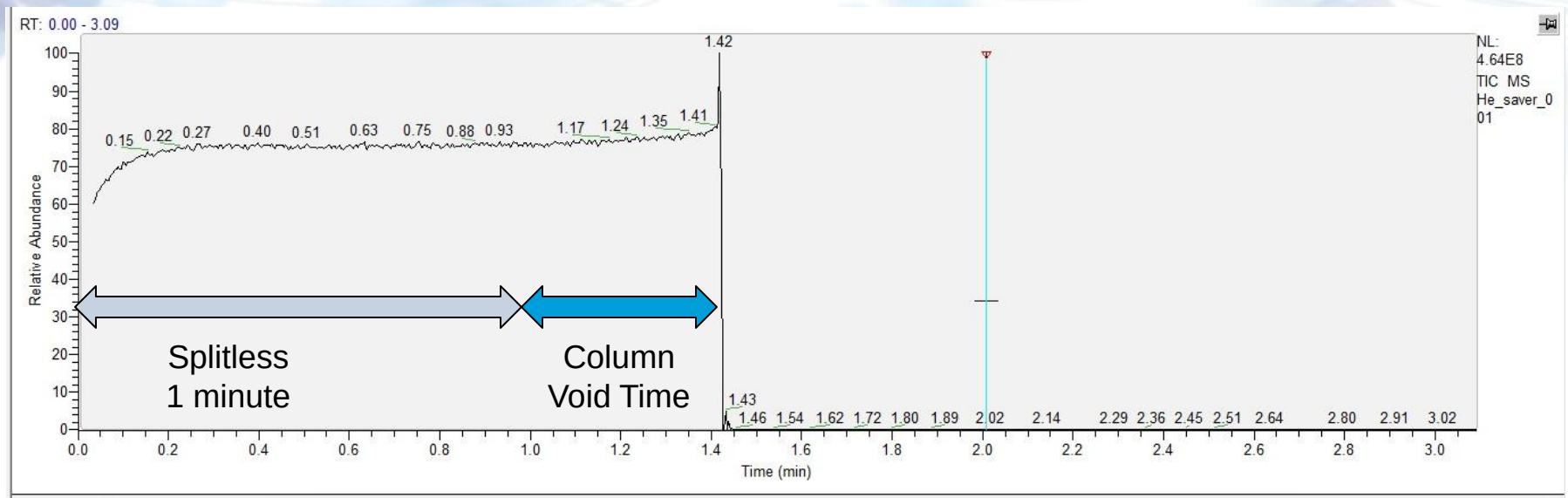
Rapid and Efficient Gas Exchange

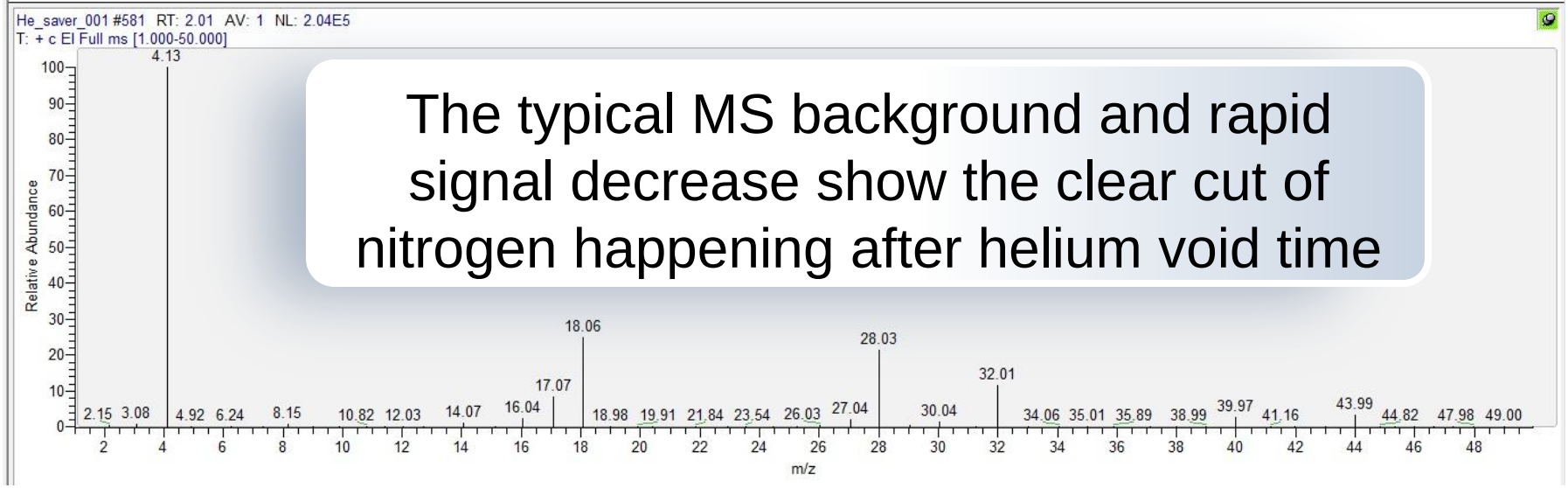




ThermoFisher SCIENTIFIC

Rapid and Efficient Gas Exchange

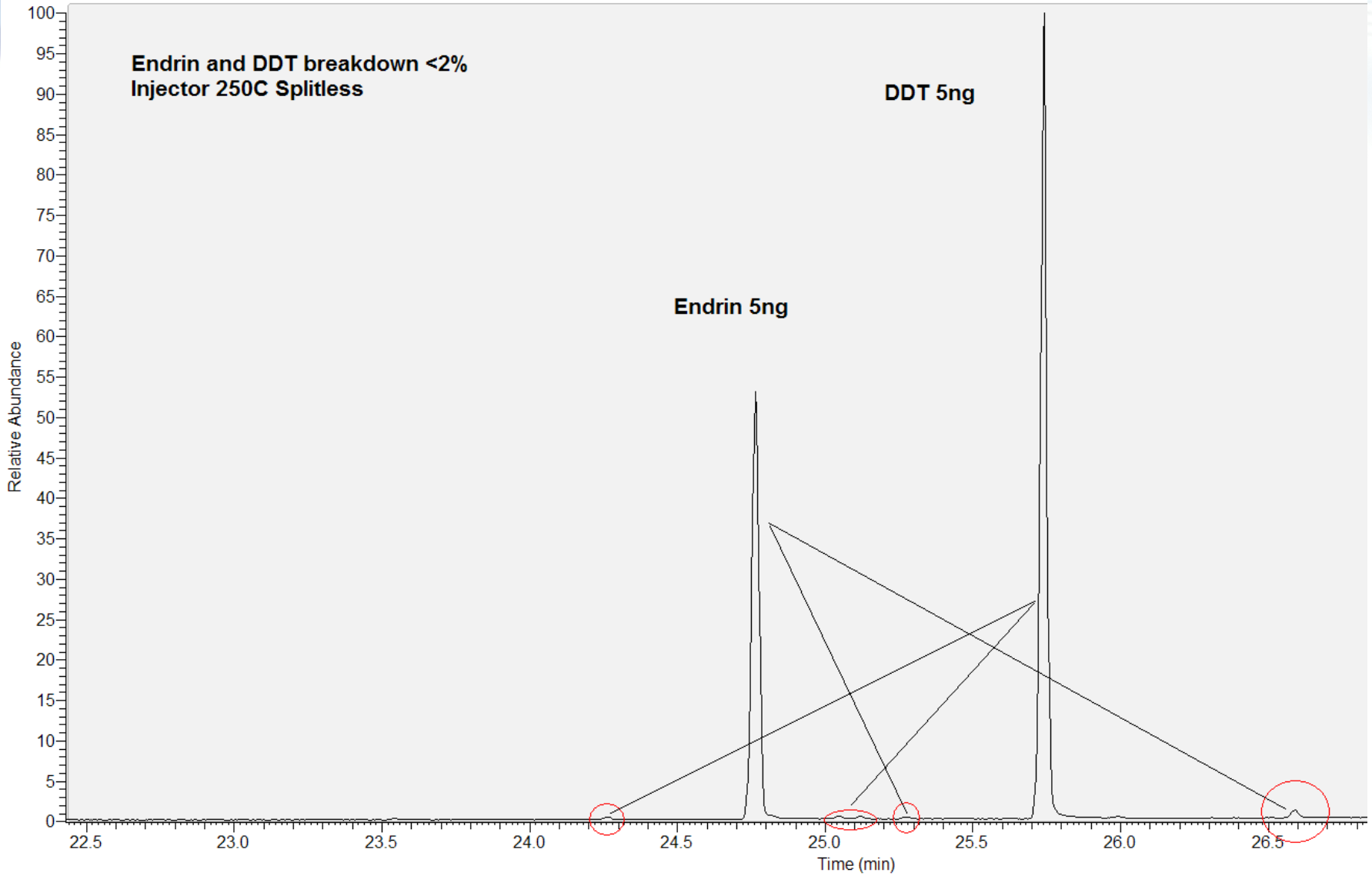




The typical MS background and rapid signal decrease show the clear cut of nitrogen happening after helium void time

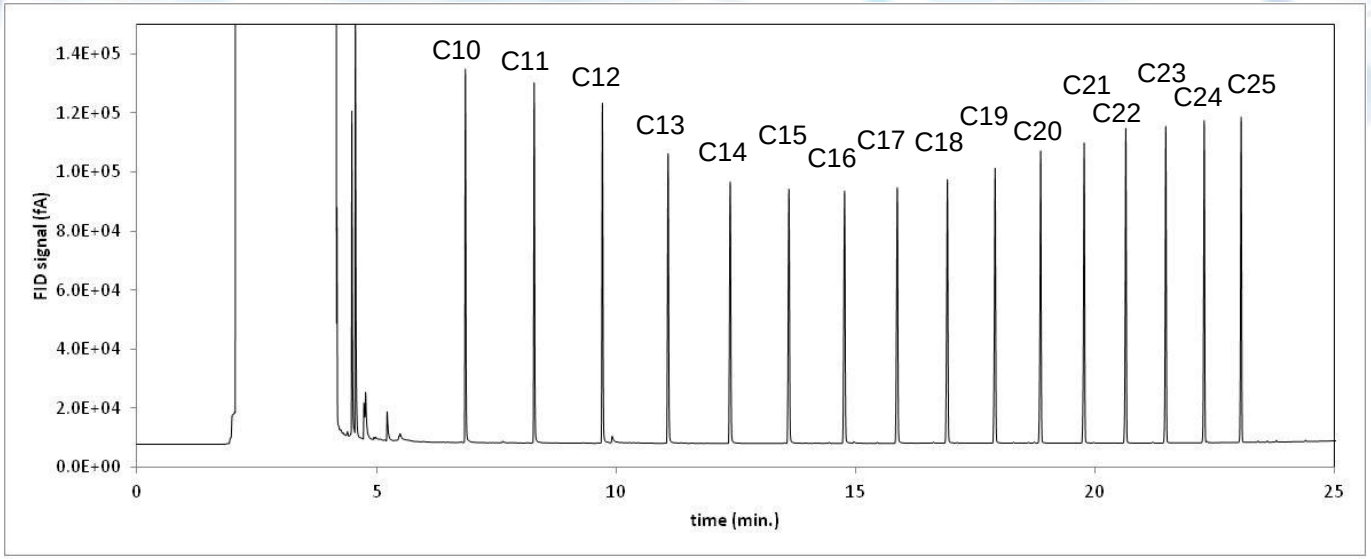
ThermoFisher SCIENTIFIC

Helium Saver: Low Activity toward Labile Compounds

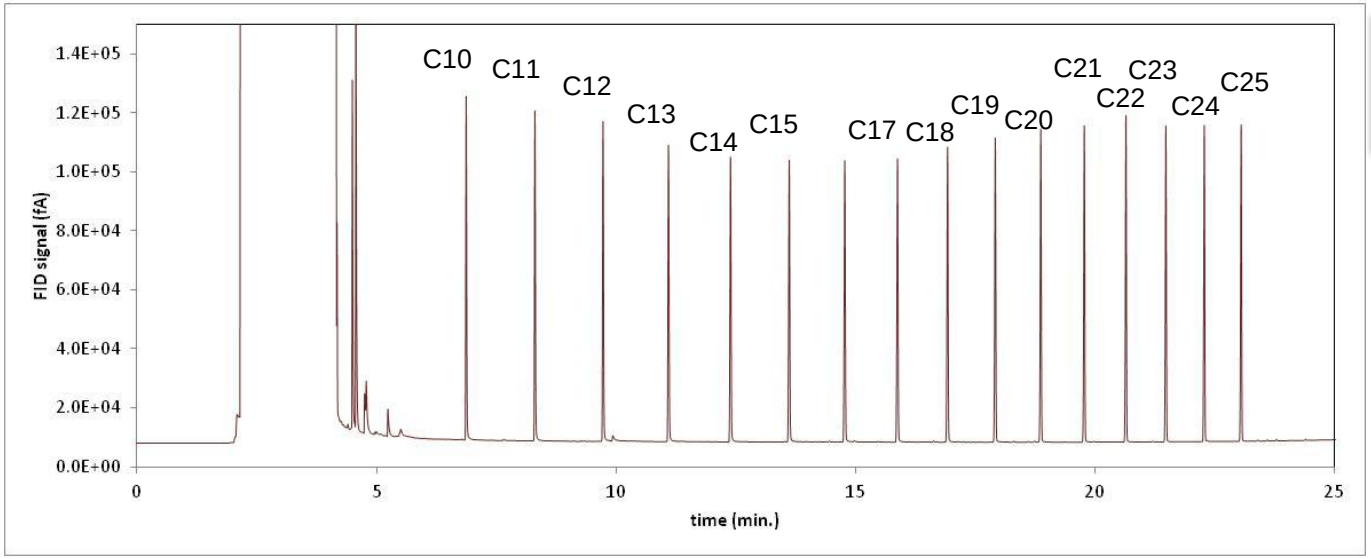


ThermoFisher SCIENTIFIC

Helium Saver vs. Conventional SSL: R_t Unchanged



Helium Saver
He column flow
N_2 split and septum purge



SSL
Only He supplied

Splitless 1 µL
30 m, 0.25 mm ,0.25 µm
Thermo Scientific™
TRACE TR5 Column
50 ˚ to 300 ˚C at 10 C/min
Column Flow: 1 mL/min
FID at 300 ˚ C

ThermoFisher SCIENTIFIC

Helium Saver Module vs. Conventional SSL

Component	Absolute peak area (counts)			Retention times (min.)			
	Helium only	Helium Saver (N2 + He)	Diff%	Helium only	Helium Saver (N2 + He)	Diff (min.)	Diff%
nC10	1509238	1643138	+8.9	6.878	6.862	-0.017	-0.24
nC11	1501697	1631649	+8.7	8.312	8.297	-0.015	-0.18
nC12	1525277	1634623	+7.2	9.733	9.720	-0.013	-0.14
nC13	1539736	1643560	+6.7	11.100	11.092	-0.008	-0.08
nC14	1528093	1626721	+6.5	12.393	12.387	-0.007	-0.05
nC15	1535544	1631809	+6.3	13.618	13.612	-0.007	-0.05
nC16	1555112	1644967	+5.8	14.778	14.773	-0.005	-0.03
nC17	1564216	1652088	+5.6	15.877	15.873	-0.003	-0.02
nC18	1566094	1652903	+5.5	16.922	16.918	-0.003	-0.02
nC19	1573423	1658194	+5.4	17.917	17.913	-0.003	-0.02
nC20	1588978	1677003	+5.5	18.867	18.865	-0.002	-0.01
nC21	1584344	1669784	+5.4	19.773	19.772	-0.002	-0.01
nC22	1585427	1668266	+5.2	20.643	20.640	-0.003	-0.02
nC23	1582252	1661415	+5.0	21.477	21.475	-0.002	-0.01
nC24	1588109	1665599	+4.9	22.278	22.277	-0.002	-0.01
nC25	1568167	1640702	+4.6	23.047	23.047	0.000	0.00

No changes on RT (few 1/1000 of a minute) nor on peak areas

Helium Saver: Precision in Splitless Mode

Component	Absolute peak area		Retention times		
	Average (counts)	RSD%	Average (min.)	SD (min.)	RSD%
nC10	1675299	0.48	6.863	0.001	0.01
nC11	1660541	0.59	8.299	0.001	0.01
nC12	1674407	0.66	9.722	0.001	0.01
nC13	1679538	0.53	11.092	0.001	0.01
nC14	1662749	0.54	12.389	0.001	0.01
nC15	1663737	0.71	13.615	0.001	0.01
nC16	1672853	0.48	14.775	0.001	0.01
nC17	1679632	0.50	15.875	0.001	0.01
nC18	1679468	0.45	16.920	0.002	0.01
nC19	1685406	0.50	17.916	0.002	0.01
nC20	1702906	0.54	18.866	0.002	0.01
nC21	1697257	0.56	19.774	0.002	0.01
nC22	1695464	0.56	20.644	0.001	0.01
nC23	1689021	0.61	21.478	0.001	0.01
nC24	1696156	0.65	22.279	0.001	0.01
nC25	1671095	0.64	23.049	0.001	0.00

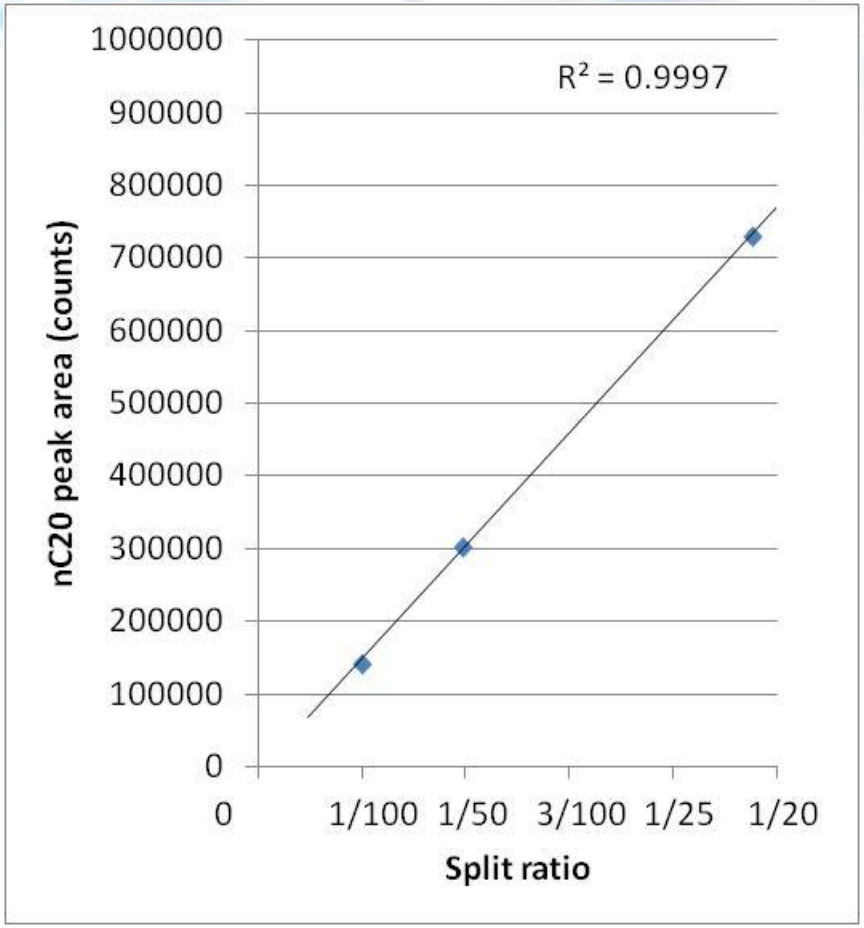
RSD% below 1% on absolute peak areas and SD in the range of 1/1000 of a minute on retention time

Precision is not affected by the Helium Saver Module

Helium Saver: Precision in Split Mode

Component	Absolute peak area*	
	Average (counts)	RSD%
nC10	739872	1.01
nC11	732835	0.81
nC12	736868	0.96
nC13	737309	0.97
nC14	730281	0.87
nC15	729157	0.99
nC16	733663	0.84
nC17	732963	0.94
nC18	731400	0.89
nC19	727888	0.76
nC20	732675	0.78
nC21	728136	0.86
nC22	724306	0.70
nC23	717839	0.72
nC24	711406	0.70
nC25	693043	0.77

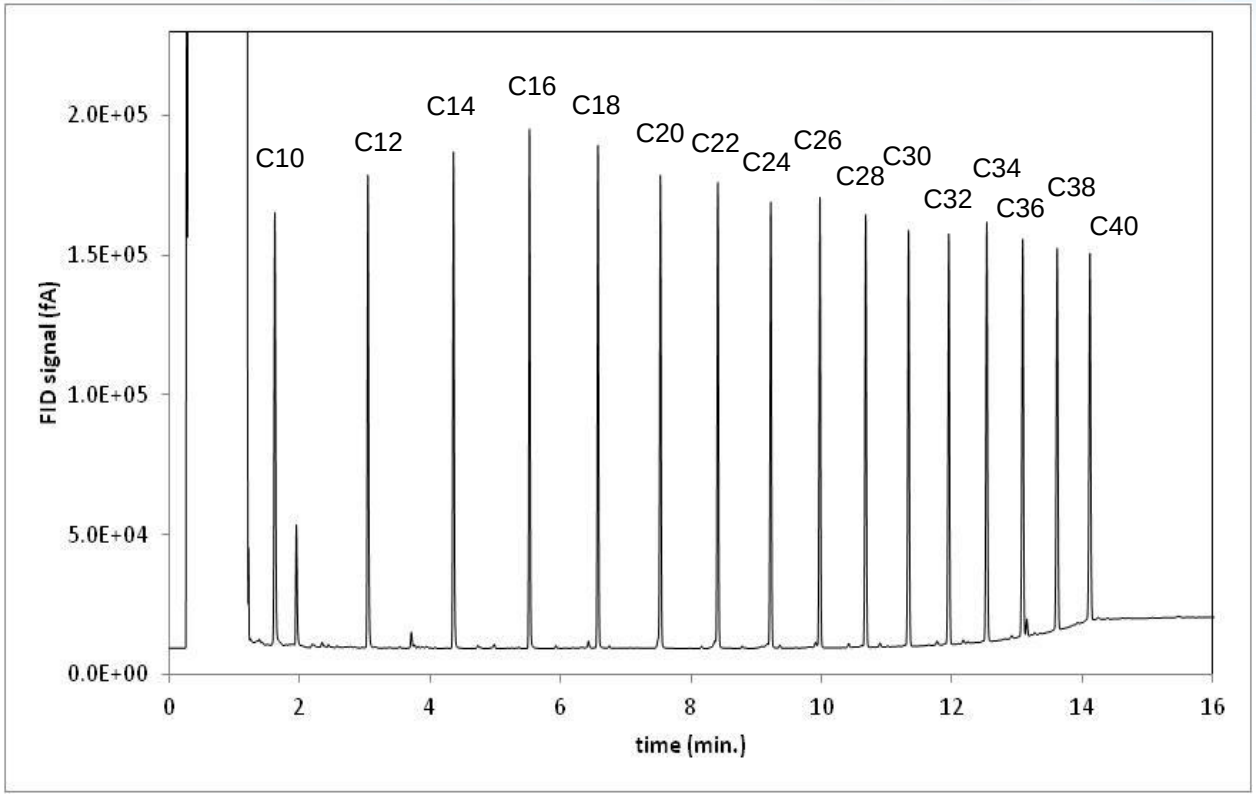
* 20:1 split ratio; n=10



RSD% around 1%. Good linearity of split ratio.
Precision and split ratio accuracy is not affected by the Helium Saver mode

Helium Saver: High Boiling Compounds Transfer

Complete recovery of high boiling compounds

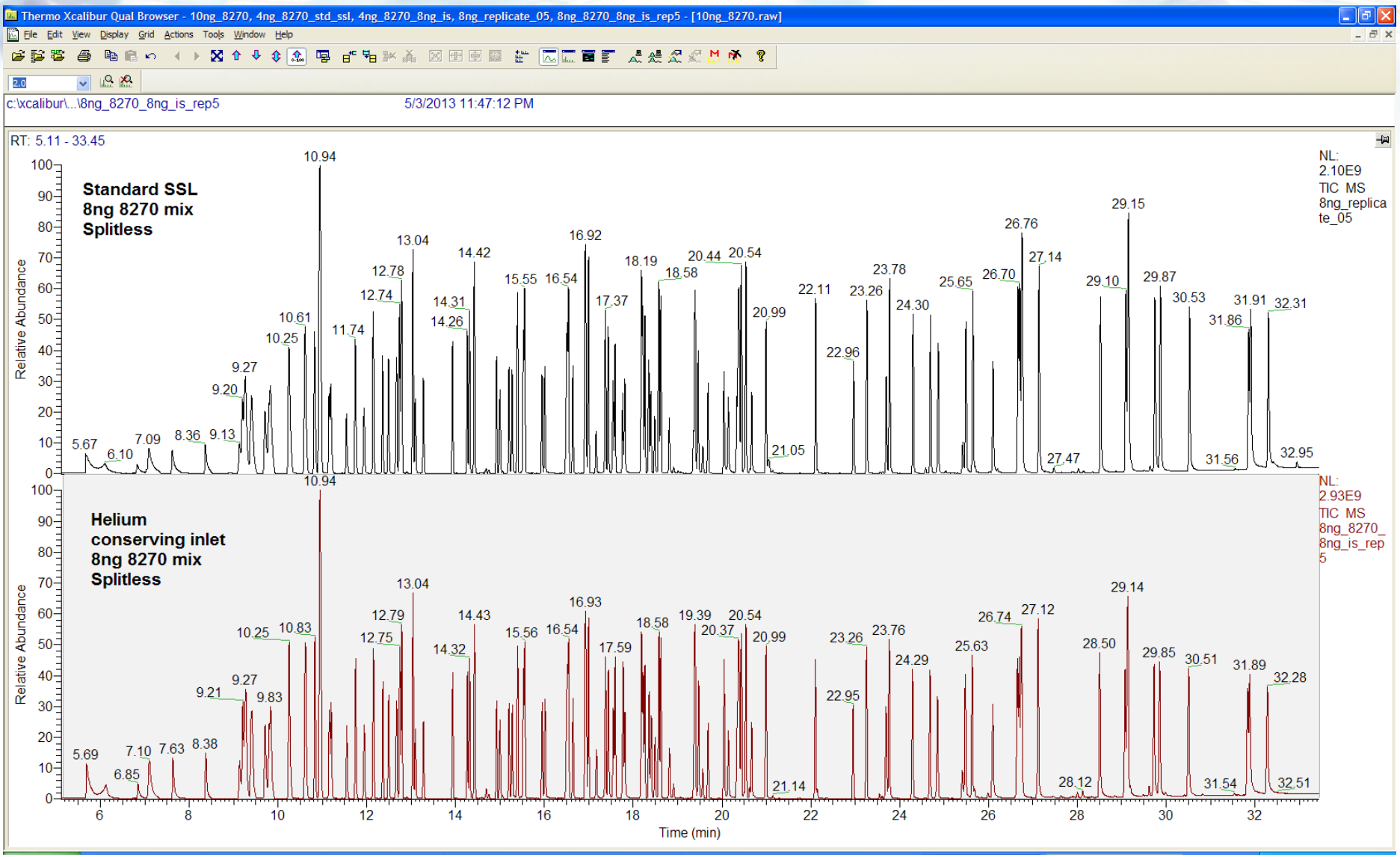


Component	Absolute Peak Areas (counts)	Recovery (%) *
nC10	2498258	100.3
nC12	2457224	98.7
nC14	2550661	102.4
nC16	2504229	100.6
nC18	2484007	99.8
nC20	2489876	100.0
nC22	2482628	99.7
nC24	2455417	98.6
nC26	2409871	96.8
nC28	2438442	97.9
nC30	2469831	99.2
nC32	2412554	96.9
nC34	2472760	99.3
nC36	2422105	97.3
nC38	2394975	96.2
nC40	2349780	94.4

* nC20 internal standard reference

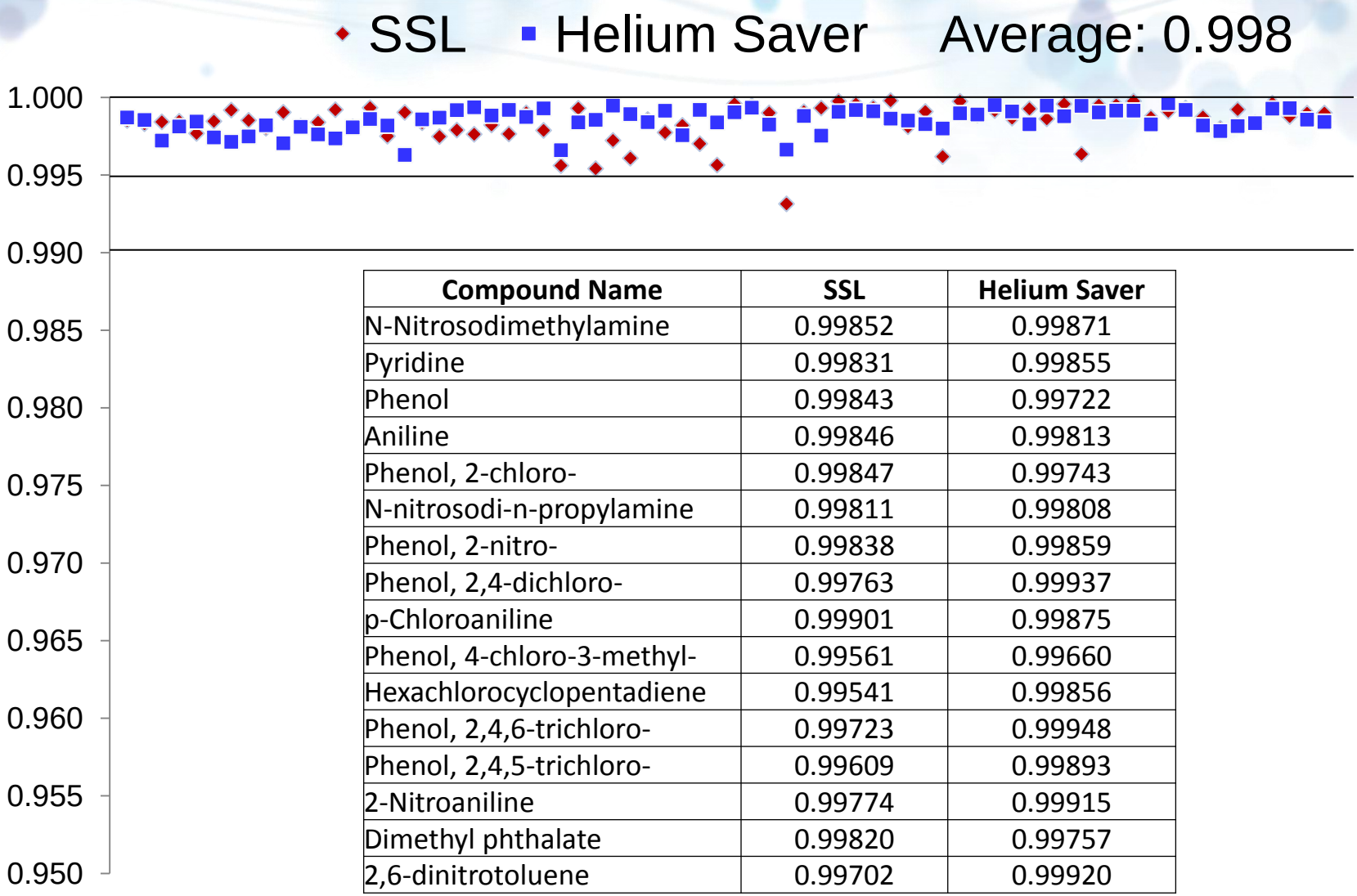
Splitless 1 µL
7 m, 0.32 mm ID,0.25 µm TRACE TR5 Column
60 ° to 320 °C at 10 C/min
CF 2 mL/min
Helium Saver SSL and FID at 340 °C

Helium Saver: EPA Method 8270 Unchanged



ThermoFisher SCIENTIFIC

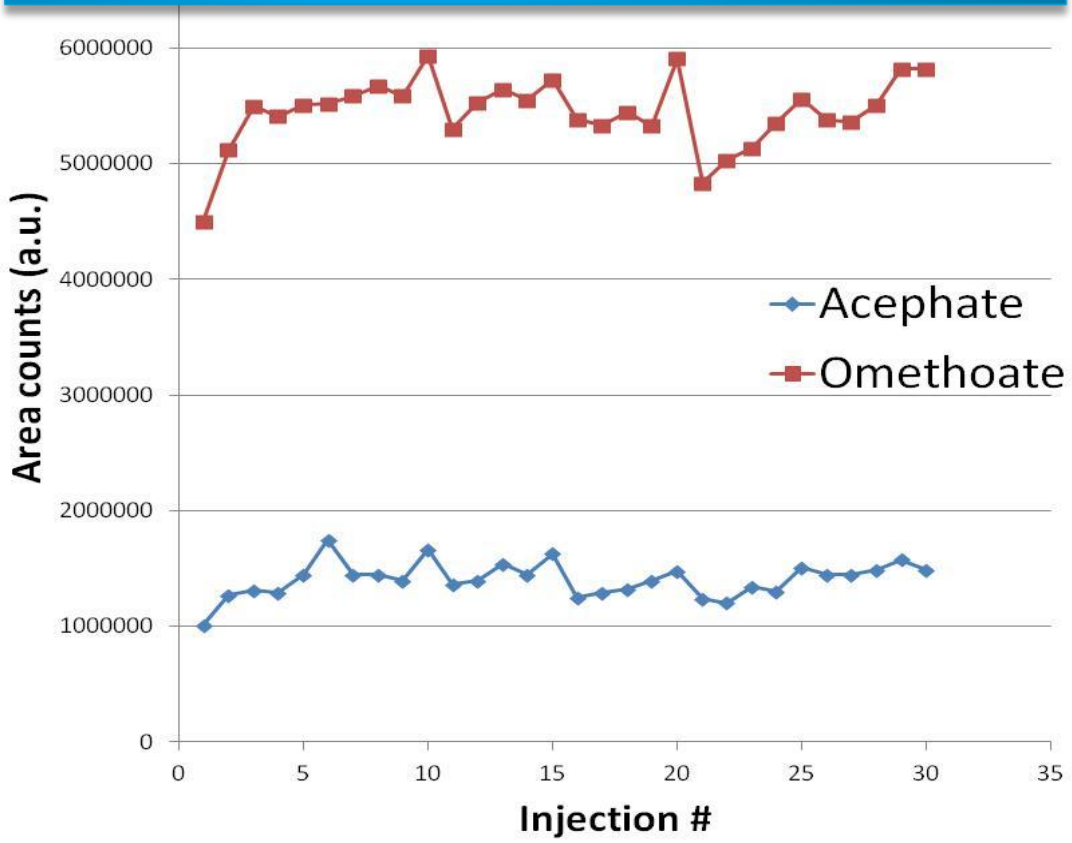
EPA Method 8270 Calibration Curves R^2 Results



Compound Name	SSL	Helium Saver
N-Nitrosodimethylamine	0.99852	0.99871
Pyridine	0.99831	0.99855
Phenol	0.99843	0.99722
Aniline	0.99846	0.99813
Phenol, 2-chloro-	0.99847	0.99743
N-nitrosodi-n-propylamine	0.99811	0.99808
Phenol, 2-nitro-	0.99838	0.99859
Phenol, 2,4-dichloro-	0.99763	0.99937
p-Chloroaniline	0.99901	0.99875
Phenol, 4-chloro-3-methyl-	0.99561	0.99660
Hexachlorocyclopentadiene	0.99541	0.99856
Phenol, 2,4,6-trichloro-	0.99723	0.99948
Phenol, 2,4,5-trichloro-	0.99609	0.99893
2-Nitroaniline	0.99774	0.99915
Dimethyl phthalate	0.99820	0.99757
2,6-dinitrotoluene	0.99702	0.99920

Helium Saver: Low Level Pesticide/Fungicide Precision

Very good repeatability and stability also for labile pesticides



7.4 % average RSD on 30 runs (500 pg level)

	% RSD
Acephate	10.6
Acibenzolar-S-methyl	3.9
Boscalid	10.5
Carbaryl	7.6
Cyromazine	3.7
Dimethomorph-1	8.7
Dimethomorph-2	12.0
Formetanate HCl	13.0
Imazalil	7.4
Indoxacarb	14.1
Metalaxyl	3.3
Myclobutanil	5.0
Omethoate	5.6
Piperonyl butoxide	8.7
Propamocarb	3.1
Propiconazole-1	6.1
Propiconazole-2	5.3
Pyridaben	8.1
Thiabendazole	6.6
Thiophanate-methyl	4.7

Helium Saver Technology: Revolutionary Approach

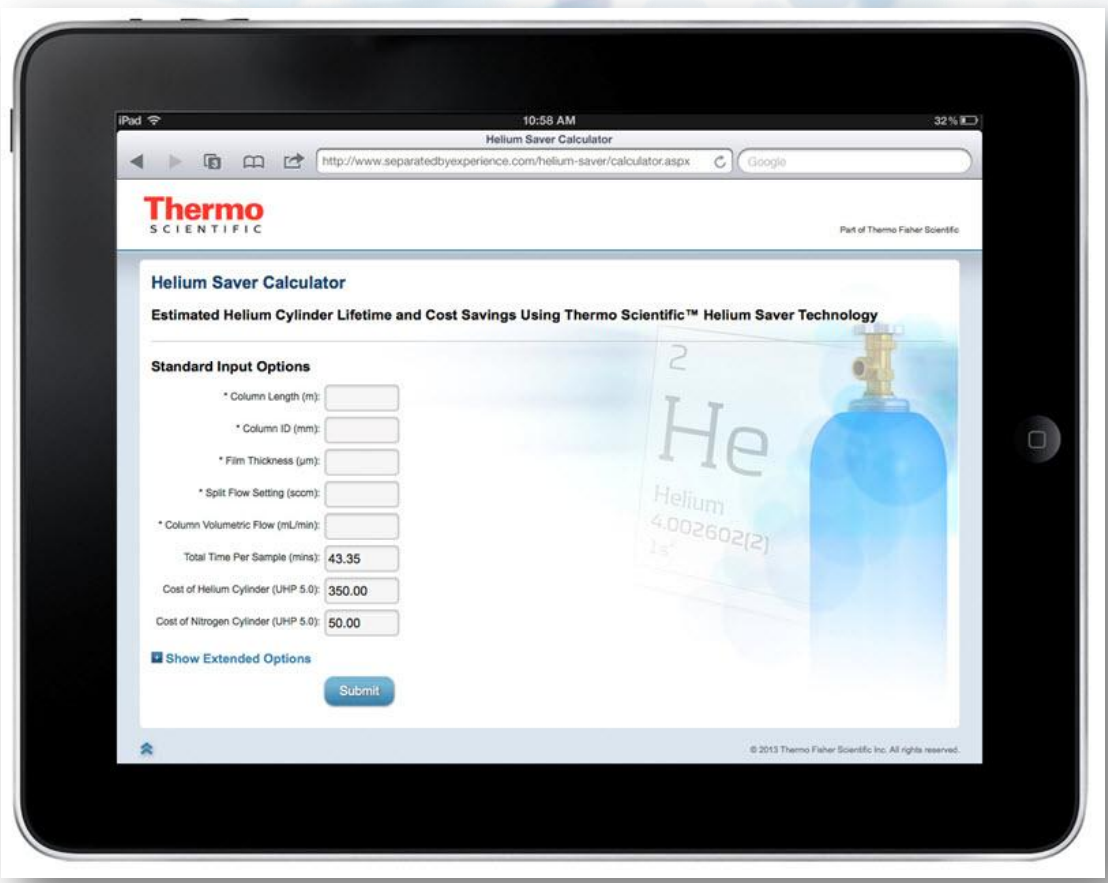
Innovative and Unique Features and Benefits

- **Up to 14 years** of one helium cylinder life time
- **Always saves** – works during analytical run *and* idle time
- **Always ready** – no switch-back equilibration time
- Change **septum and liner** without GC or MS cooling down
- Can maintain **existing** methods
- Helium Saver Technology is covered by U.S. Patent 8,371,152

How Long Can One Helium Cylinder Last in YOUR Lab?

Use our calculator to find out how much the Helium Saver Module can help your lab. Enter your working parameters and discover the following:

- How long one cylinder of helium can last in your lab
- How much budget you can save on helium supplies over the lifetime of your GC or GC-MS instrument

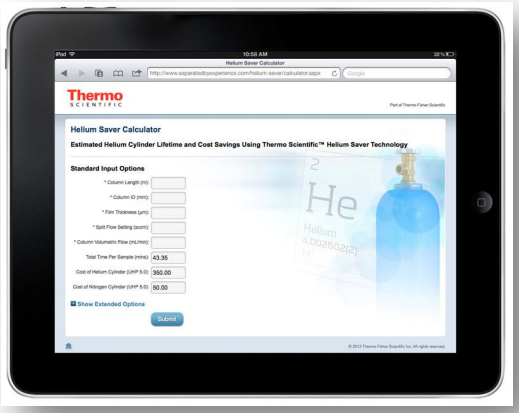


www.thermoscientific.com/heliumsaver

ThermoFisher SCIENTIFIC

Thank You for Your Attention!

Questions?



www.thermoscientific.com/heliumsaver

Stay connected with us

Twitter
@ChromSolutions

Chromatography Solutions Blog
http://chromblog.thermoscientific.com/blog

YouTube
http://www.youtube.com/ChromSolutions

Facebook
http://www.facebook.com/ChromatographySolutions

Pinterest
http://pinterest.com/chromsolutions/

ThermoFisher SCIENTIFIC