Agilent Portfolio

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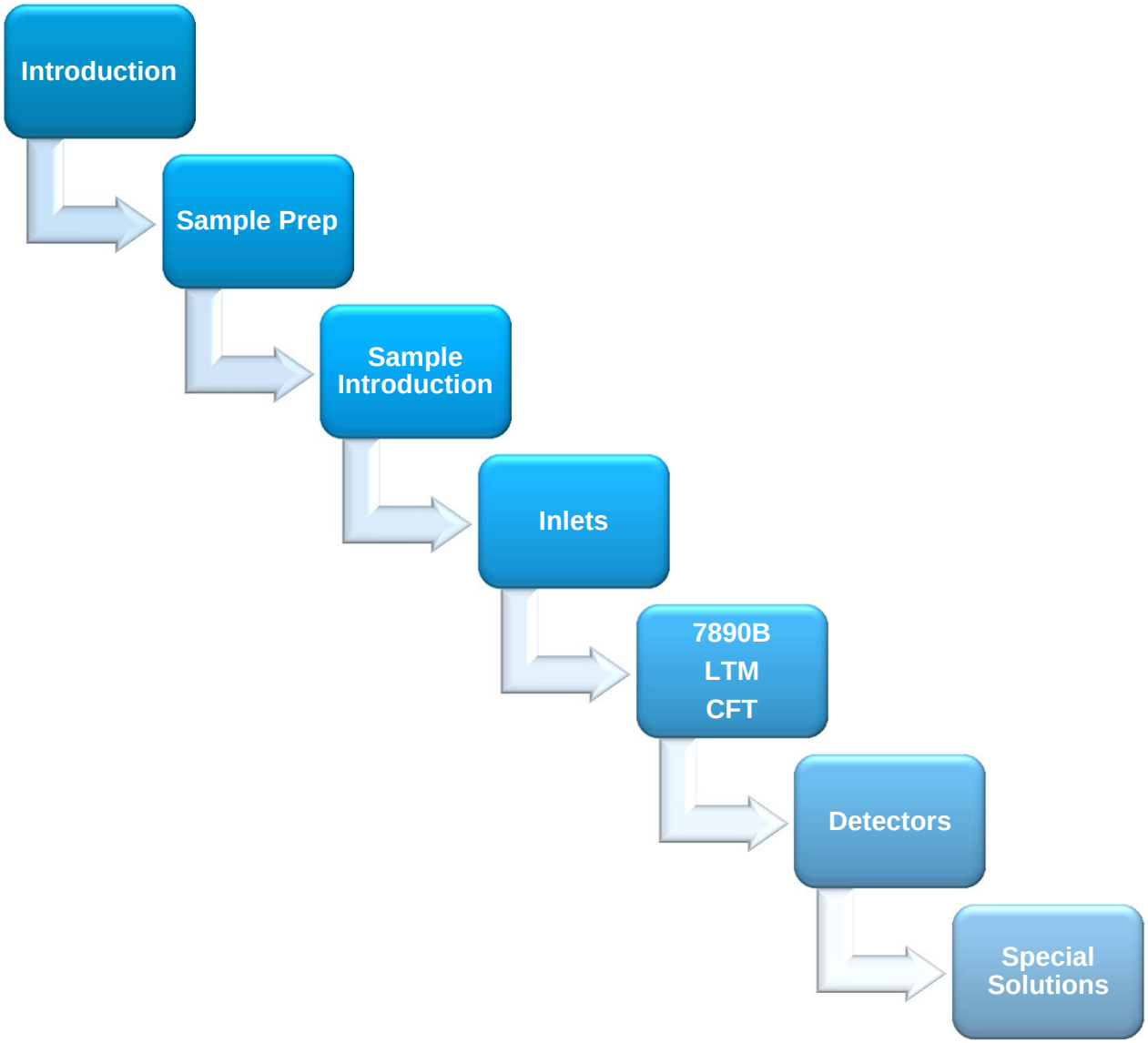
Technical Marketing Specialist GC-GCMS

Agilent Technologies

Summary


Introduction
Sample Prep
Sample Introduction
Inlets
7890B
LTM
CFT
Detectors
Special Solutions

Agilent Gas Chromatography Portfolio

Chromatography *is the collective term for a set of techniques for the separation of mixtures.*

7890B

6850

7820A

490 µGC

PREPARE THE SAMPLE

Sample Preparation – The Agilent Workbench

- Dilution/Aliquoting/Reconstitution
- Additions (Standards, reagents, etc)
- Heating (Reactions, Derivatization, etc)
- Mixing (Spin/Vortex)
- Barc Code Reader

2-Glycerins in Biodiesel (ASTM D6584)

10mg B100

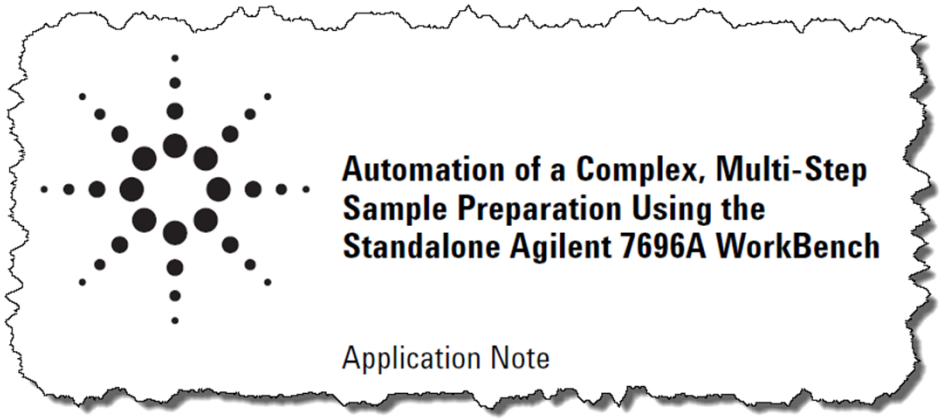
ISTD1 and ISTD2 addition

MSTFA addition, react 15’

n-Heptane addition and mixing

GC-FID

Ten times less reagents!



Faster, cheaper, safer!

3-Hydrocarbon Oil Index in water

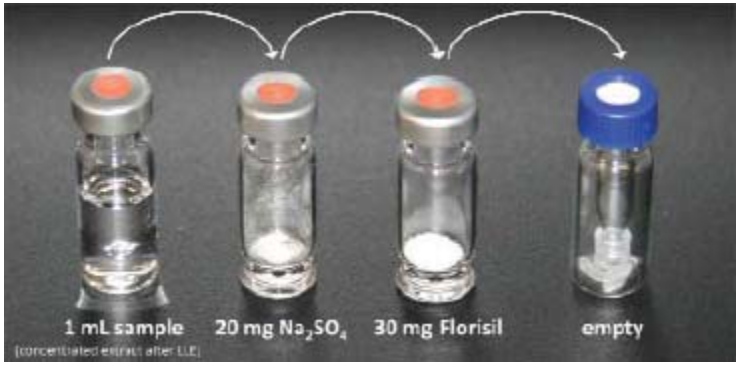
Hexane extract

Na_2SO_4 treatment (water removal)

Florisil dispersive SPE

Transfer to GC vial

GC-FID



Automated Clean-up for Mineral Oil (Hydrocarbon Oil Index) Analysis using the Agilent 7696A Sample Prep WorkBench

Application Note

Automated Sample Preparation

Faster, cheaper, safer!

4-PCB in waste oil

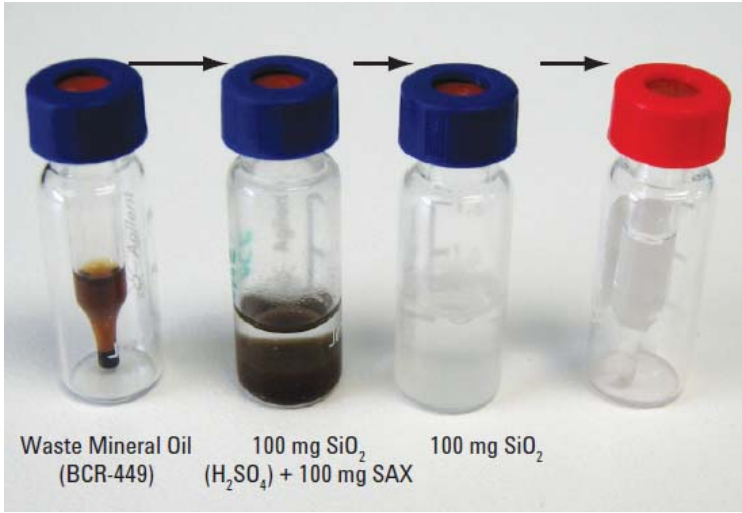
Hexane extract

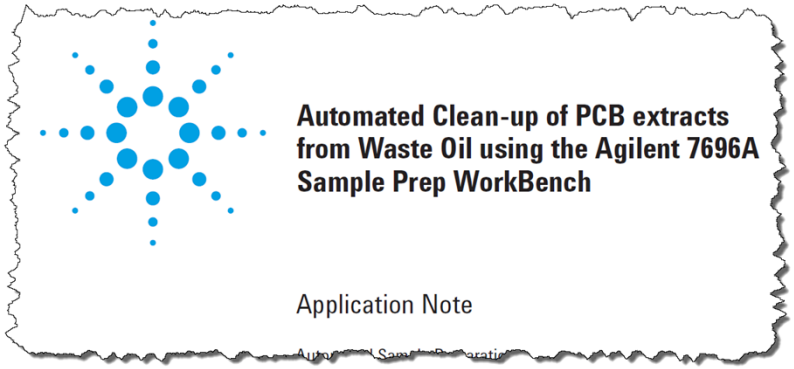
Acidified silica/anion exchange dispersive SPE

Silica dispersive SPE

Transfer to GC vial

GC-MSMS



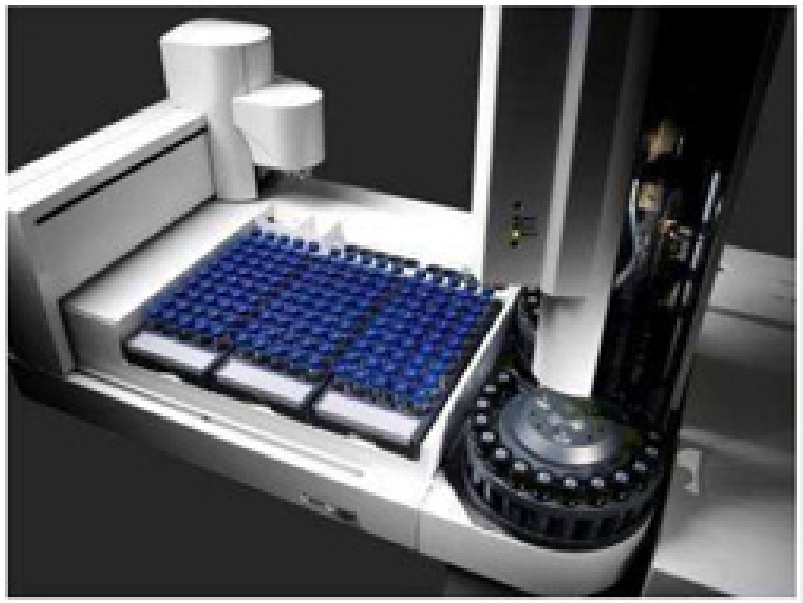


Faster, cheaper, safer!

Agilent Technologies

BRING THE SAMPLE TO THE GC

Sample handling



Agilent 7693 ALS

With (limited) Sample Prep capabilities

Agilent Headspace Sampler

Sample handling

Stratum P&T

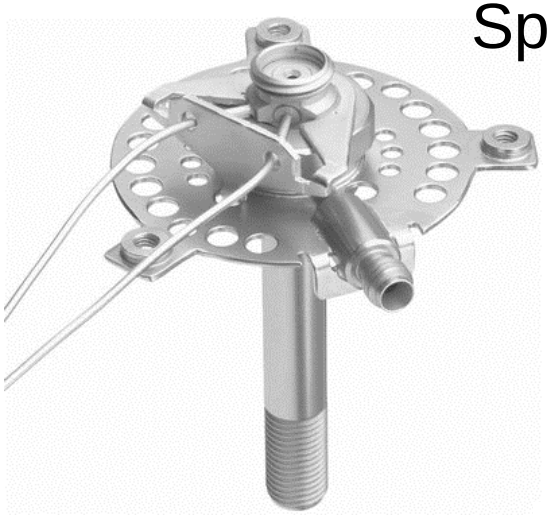
Markes TD

Pal Sampler 80/120

INJECT THE SAMPLE INTO THE GC

Inlets

Split/Splitless



Multimode

Gas/Liquid
Sampling
Valves

Plus also:
Volatile Interface
Cool on column

A quick look at the most versatile inlet: MMI Design

MMI Programmable Temperature Vaporizing Inlet – injection modes

Hot split/splitless (also pulsed)

- similar to the S/SL inlet using the same liners

Cold split/splitless (also pulsed)

- Significantly more inert than hot splitless
- Can inject 3-5 uL with no solvent venting
- Better sensitivity than hot splitless because large vapor cloud is not formed which travels outside the liner and portions are lost

LVI-Solvent Vent

- An extension of cold splitless
- Large volume injection for maximum sensitivity

Advantages of MMI vs. S/SI

Advantages

- Cold injection mode eliminates needle discrimination and reduces thermal decomposition
- Matrix can be trapped in the liner more readily
- Thermal cleanout step is possible
- Larger injection volumes possible

MMI , Pentachlorophenol, 10.8 min

1 Hot Splitless

2 Pulsed Hot Splitless

3 Pulsed Hot Splitless with SPC

4 Hot Splitless with SPC

5 Cold Splitless

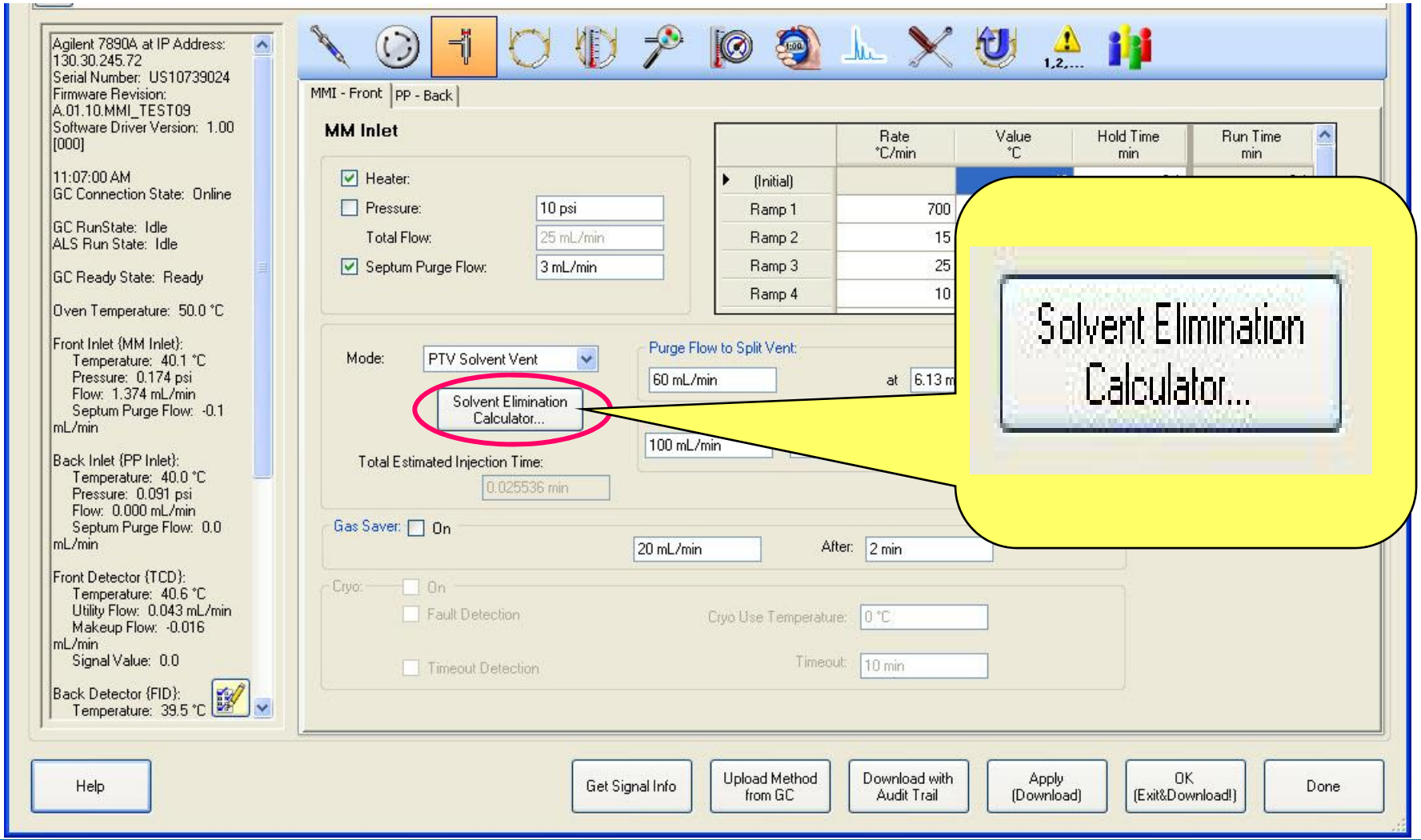
6 Pulsed Cold Splitless

7 Pulsed Cold Splitless with SPC

8 Cold Splitless with SPC

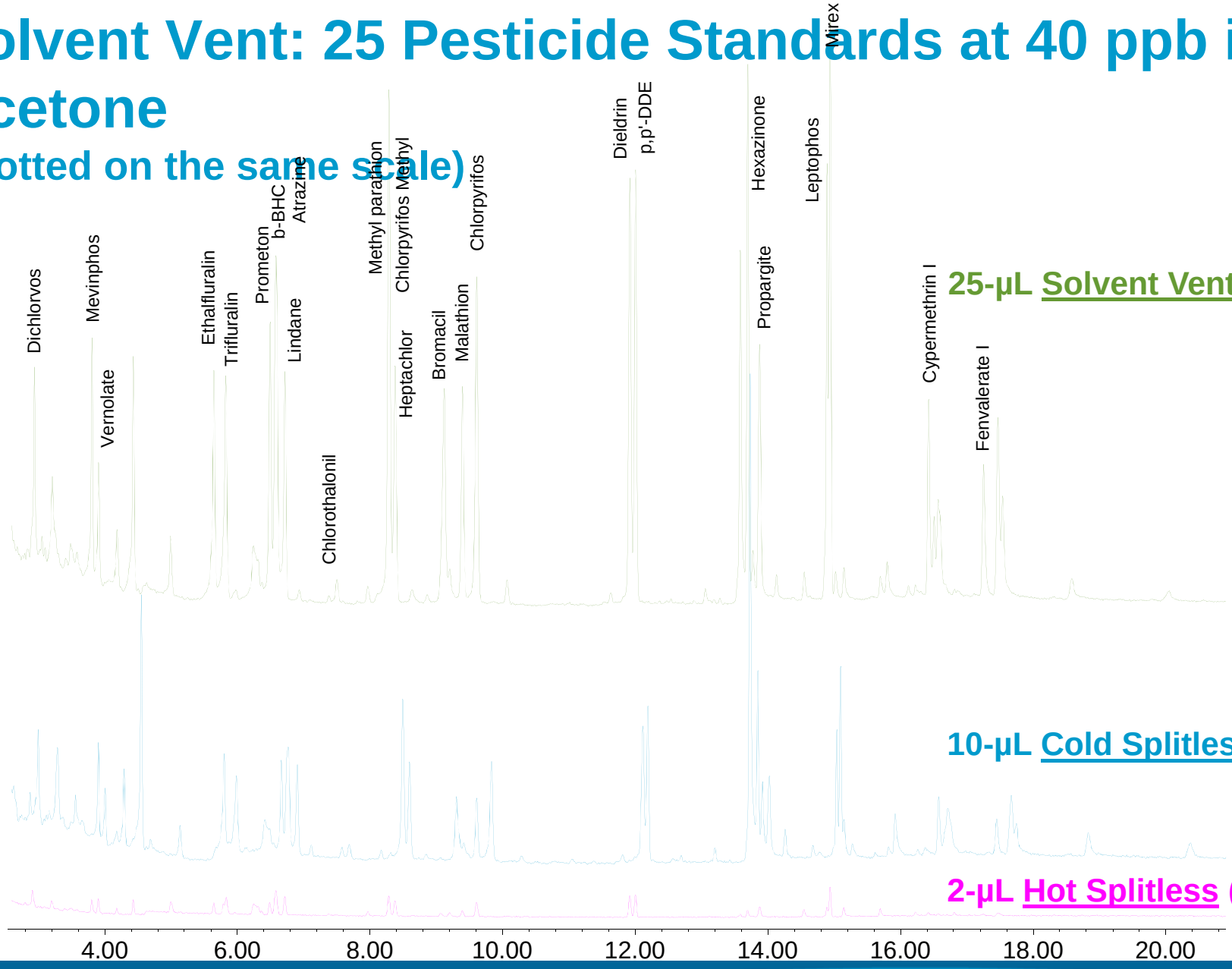
An active compound where cold splitless is used,
… is better than the best hot splitless

New Multimode Inlet “Solvent Elimination Wizard” Built-into ChemStation for Easy Method Development



Solvent Vent: 25 Pesticide Standards at 40 ppb in Acetone

(plotted on the same scale)



SEPARATE THE SAMPLE - THE GC

7890B – Worldwide Leading Gas Chromatograph

Reliability

Productivity

Flexibility

7890B Features

- ✓ 5th generation EPC
- ✓ 3 detectors and 4 signals Low Thermal Mass
- ✓ Early Maintenance Feedback (EMF), Sleep/Wake modes
- ✓ Method Translation Calculator
- ✓ Enable 2-way GC/5977A MSD communication
- ✓ Sleep/Wake Modes - Reduce Power/Gas Costs
- ✓ Third party detectors ready
- ✓ Special Solutions ready

Technologies that matter: Only from Agilent

Agilent has developed core competency in chemical vapor deposition surface deactivation resulting in proprietary processes to dramatically improve GC inertness.

Deactivation processes for:

- Glass
- Steel
- Gold
- Glass wool

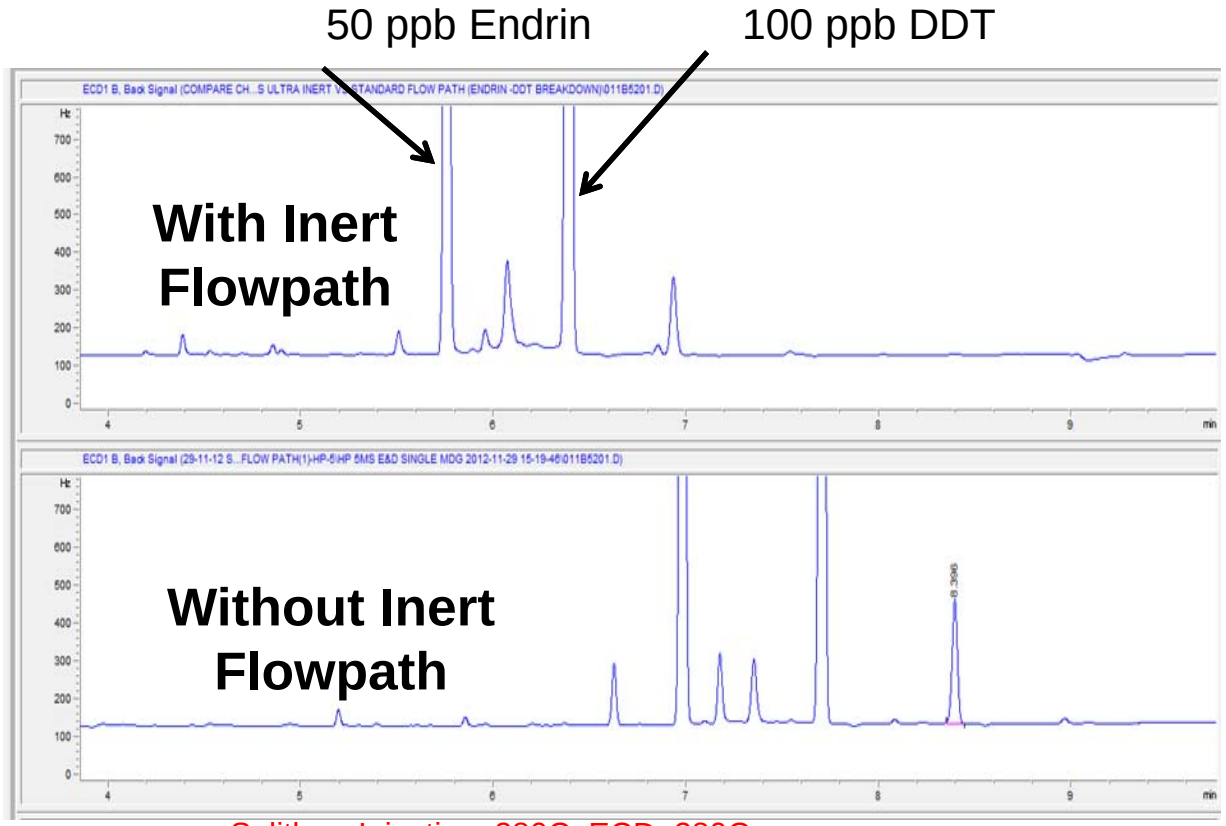
Agilent Inert Flow Path … From Injection to Detection

Ensures superior performance for trace level analysis

Agilent's Inert Flowpath..*From Injection to Detection*

Clearly less breakdown of a ppb level standard after 100 injections!

<u>Consider the following</u>:
Inlet liner
Gold seal
Inlet weldment
Column
Capillary Flow Device
Detector



Splitless Injection, 280C, ECD, 280C

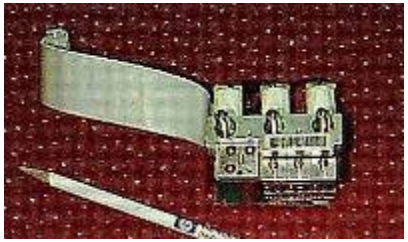
5th Generation Electronic Pressure Control (EPC)

1st, 2nd Generation EPC
-- 0.1 psi
-- cables
-- gas lines & connectors
-- large size

5890 GC

3rd, 4th Generation EPC
-- 0.01 psi
-- Diffusion bonded plate (2D)
-- one cable
-- three gas connectors
-- "credit card" size

6890N GC



7890B GC

The only GC to regulate pressure to 0.001 psi

5th Generation EPC
- Metal injection molded (3D)
- Digital signal pathways

… improved reliability and precision

Retention Time Locking - RTL

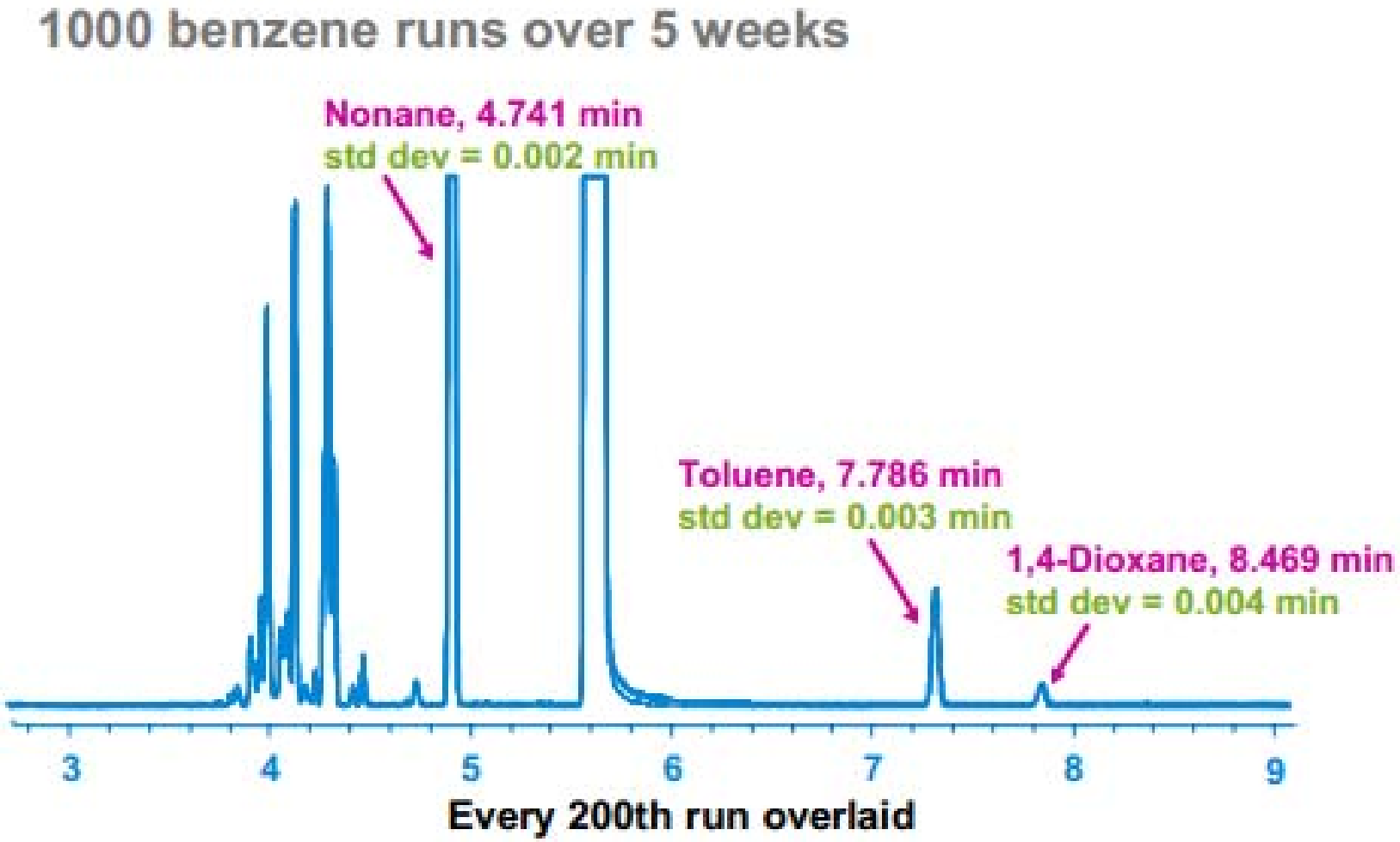
What is RTL?

- The ability to precisely match chromatographic retention times in a single GC and/or group of GCs using the same nominal method and column.

How is this done?

- This is done by adjusting the column head pressure using Electronic Pressure Control (EPC) and interactive software.

Retention Time Locking - RTL

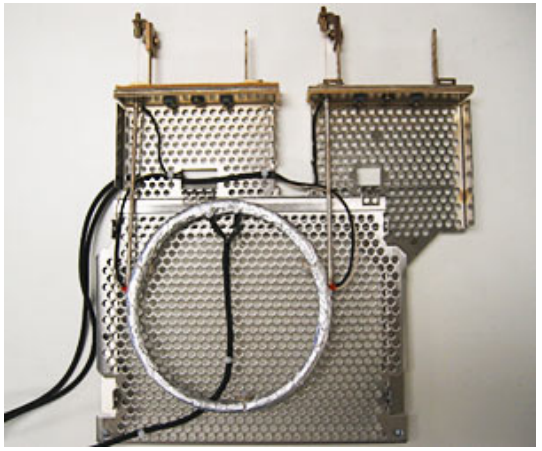


RTL on 10 Different Systems, Columns, Operators

			Retention Times (minutes)		
Inlet	*Detector*	*Injection Technique*	*Dichlorvos*	*Chlorpyrifos methyl*	*Mirex*
S/SL	MSD	Splitless	5.897	16.593	29.800
PTV	µ-ECD	Split	5.798	16.576	29.876
PTV	FID	Splitless	5.797	16.587	29.856
S/SL	AED	Splitless	5.829	16.600	29.839
S/SL	µ-ECD	Split	5.860	16.597	29.864
PTV	µ-ECD	Cold Splitless	5.862	15.589	29.867
S/SL	Dual FPD	Splitless	5.814	16.596	N/A
S/SL	AED	Splitless	5.837	16.604	29.851
OC	MSD	On-Column	5.862	16.607	29.836
S/SL	NPD	Splitless	5.814	16.596	N/A
Hi- Lo			0.100	0.028	0.076
Average			5.837	16.595	29.849
STDEV			0.033	0.009	0.024

SPEED UP YOUR WORKLOAD - LTM

A Closer Look

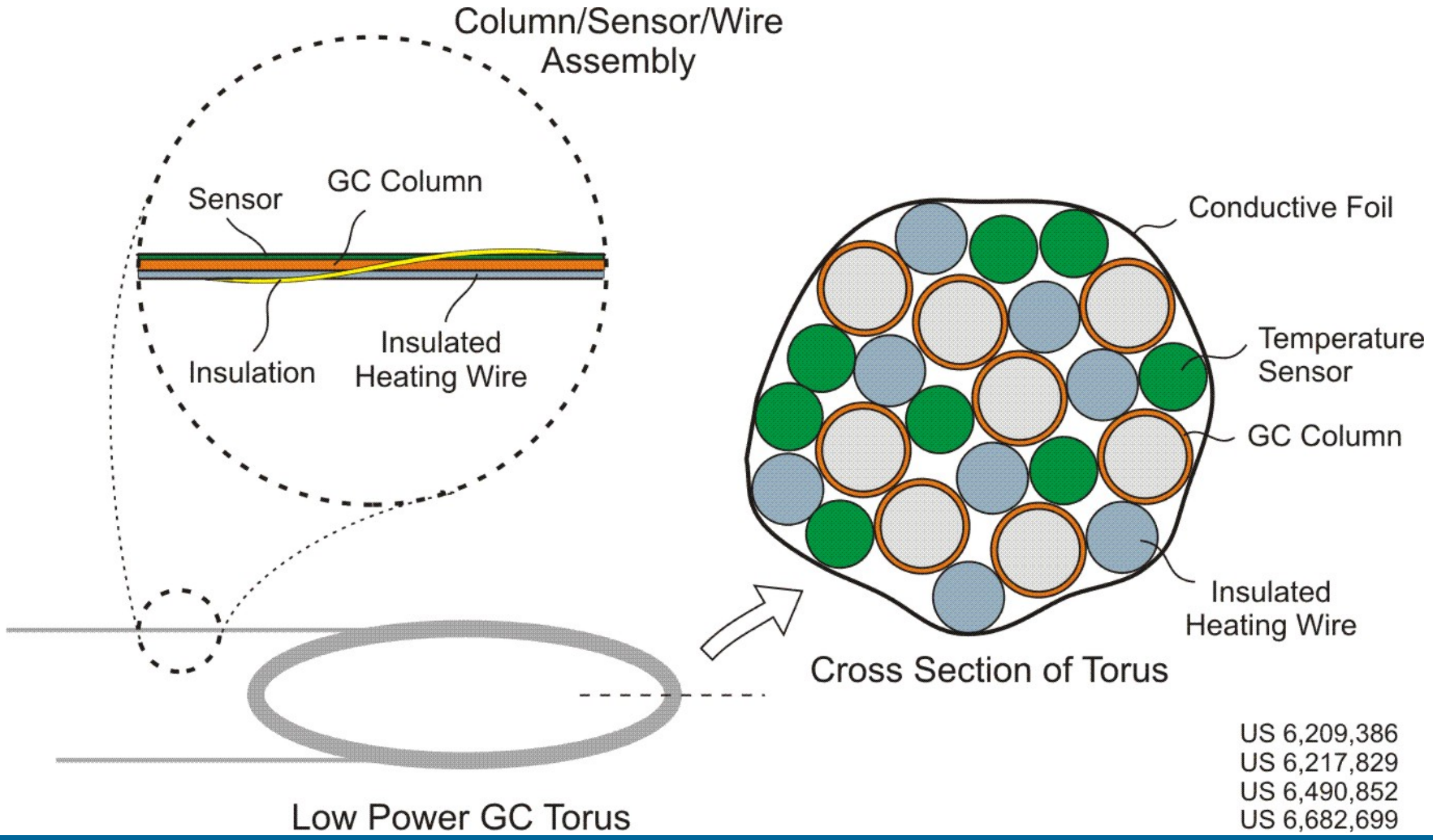


LTM Column Assembly

LTM Retrofit Door

LTM Column Module

“LTM” (Low Thermal Mass) Technology (Patented) for Ultra Fast Chromatography



US 6,209,386
US 6,217,829
US 6,490,852
US 6,682,699

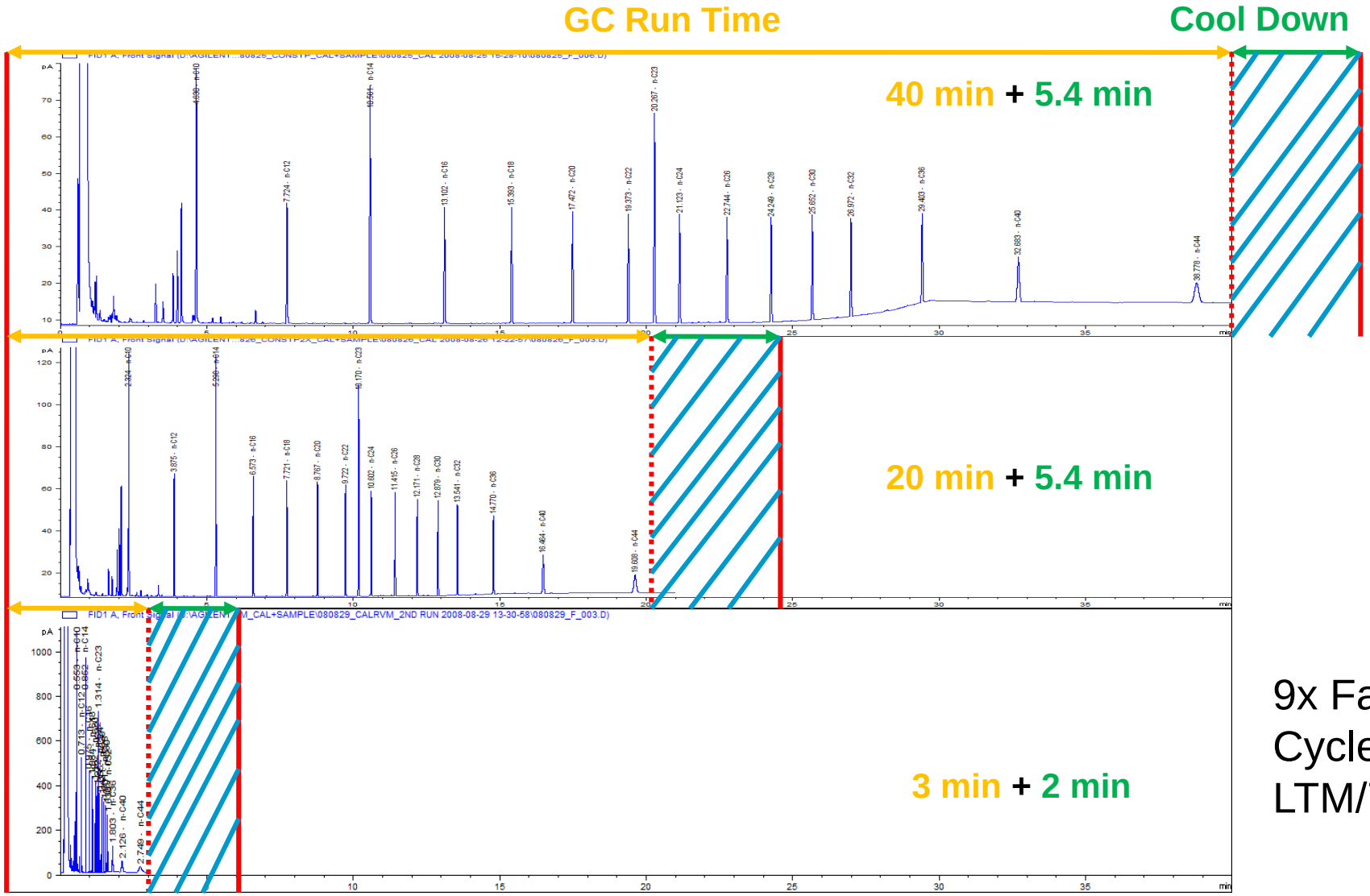
Environmental – TPH/Mineral Oil Analysis
#1 "Killer App" for LTM

- When there's a need for high through-put, there's a need for LTM!
- Analytical cycle times are a critical element in making a profit

5990-3201EN Ultra-Fast Total Petroleum Hydrocarbons (TPH) Analysis

- 9x faster TPH throughput using LTM
- 18x faster TPH using LTM and dual simultaneous injection

LTM Also Greatly Reduces Cool-Down Times, → 9x Faster Heating/Cooling Cycle Times



9x Faster Cycle Time LTM/7890

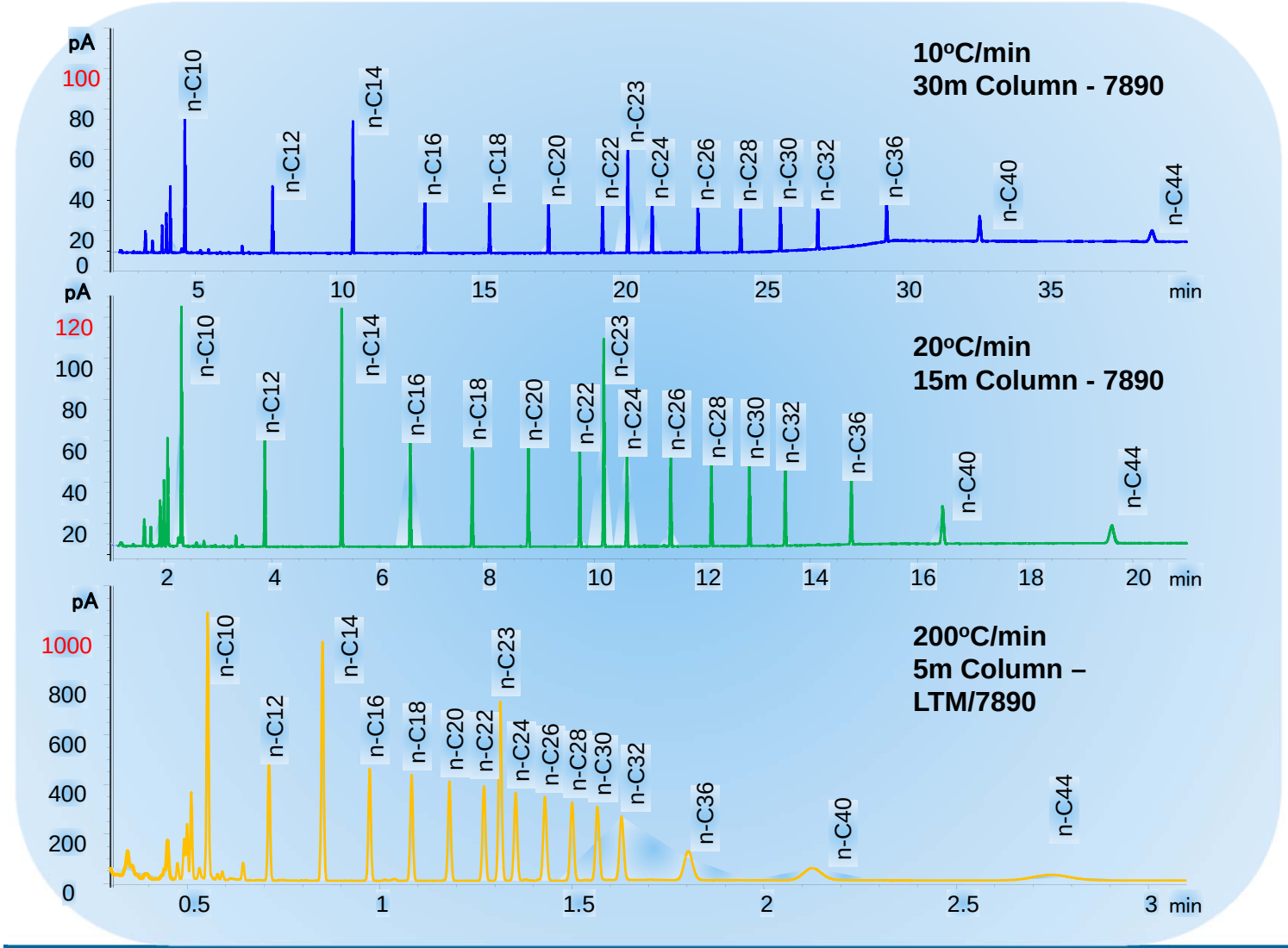
Conventional Air Bath vs. LTM

Heating	Column	Program	Cool Down	Cycle Time
7890A (120V)	30M x 0.53mm x 3.0um DB624	40 C(20 min) to 240 C (20 min) @ 10 C/min	6 min 50 sec with 3 min oven equil.	67 min
7890A (220V)	7M x 0.25mm x 1.4um DB624	35 C (5 min) to 240 C (5 min) @ 45 C/min *	8 min with 3 min oven equil.	22 min 30 sec
LTM (Fast)	7M x 0.25mm x 1.4um DB624	35 C (5 min) to 240 C (5 min) @ 60 C/min	1 min 45 sec (one module system)	15 min 10 sec
LTM (Faster)	7M x 0.25mm x 1.4um DB624	35 C (5 min) to 240 C (3 min) @ 100 C/min	1 min 45 sec (one module system)	11 min 45 sec
LTM (Fastest)	7M x 0.25mm x 1.4um DB624	35 C (4 min) to 240 C (3 min) @120 C/min	1 min 45 sec (one module system)	10 min 30 sec

- LTM is 4x-6x faster than Conventional GC Method
…depending on which solvents analyzed → even faster is possible!

- LTM cooldown much faster than Conventional GC

Faster GC Run Times for TPH Analysis (oil index as per ISO 9377-2)



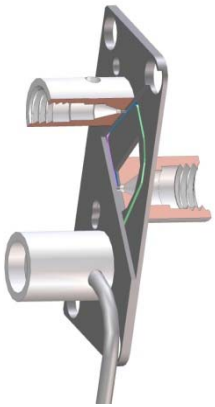
Standard GC Run Time

2x Faster, 7890

10x Faster, LTM/7890

MORE FLEXIBILITY - CAPILLARY FLOW TECHNOLOGY

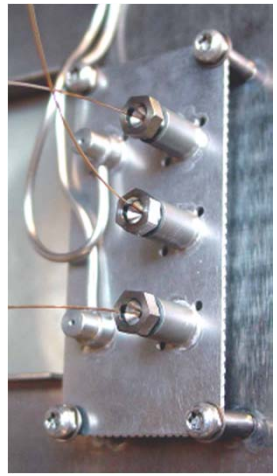
Backflush Capability is Provided by Any Purged Capillary Flow Device



QuickSwap

2-Way Splitter with Makeup

3-Way Splitter with Makeup



Deans Switch

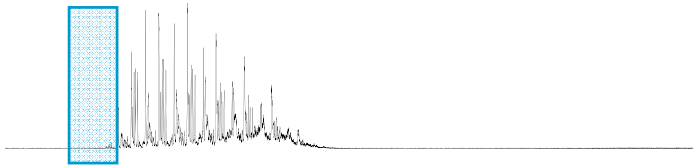
Purged Tee

Capillary Flow Technology Devices

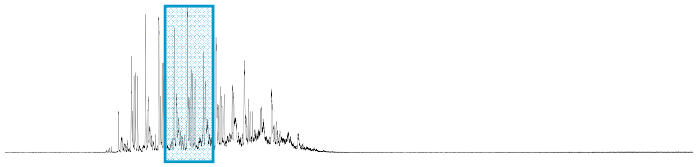
Family of devices based on diffusion-bonded plate technology. Devices include:

- Column-Column connectors (purged and un-purged)
- Effluent splitters (purged and non-purged)
- Dean's switch
- MSD no-vent (With Purged Ultimate Union)
- Multiple column effluent combiner
- Flow Modulator

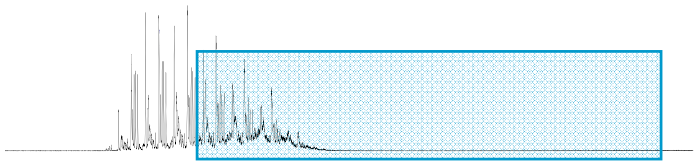
Capillary Flow Technology- Capabilities



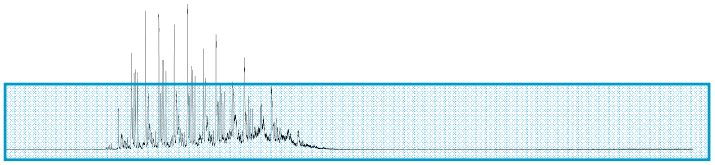
Solvent Bypass



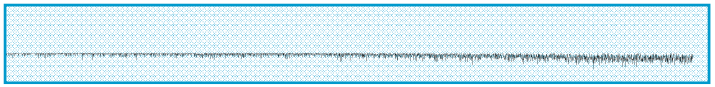
Heart Cutting (Deans Switch)



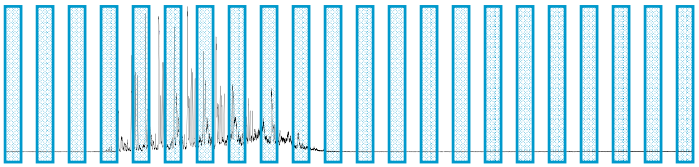
Backflush



Detector Splitting

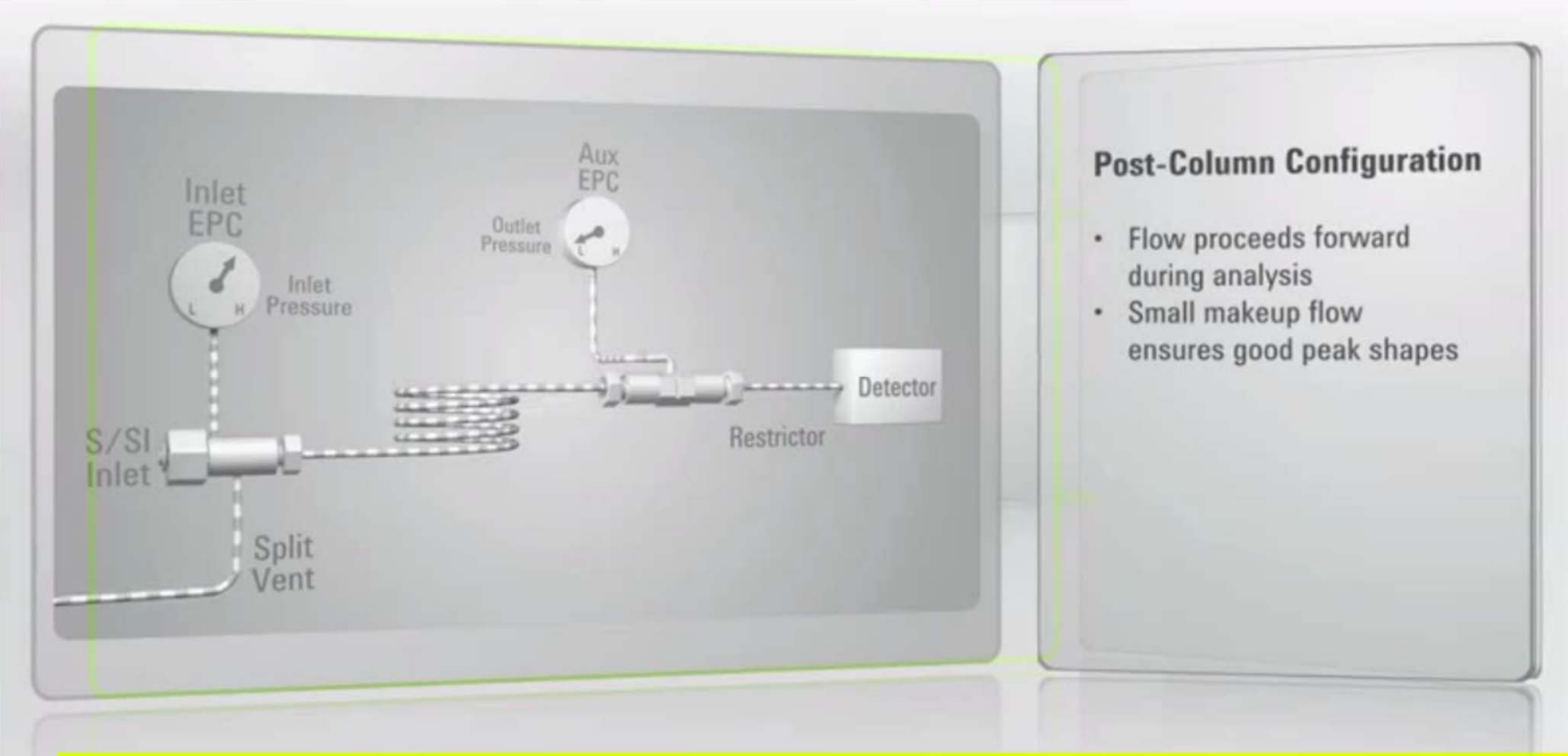


QuickSwap



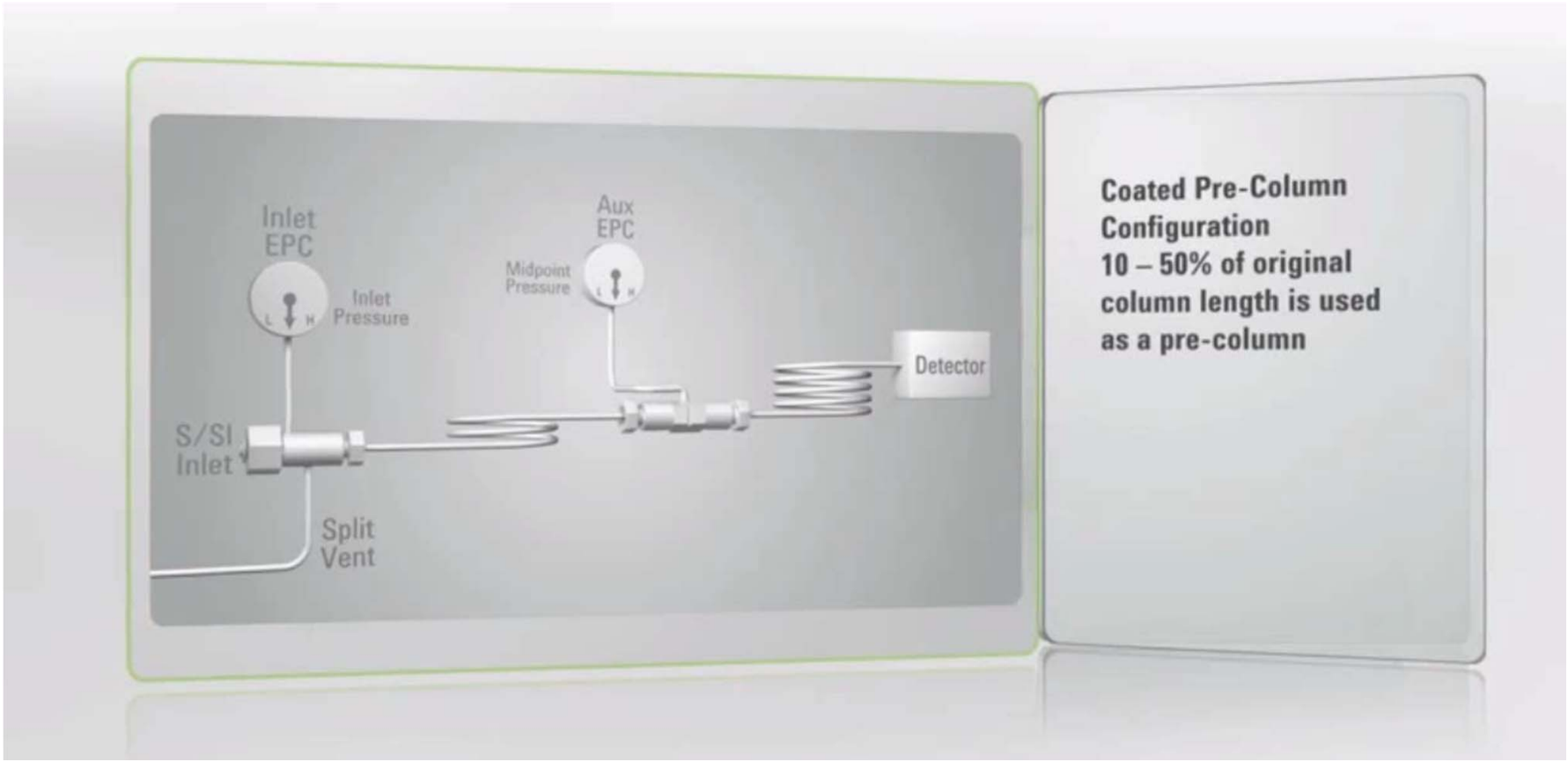
Modulation (GCXGC)

Post Column Backflush



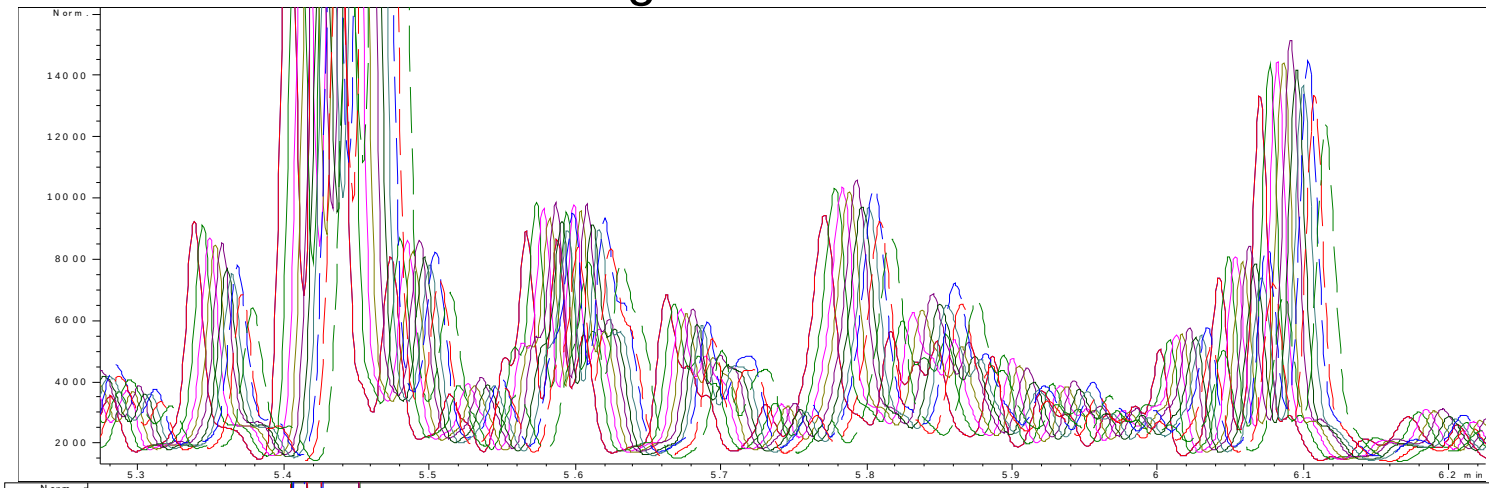
Pre or Mid Column Backflush

Allows also concurrent backflush

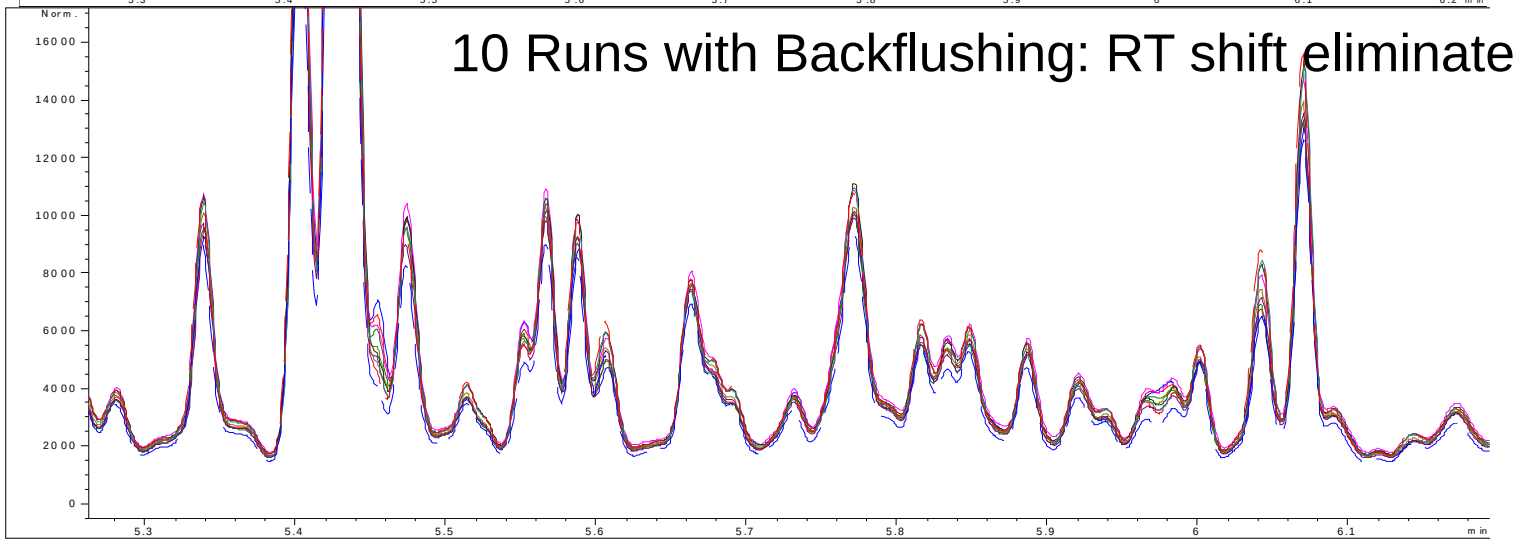


10% Fish Oil In Acetone: Retention Time Shifts Eliminated With Backflushing

10 Runs without Backflushing: Retention times shift ~4-5 sec during 10 runs



10 Runs with Backflushing: RT shift eliminated



Agilent Technologies

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DETECT THE COMPOUNDS

Detectors

FID

- Broad application as the most used general detector

TCD

- Petroleum & Petrochemical, Gas analysis of process streams, natural gas

NPD

- Selective detector for N2 and P compounds

µECD

- Chlorinated Pesticides and PCB analysis, selective for electronegative compounds

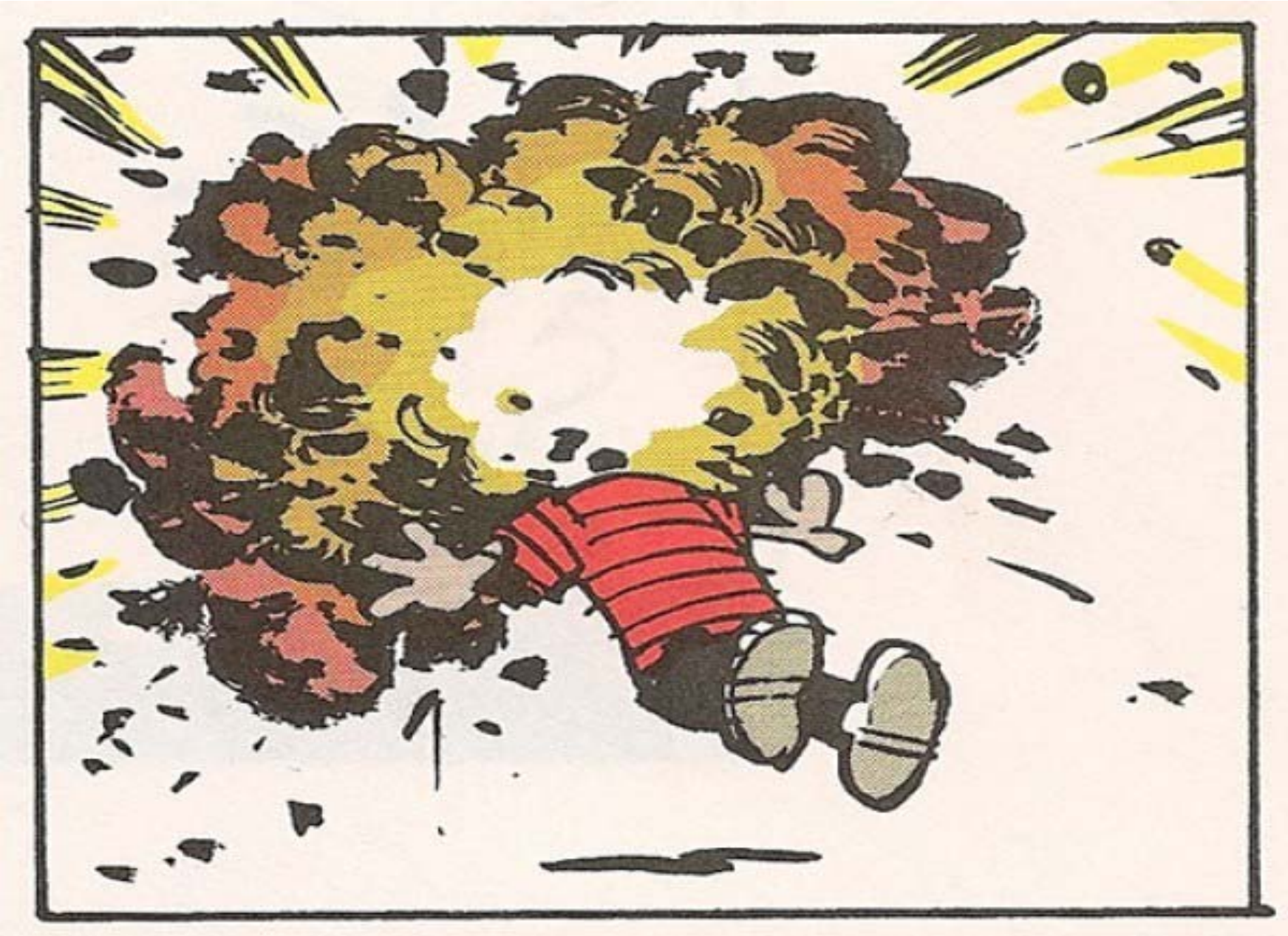
FPD

- Sulphur in process stream, fuels and oil products

Chemiluminescence NCD/SCD

- Selective N2/S8 compounds, Low Sulfur regulations

Agilent Plug ‘n Play Solutions



Agilent Understands the Pressures YOU Face:

- Process thousands of samples
- Screen for hundreds of compounds
- Trace analysis in complex matrix
- Better sensitivity to meet changing regulatory requirements
- Quickly validate method for real world samples
- Generate quality data more quickly

… all with limited resources

The Value of the Analyzer Solutions

- Receive systems optimized for your particular analysis
- Obtain accurate and reliable results
- Save time and reduce cost for system configuration and method development
- Quicker start to system calibration and validation

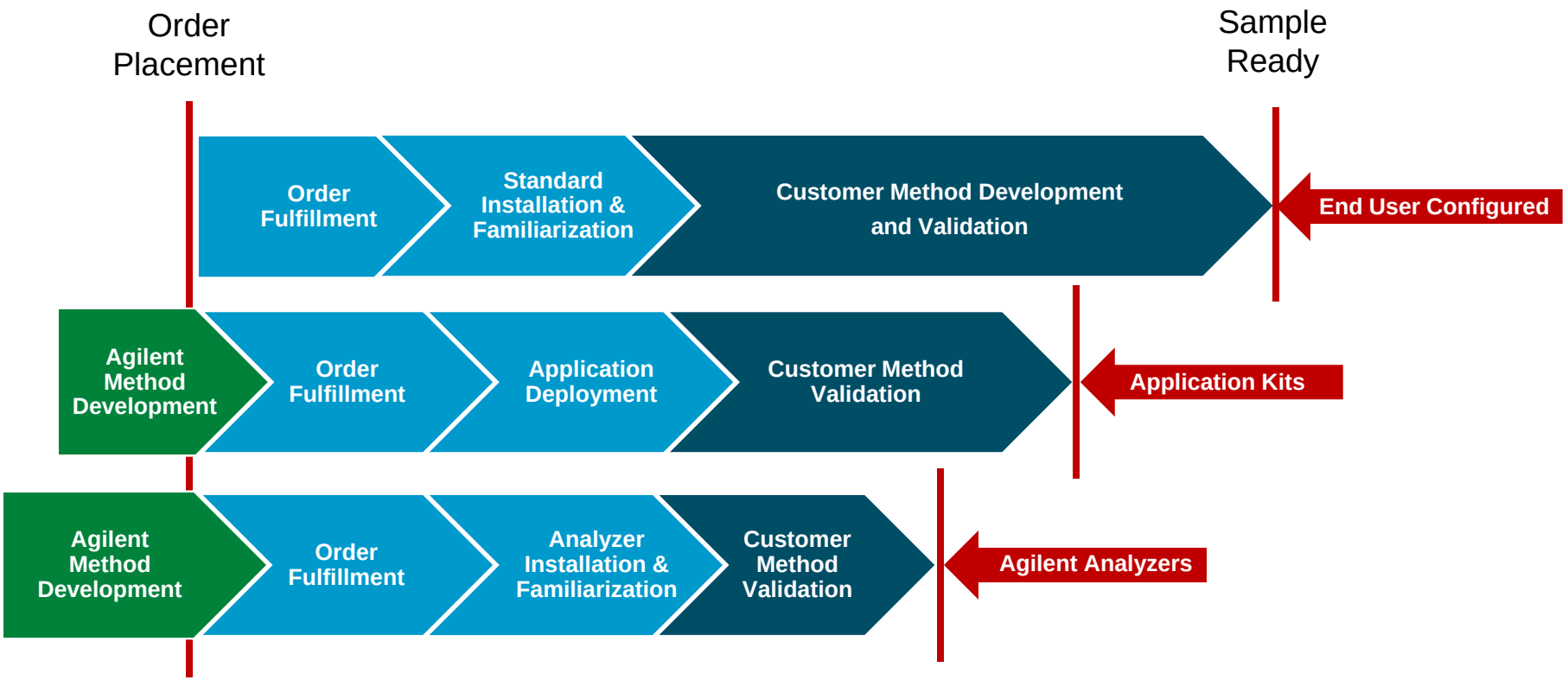
The Analyst's Needs

Agilent Analyzer

Application Notes and Onsite training

The Value of Analyzers and Application Kits

Reduce the time required for system deployment



…Faster Application Startup and a High Quality Method

Agilent HPI Solution Portfolio overview

SP1 Solutions

- Factory provided hardware modifications and solutions for GC and GC/MSD sold by Agilent.
- Performance guarantee for standard applications

SP2 Solutions

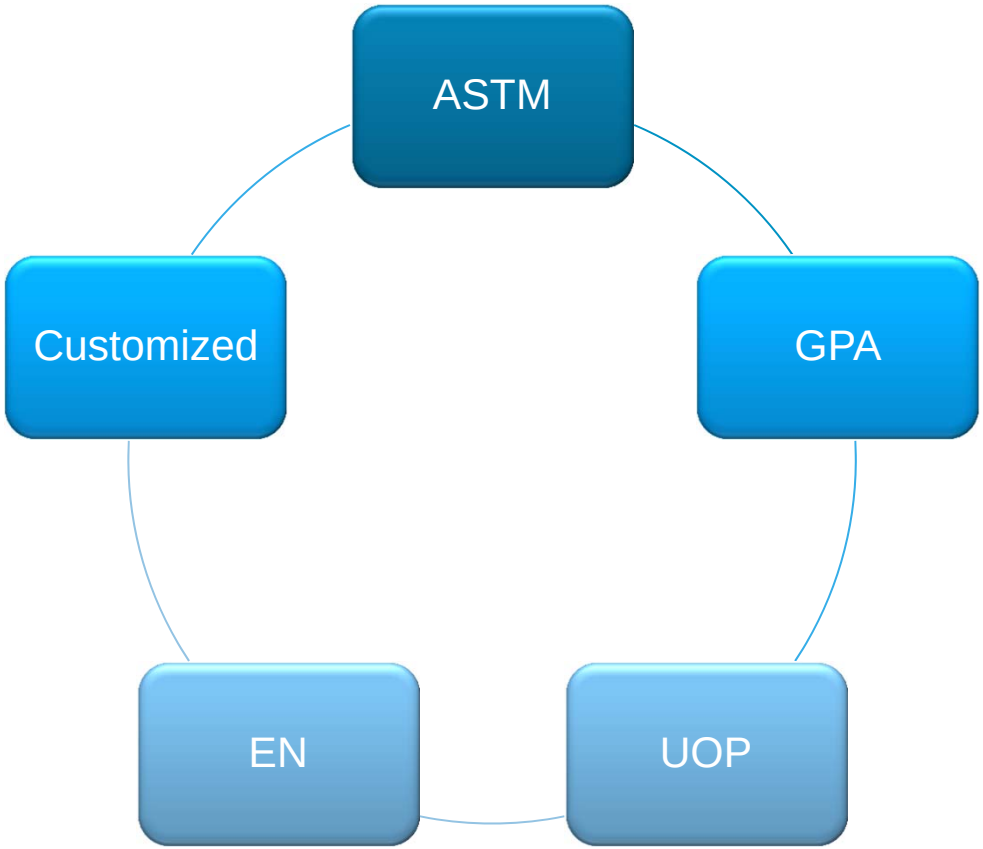
- Solutions sold and supported by Agilent but developed and supplied by 3rd party suppliers

Types of Analyzers Available as Special Products

- Natural Gas Analyzers
- Refinery Gas Analyzers
- LPG analyzers
- High purity gases and monomer analyzers
- Sulfur in gases and liquids
- Oxygenates and aromatics in fuels
- Simulated distillation
- Biodiesel/Biofuel
- Greenhouse gases
- TOGA analyzers
- Prefractionator for crude oil characterization

600+ analyzers!!!

Agilent Analyzers and Standard Methods



Natural Gas Analyzers

Natural gas is an hydrocarbon gas mixture consisting primarily of methane, with other hydrocarbons (Cx to Cy+), carbon dioxide, nitrogen and hydrogen sulfide.

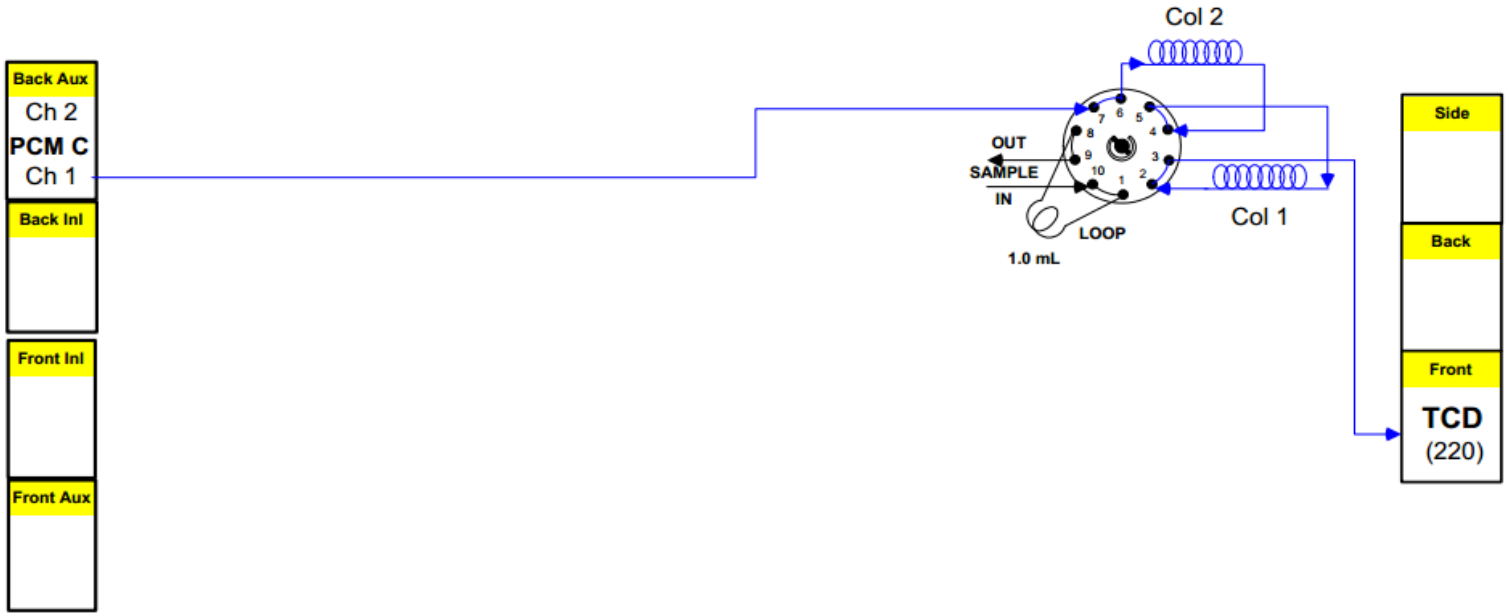
- Simple
- Fixed Gas
- Extended
- Sulfur Compounds

NGA Single Channel Single Valve

Agilent Technologies	Valve System	Date :	S/N :
		Order No :	Item :

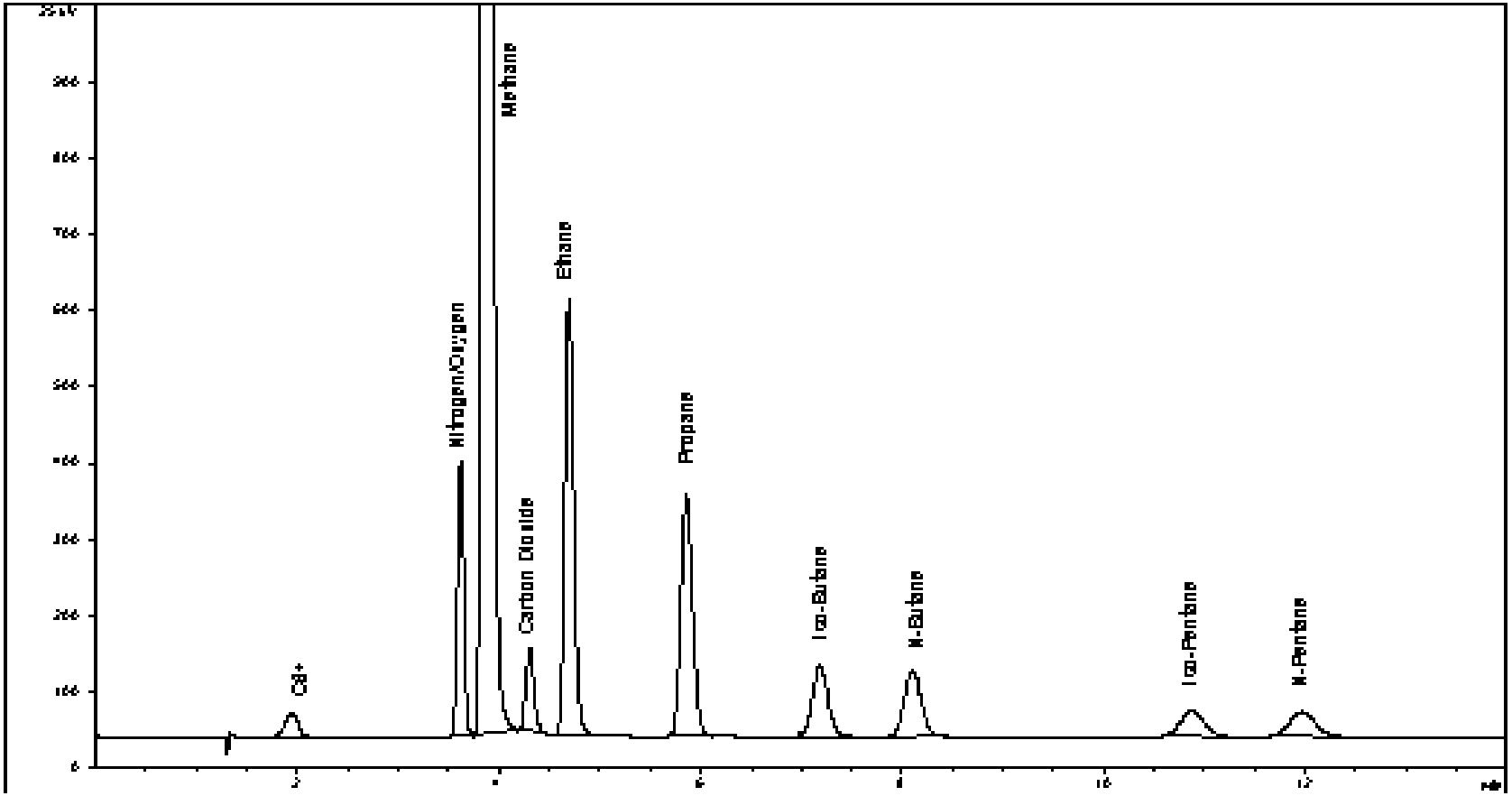
FLOW SOURCE	OVEN LEFT SIDE	INJECTION PORT	VALVE COMPARTMENT BLOCK 2	VALVE COMPARTMENT BLOCK 1	DETECTOR

1/805

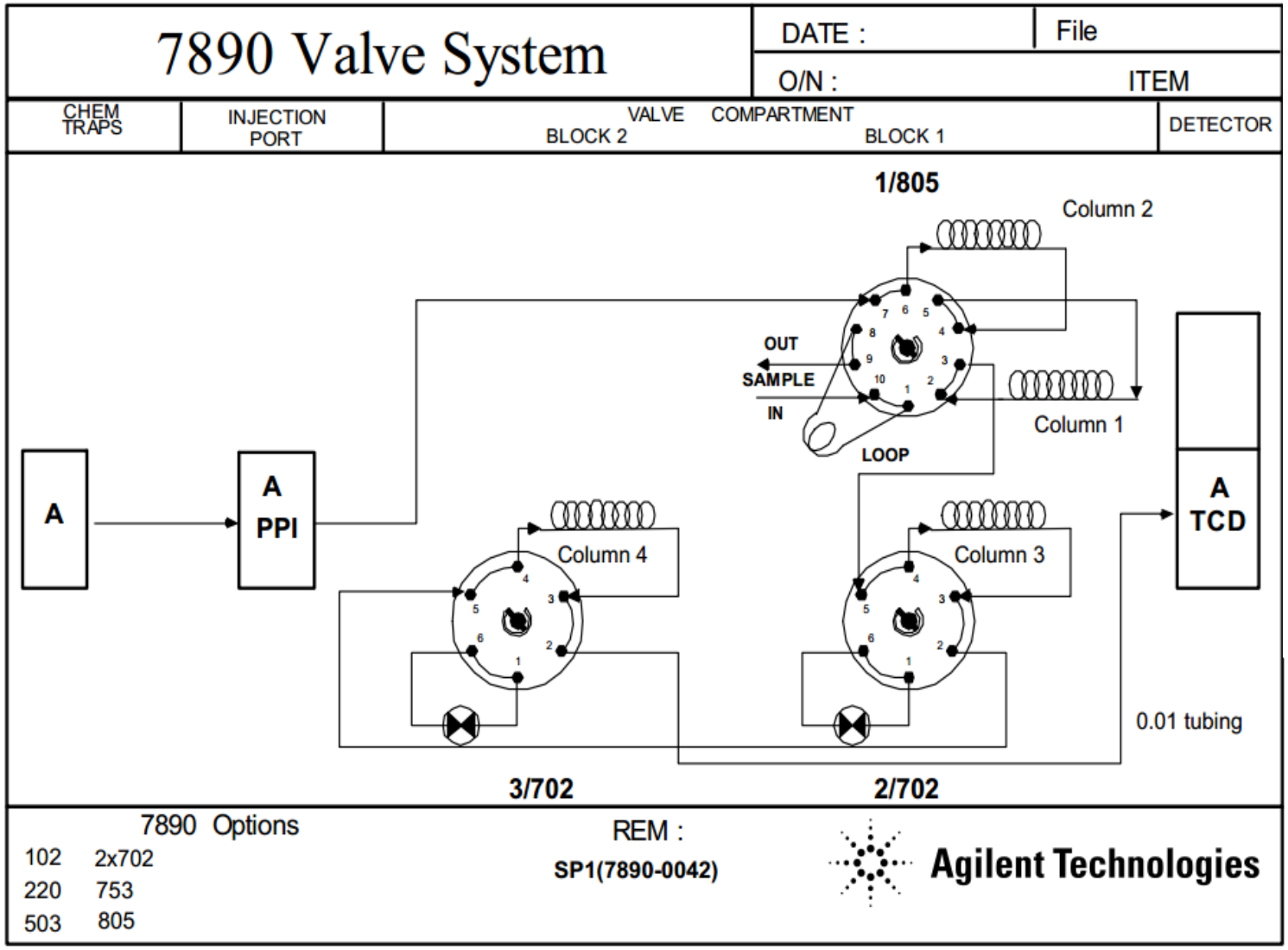


Options	SP1 options	Remarks
220,309,503,751,805	7890-0012	

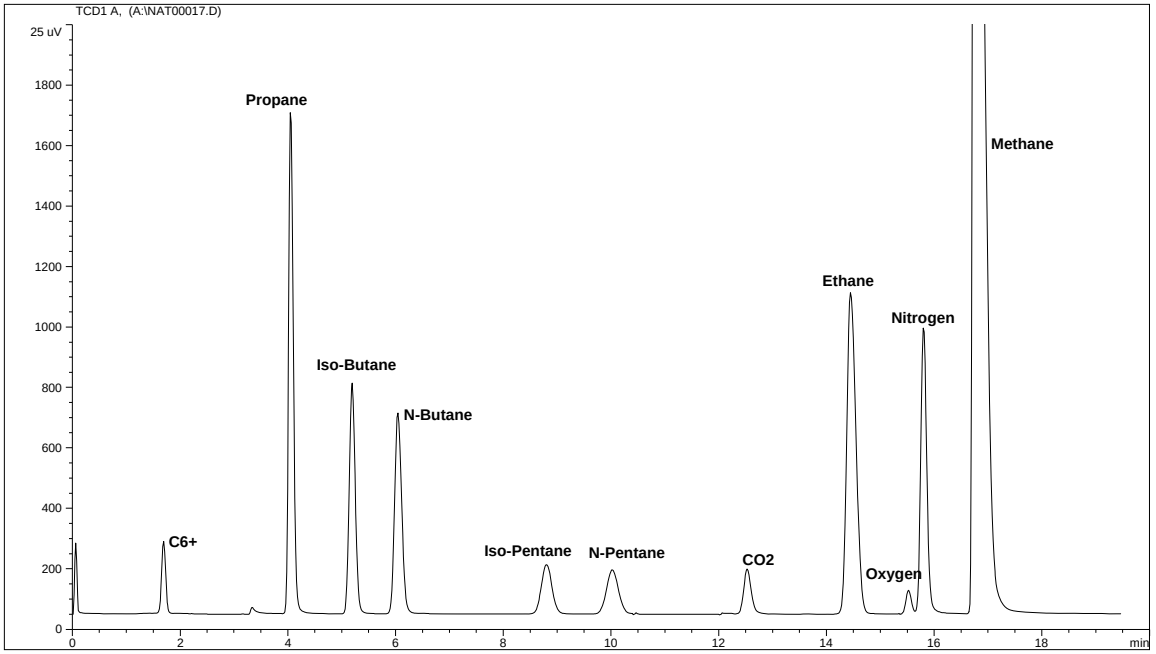
NGA Single Channel Single Valve



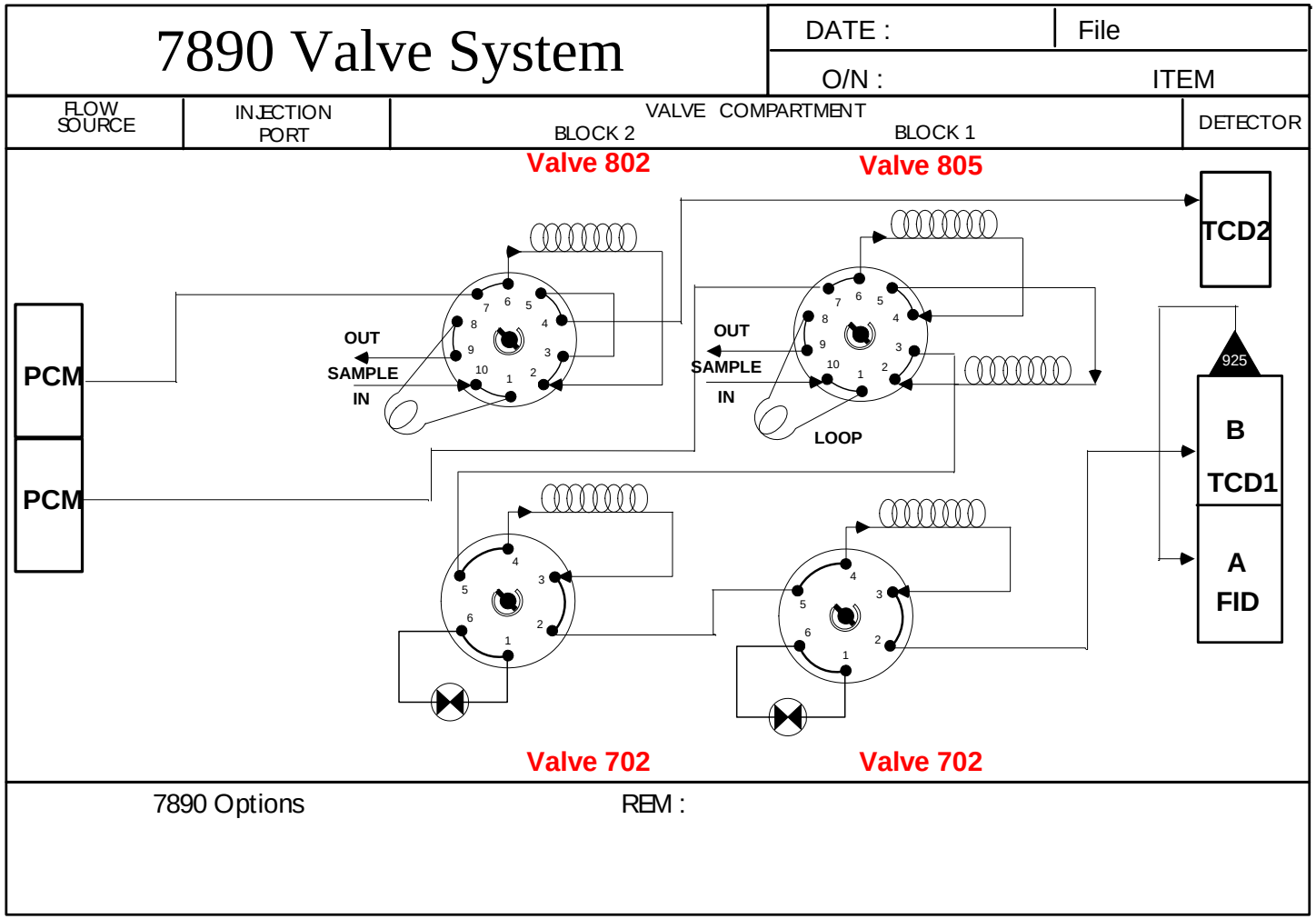
NGA Single Channel, 3 Valves



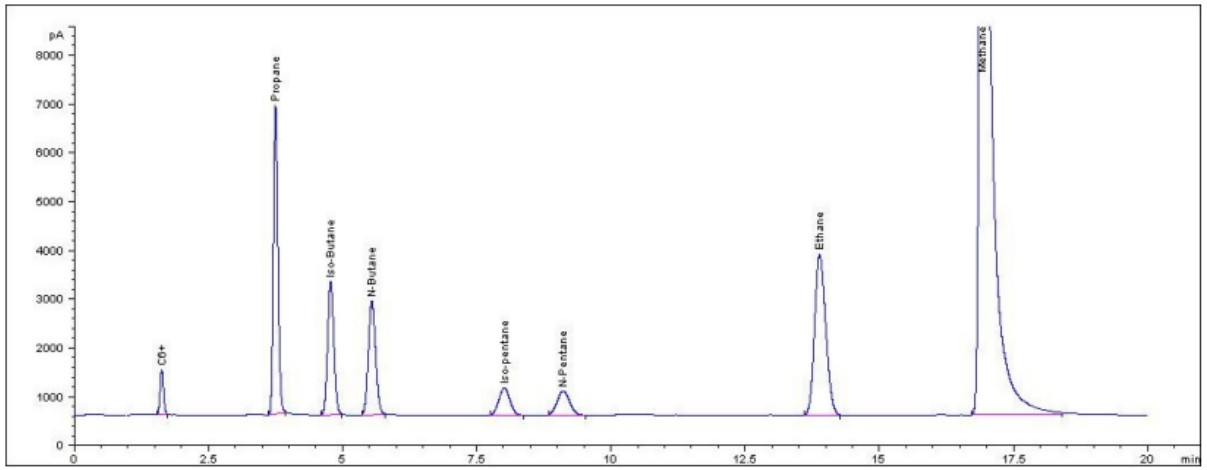
NGA Single Channel, 3 Valves



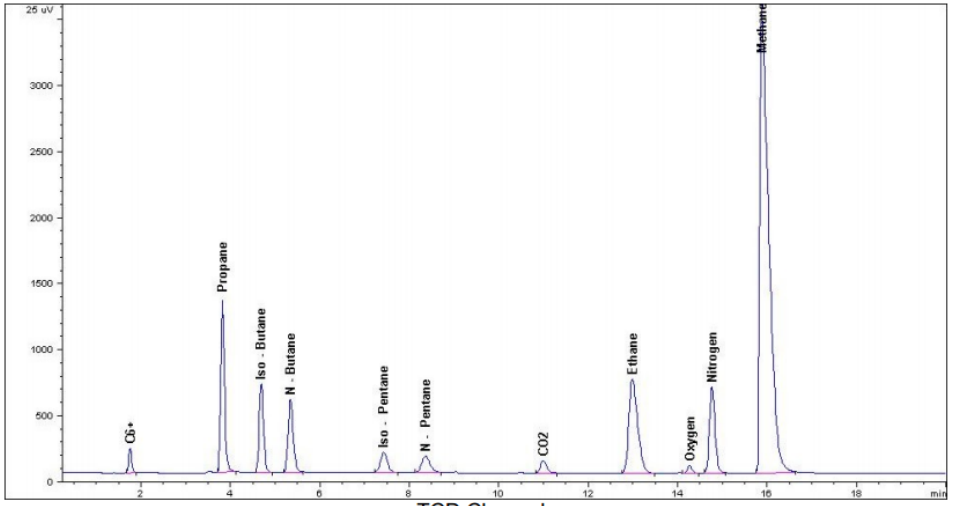
NGA Dual Channel 3 Detectors



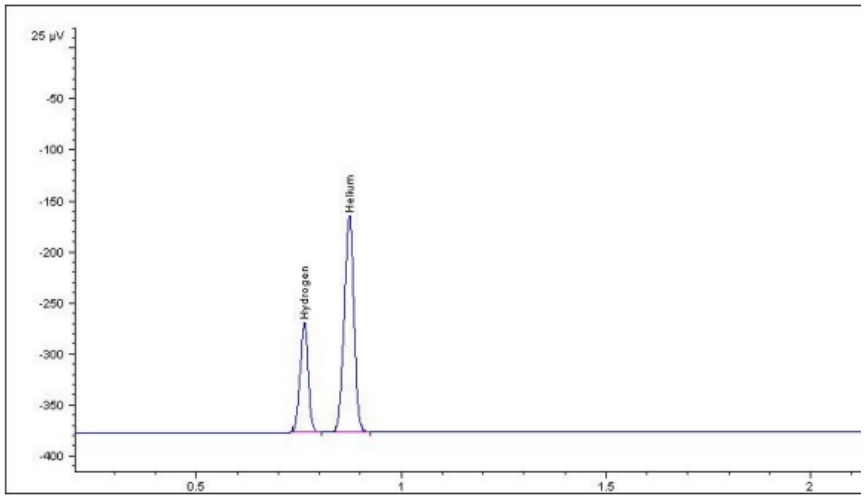
NGA Dual Channel 3 Detectors



FID Channel



TCD Channel



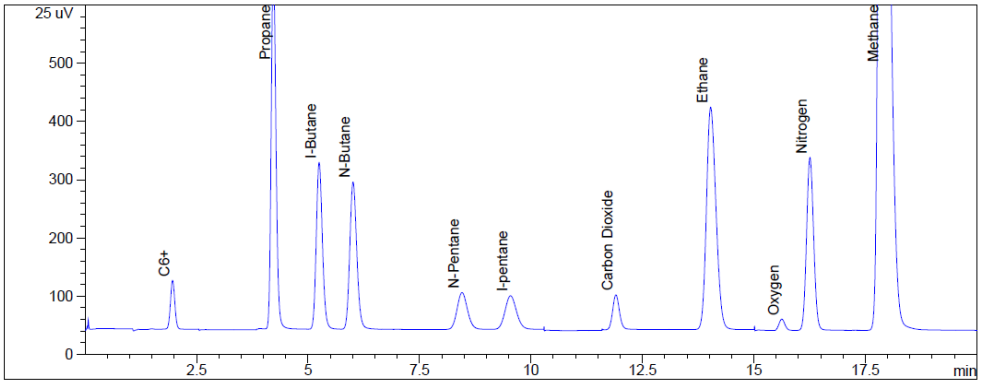
Aux TCD Channel

Natural Gas ISO Type Report

Natural Gas Analysis

Data File: C:\CHEM32\2\DATA\NGA_1.D

Sample Injected on: 3/3/2003 1:16:33 PM



ISO Calculation: Metering temp 15°C Combustion temp 15°C 101.325 kPa

Compound	RT	Area	Mole%	Hs kJ/mol	Hi kJ/mol
C6+	1.961	574.3	0.1132	4.75	4.40
Propane	4.222	4753.3	2.6546	58.96	54.24
I-Butane	5.248	2741.9	1.0070	28.91	26.67
N-Butane	6.009	2764.5	1.0070	29.00	26.76
N-Pentane	8.453	1022.2	0.2704	9.57	8.85
I-pentane	9.541	1028.1	0.2704	9.55	8.83
Carbon Dioxide	11.904	654.8	0.4433	0.00	0.00
Ethane	14.030	5668.2	5.8394	91.22	83.44
Oxygen	15.626	176.2	0.3049	0.00	0.00
Nitrogen	16.257	3268.2	4.1787	0.00	0.00
Methane	17.864	27968.8	83.9112	748.12	673.55
Total				980.08	886.73

Real Gas Values	Dry	Saturated
Superior Heat Value(Vol)	41.57 MJ/m^3	40.91 MJ/m^3
Inferior Heat Value(Vol)	37.61 MJ/m^3	36.99 MJ/m^3
Mean Molecular Weight	19.51	19.48
Compressibilty Factor	0.9972	0.9969
Relative Density	0.6755	0.6749
Wobbe Index (Superior)	50.57 Mj/m^3	49.80 MJ/m^3
Carbon Dioxide	2.15 kg/m^3	2.12 kg/m^3

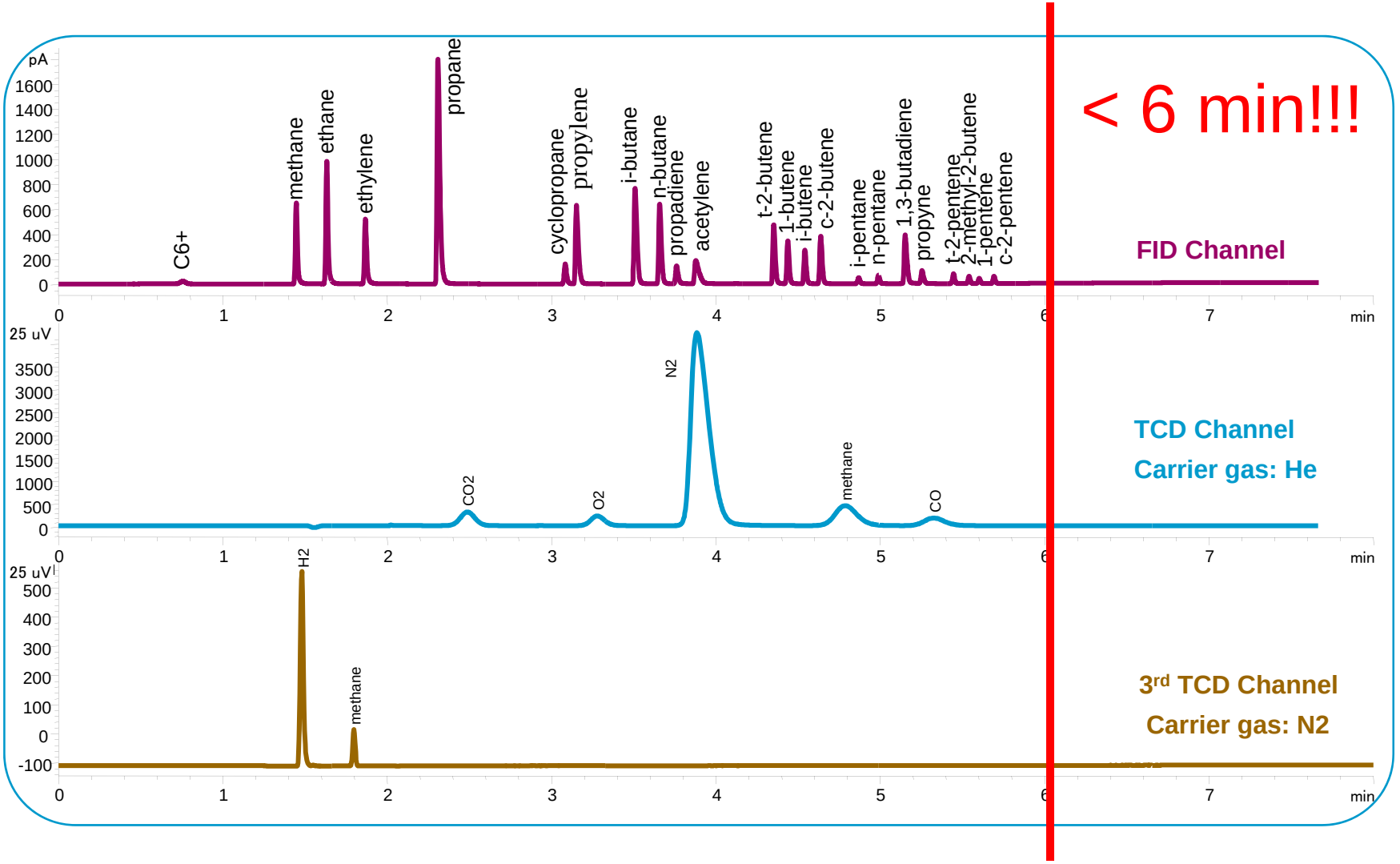
Refinery Gas Analyzers

- **Refinery gas is a collection of various gas streams produced in refinery processes**
- **Refinery gas composition is very complex, determining individual components of each gas stream is a challenge**
- **Analysis of refinery gas is essential for process and product quality control**

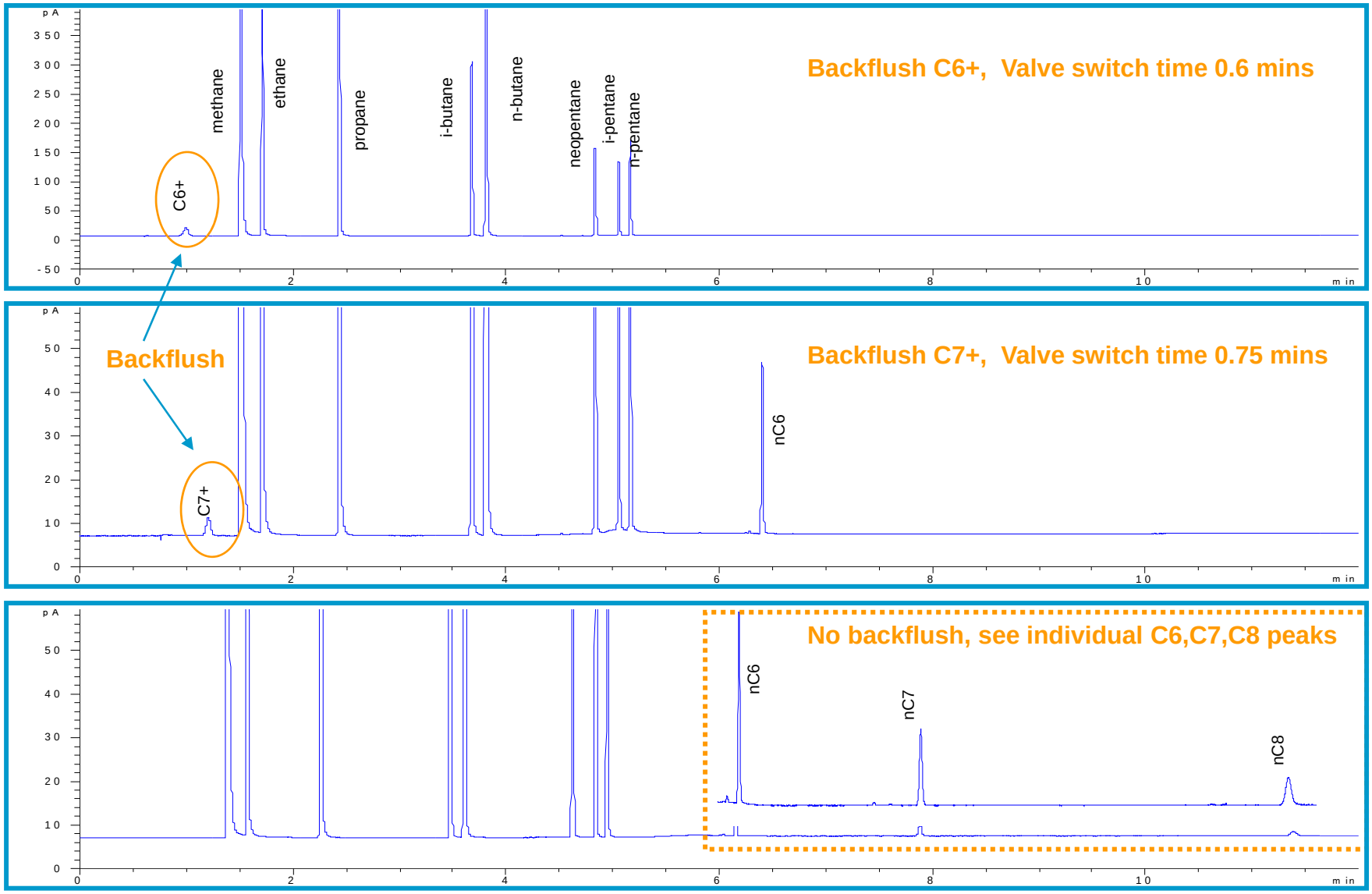
Refinery Gas Analyzers

- Dual Channel RGA
- Extended RGA up to C12
- Sour (high H_2S) RGA
- Three Channel Fast RGA
- PFPD RGA
- …and more!

Fast Refinery Gas Analysis in 6 min



Flexibility for Hydrocarbon Analysis



Agilent Technologies

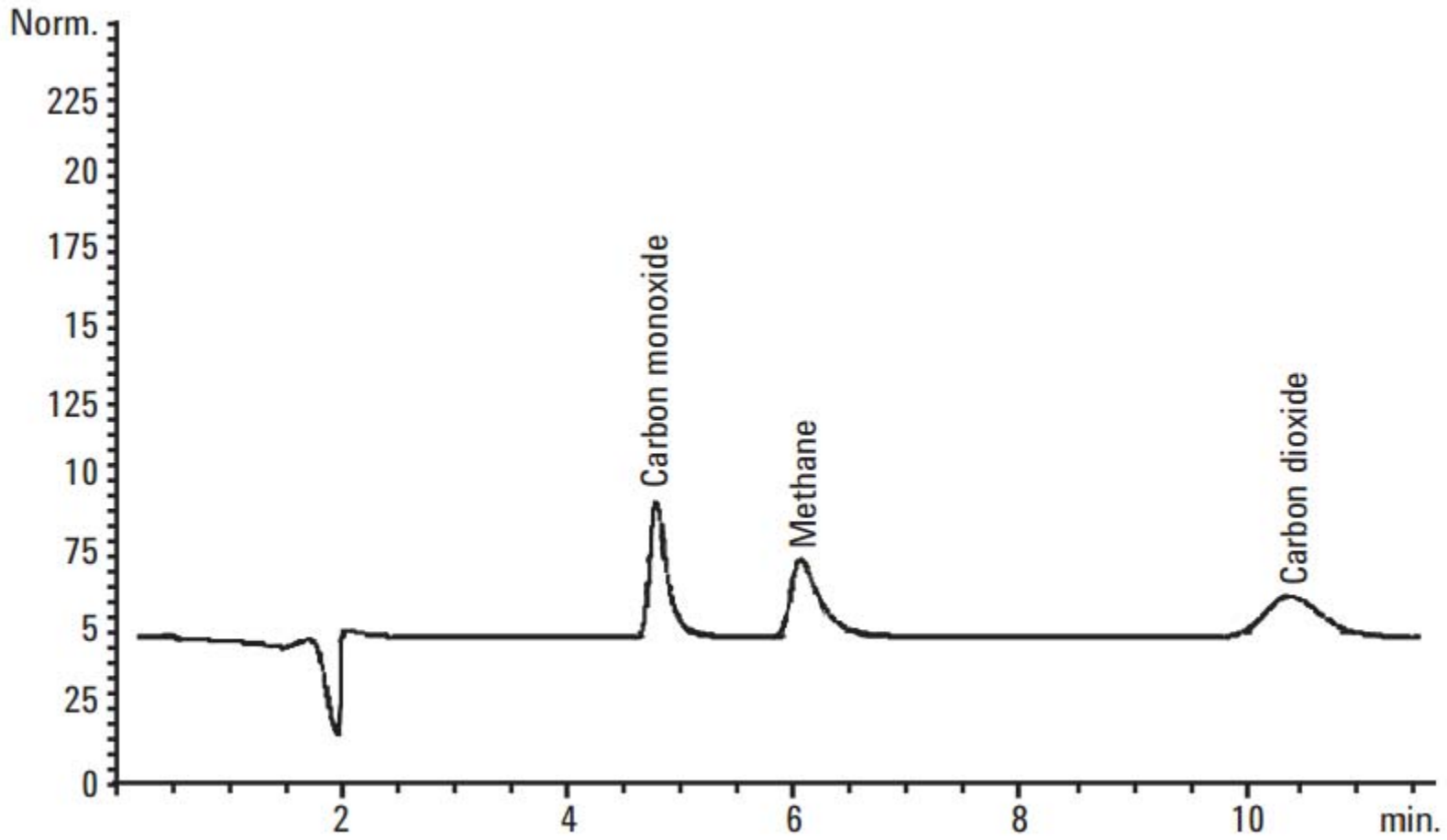
High purity gases and monomers

Traces of CO, CO_2 in process gases containing high amounts of CH_4 and higher hydrocarbons.

Traces of CO_2, CO, and CH_4 in process streams containing higher hydrocarbons with low CH_4 content

CO, CO_2 traces in hydrogen and inert gases

CO, CO_2 traces in hydrogen and inert gases
0.2ppm CO, 0.4ppm CO_2

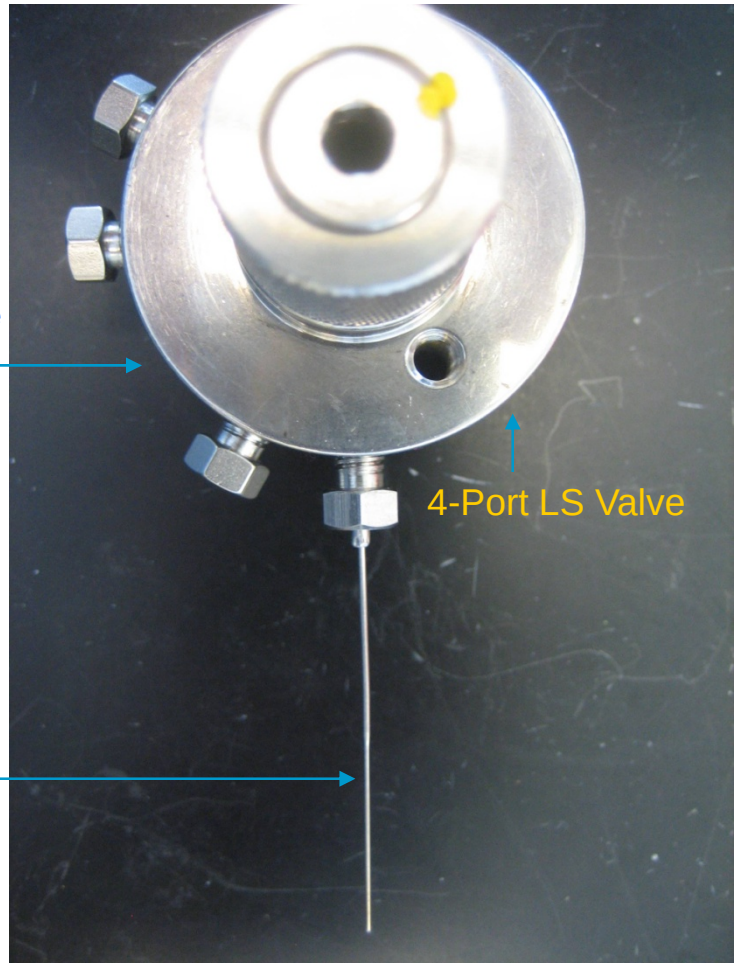


High Pressure Liquid Sampler for LPG and Unstable Liquids

Simple, No transfer line, High pressure,

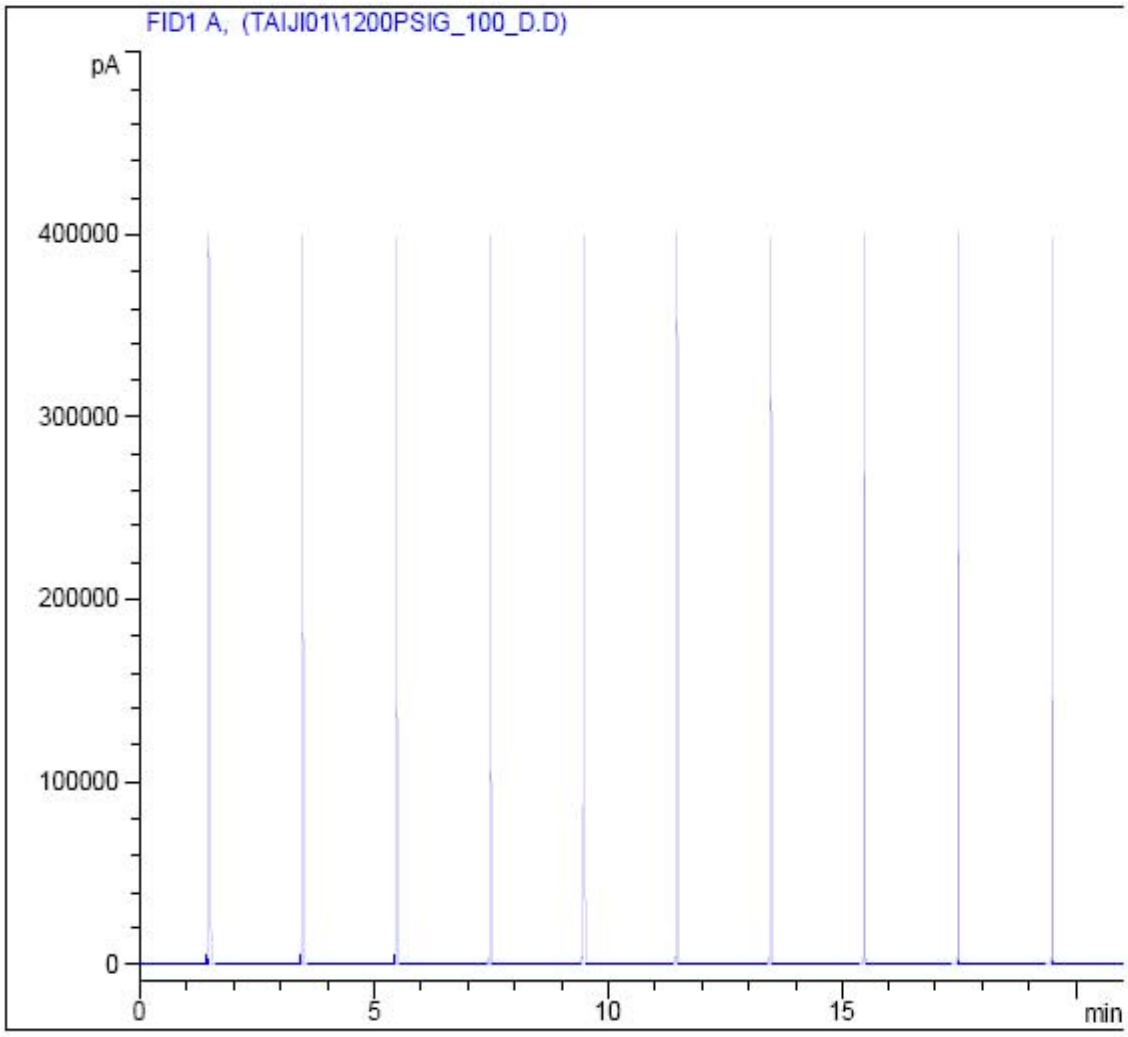
Automatic operation and long service life

Syringe Body
replaced by Liquid Valve



Removable Needle
installed on one
Port of valve

Performance
Repeatability of 10 continue injection of Propylene



	Area
Injection #1	459511
Injection #2	461557
Injection #3	459593
Injection #4	459936
Injection #5	460447
Injection #6	461986
Injection #7	459810
Injection #8	459187
Injection #9	461952
Injection #10	460173
RSD%	0.23%

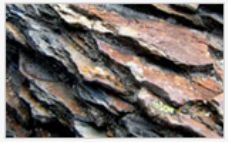
Where can I find more information?

www.Agilent.com

Energy & Chemicals

Meeting the world's increasing need for energy is a challenge. Regulatory requirements, efficiency improvements dictated by downward price pressure, and good environmental stewardship impose tough demands on your industry. Agilent Technologies provides custom or standard analyzers configured for your specific chemical analysis applications whether you need to quickly obtain detailed speciation of a complex hydrocarbon stream, precisely calculate gas calorific values in the field, assess efficien of your fuel cell stack, or analyze a new bio-fuel formulation, Agilent has custom methods and solutions for your specific needs Our product and application experts work with you to achieve the highest productivity and profitability for your lab, while meetir the industry's stringent quality requirements.

Biofuels & Alternative Energy



Exploration & Production

Natural Gas

Petrochemicals

Polymers

Power Generation

Refining

Parallel GC For Complete Refinery Gas Analysis

Refinery gas is a mixture of various gas streams produced in refinery processes. An exact, fast component analysis is essential to optimize refinery processes and control product quality. Refinery gas stream composition is complex mixture of hydrocarbons, permanent gases and sulfur compounds. Successful separation of such a mixture can be difficult on a single channel GC. The Agilent 7890 GC supports three parallel channels allowing the complex separation to be divided and optimized. TCD with helium carrier is used for permanent gases like O2, N2, CO and CO2. Hydrogen is measured with a second TCD with nitrogen or argon carrier. Light hydrocarbons are separated on an alumina PLOT column and detected by FID. The complete separation takes only 6 minutes. Agilent offers a family of turnkey Refinery Gas Analyzers.

Relevant Products | Featured Analyzers

Featured Refinery Gas Analyzers

Agilent has made it simpler for you to learn more about which refinery gas analyzer best fits your needs. Below is a table with the key features for each recommended our most popular RGA analyzers.

Short Description	Configured Per Method	Sample Types	Target Analytes
3-Channel Fast Refinery Gas Analyzer	ASTM D1945, D1946, UOP 539	Refinery gas such as atmospheric overhead, FCC overhead, fuel gas, recycle gas	C_1-C_5, C_{6+} as backflush, H_2, He, O_2, N_2, CO_2, CO
Fast Refinery Gas Analyzer - H_2S and COS (3-Channel)	ASTM D1945, D1946, UOP 539	Refinery gas, such as atmospheric overhead, desulfurizer off gas, FCC overhead, fuel gas, recycle gas	C_1-C_5, C_{6+} as backflush, H_2, He, N_2, CO_2, CO, H_2S and COS

Questions?