SCION INSTRUMENTS

Petrochemical Gas Chromatographs

- Analyzer Solutions

Scion Instruments has the experience and know-how to provide pre-configured gas chromatographs that are ready at power up to handle your key applications. Our long experience in designing, configuring and manufacturing complete systems, with all their analytical benefits, ensures you get the solution that's right for you. With a host of standard solutions configured to meet the performance specifications outlined in international methods, and the capability to produce unique, tailor-made solutions, we have the answer that you seek.

Scion Analyzer Solutions

Benefits

Scion configures and tests GC hardware and software according to widely used industry standard methods (e.g. ASTM, UOP, EN, ISO, GPA,…), to save its clients time and to ensure confidence in results. Solutions are configured to meet the performance specifications outlined in the set method itself.

Included with all Scion Analyzer solutions:

- All Hardware
- Software (incl. special "plug-ins" where appropriate)
- Pre-Installed methods
- Test Chromatograms
- Installation/ Validation Data
- Trouble Shooting Guide
- User documentation customized for the specific method

Scion Simulated Distillation Analyzers

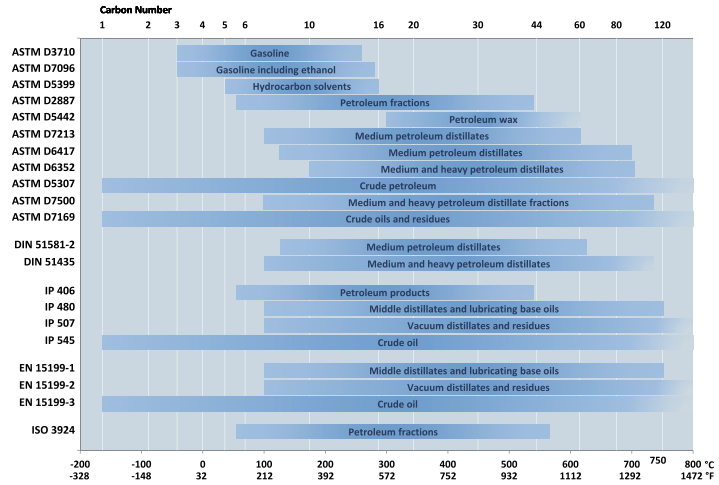


Table 1: Overview Simdist methods.

A gas chromatographic (GC) technique, Simulated Distillation (SimDist) reproduces the physical distillation of petroleum materials and products by determining boiling point distribution. Scion Instrument's range of Simulated Distillation Analyzers are designed to meet all industry standard methods, Scion's analyzer software includes both ASTM D86 and ASTM D1160 correlations. Scion's highly automated GC, CompassCDS Chromatography Data Handling Software, and integrated SimDist software are also designed to meet worldwide industry standard test methods.

436-GC with Sampler

Key Benefits Include:

- Accurate boiling point distribution up to 750°C
- Integrated standard test methods, applications fully comply with ASTM, IP, DIN and ISO standard test methods
- Complete, single vendor solution
- Complete control from initial setup to final report
- ASTM D86 and ASTM D1160 correlation

Built-in Reports:

Scion's SimDist software provides a wide variety of report options to meet specific requirements including;

- Chromatogram with merged corrected blank analysis and IBP/FBP marks versus retention time
- Boiling point versus percentage of sample
- Table and plot with retention time versus boiling point
- D86 and D1160 correlations
- DIN Noak and motor oil volatility reports
- Table with cut points and fractions plus residue analysis with recovery calculation up to C120

Hydrocarbon Analysis by Group (PIONA+™)

Figure 1: Traps are easily accessible and do not require any tools to install or replace.

Characterization of Engine Fuels by Hydrocarbon Group Type

Scion's PIONA+™ Analyzer is a highly flexible GC analysis platform to obtain comprehensive characterization and quantitative information, including hydrocarbon group types, oxygenates and carbon number distribution for spark ignition engine fuels.

Key Analyzer Capabilities:

- Unparalleled operational flexibility
- Compliant with established standards
- A complete and fully integrated solution
- A powerful analyzer, easy to use, generating outstanding analysis results day after day

The PIONA+ Analyzer performs a complete analysis (as described in ASTM D6839 and similar methods) and provides unprecedented analytical flexibility and simplified operation through the use of a novel approach to column/trap heating and exchange (Figure 1).

Reduced Analysis Time and Increased Sample Throughput Efficiency through the Use of "Concurrent" Heating

A unique aspect of the design of the Scion PIONA+ system is the ability to independently heat the individual traps.

This has 2 major operational benefits:

- Enhanced elution integrity for wide range sample
- Significantly Reduced Analysis Time

The independent and concurrent heating design permits greater trap control and benefits in improved elution integrity of the component groups e.g napthene, iso-paraffins and n-paraffins even for a wide range sample (C4 - C11). In addition, only a single Molsieve column temperature cycle is employed thus reducing the analysis time by almost half allowing a "fast" PIONA mode of operation (see figures 2 and 3).

By employing this technique, sample throughput can be nearly doubled compared to systems that do not offer this unique capability.

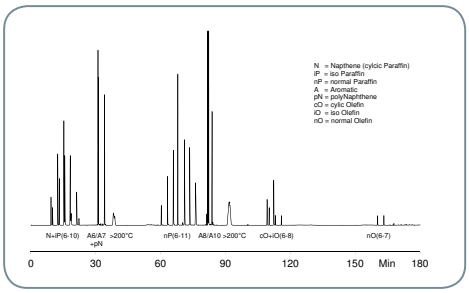


Figure 2: Chromatogram of a test mix in conventional PIONA mode. (Analysis Time - 180mins)

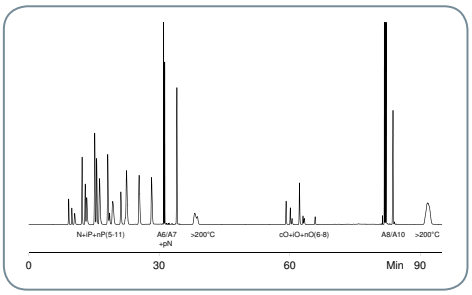


Figure 3: Chromatogram of a test mix using concurrent heating in "fast" PIONA mode. (Analysis Time = 95mins)

Determining Total Olefin Content Is Now Practical

The stability, sample loading and lifetime for all of the critical chromatographic components have been improved and optimized in the Scion PIONA+ Analyzer. Of special and particular note is the improvement in increasing the sample loading capacity of the "olefin" trap. As a result, it is now possible to analyze streams with olefin content as high as 35-40% or more. This makes it practical to employ a single analytical method to obtain total olefin content (Table 2).

Table 2

	Saturates			Unsaturates					
Carbon	Cyclic	Iso	Normal	Cyclic	Iso	Normal	Aromatics	Oxygenates	Total
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.06	0.00	0.03	0.54	0.00	0.00	0.63
5	0.31	11.37	2.98	0.87	9.92	7.58	0.00	0.00	33.03
6	3.19	9.98	1.40	2.40	8.59	4.40	1.72	0.00	31.68
7	4.31	6.77	0.00	2.14	4.76	1.91	7.47	0.00	27.36
8	1.42	3.12	0.00	0.39	2.06	0.00	0.07	0.00	7.06
9	0.01	0.00	0.00	0.04	0.02	0.00	0.03	0.00	0.10
10	0.01	0.00	0.00	0.09	0.00	0.03	0.01	0.00	0.14
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**9.25**	**31.24**	**4.44**	**5.93**	**25.38**	**14.46**	**9.30**	**0.00**	**100.00**

Example weight % report for a Naphtha sample with high (46%) olefinic content; (highlighted in blue).

The analyzer design allows the operator to conduct analyses in any one of a number of different operational modes including PNA, PONA, PIONA, O-PONA and O-PIONA in standard and concurrent heating configuration. The system is compliant with established standard methods (see adjacent array).

	PNA	PONA	PIONA	O-PONA	O-PIONA
EN 14517					✓
EN-ISO-22854					✓
ASTM D6839				✓	
DIN 51448-2			✓		
ASTM D1319 (FIA)		✓			
DIN 51448-1	✓				
ASTM D5443	✓				
UOP 870	✓				
IP 382	✓				

✓ Compliant with the method

More information generated than required for the method

Detailed Hydrocarbon Analyzer

The DHA Analyzer is a complete high resolution GC solution for the analysis of hydrocarbons in petroleum streams. It is capable of performing all of the standard methods including ASTM D6729, D6730, D6733, D5134, D6623, IP 344/ DHA "Front End" and "Fast DHA".

Although each DHA analyzer is configured, tested and certified at the factory for a standard method specified by the customer, the DHA software permits the operator to utilize any of the other popular standard methods as well. And, because of the outstanding performance and flexibility of the Scion GC and CompassCDS software design, Scion is able to quickly modify the existing methods or add new ones if required as a result of the on-going dynamic industry standard processes.

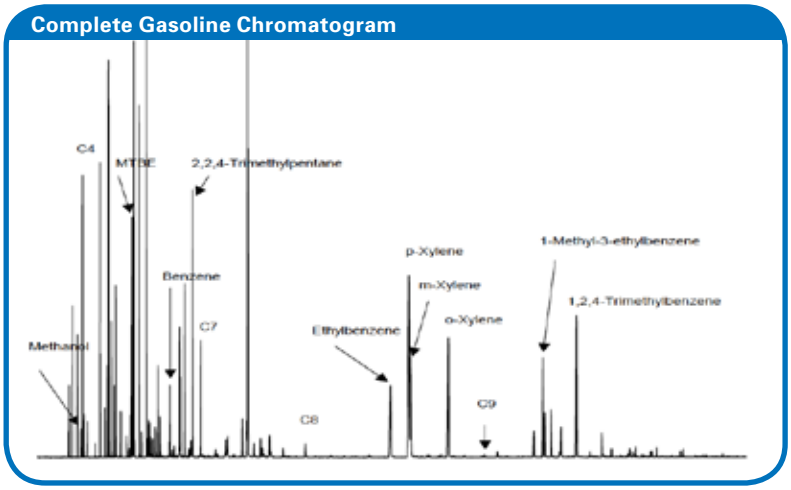


Figure 4: The analysis of permanent gases and hydrogen using the Rapid RGA.

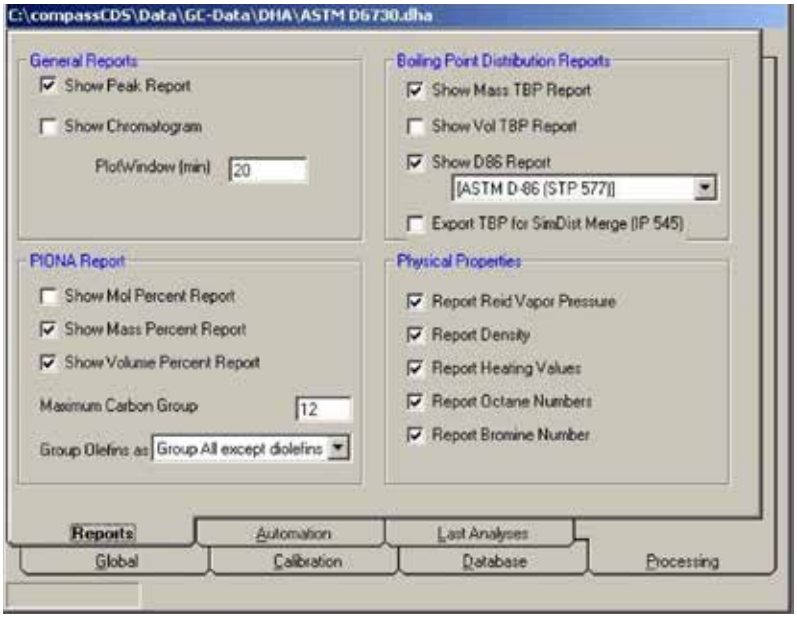


Figure 5: Report selection output.

Scion Refinery Gas Analyzers

Peak Identification

1. Hydrogen
2. Carbon Dioxide
3. Hydrogen Sulfide
4. Oxygen
5. Nitrogen
6. Carbon Monoxide
7. Methane
8. Ethane
9. Ethylene
10. Propane
11. Cyclo Propane
12. Propylene
13. i-Butane
14. n-Butane
15. Propadiene
16. Acetylene
17. t-2-Butene
18. i-Butene
19. c-2-Butene
20. i-Pentane
21. n-Pentane
22. 1, 3-Butadiene
23. Propyne
24. Butyne
25. C6+
26. Helium

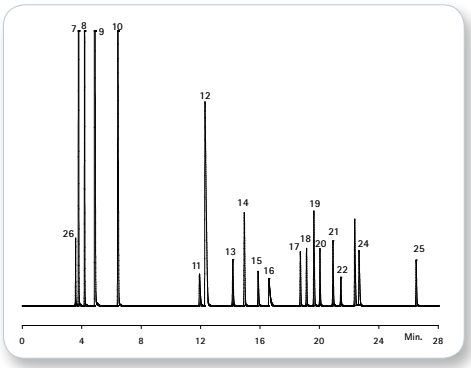


Figure 6: The separation of light hydrocarbons using the Standard RGA.

The source and composition of refinery gases varies considerably. Measuring gas composition precisely and accurately is a significant challenge in today's refinery operations. Scion's Refinery Gas Analyzers (RGA) are designed to deliver superior, reliable results for a wide range of sources and analysis throughput requirements.

Key Benefits:

- Pre-configured and tuned
- Standard methods including UOP 539, DIN-51666 and ASTM D2163
- Integrated micro-gasifier ensures complete vaporization of LPGs and high pressure samples to prevent sample discrimination (option)
- Multi-channel approach

Characteristics	Standard RGA	Rapid RGA
No. of Channels/Detectors Used	3	3
No. of Column Ovens	1	2
Analysis Time	25 min	5 min (7 min with H_2S)
Repeatability	<1%	<1%
Linear Bench Space Required	66 cm/26 in.	66 cm/26 in.
Minimum Component Detection Level	0.01% all components except H_2S = 0.05%	0.01% all components except H_2S = 0.05%
Suitability		
Typical Refinery Gas	Excellent	Excellent
Impurities in Bulk Ethylene	Excellent	Excellent
Impurities in Bulk Propylene	Excellent	Good
Impurities in Bulk C4	Good	Good

Table 3: Standard RGA vs Rapid RGA.

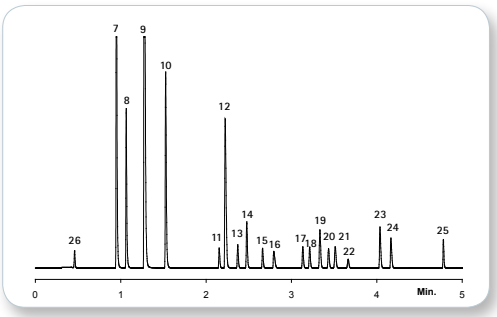


Figure 7: The analysis of light hydrocarbons using the Rapid RGA, with complete separation in less than five minutes.

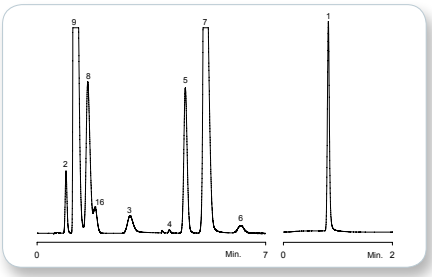


Figure 8: The analysis of permanent gases and hydrogen using the Rapid RGA.

Scion Offers Two RGA Systems to Meet the Widest Range of Analysis Requirements:

Standard RGA:

A three channel multi-valve design using both capillary and packed columns.

Channel 1 - Analysis of permanent gases
Channel 2 - Light hydrocarbons
Channel 3 - Hydrogen.

Total analysis time for all components in 25 minutes.

Rapid RGA:

The Standard RGA packed columns in the hydrogen and permanent gas channels are replaced by micro packed columns and installed in a separate column oven. Key benefits of this design are:

- Flexibility
- Reduced Analysis Time - 5mins (with H_2S - 7mins)
- Increased Sample Throughput

Low Level Oxygenates Analyzer

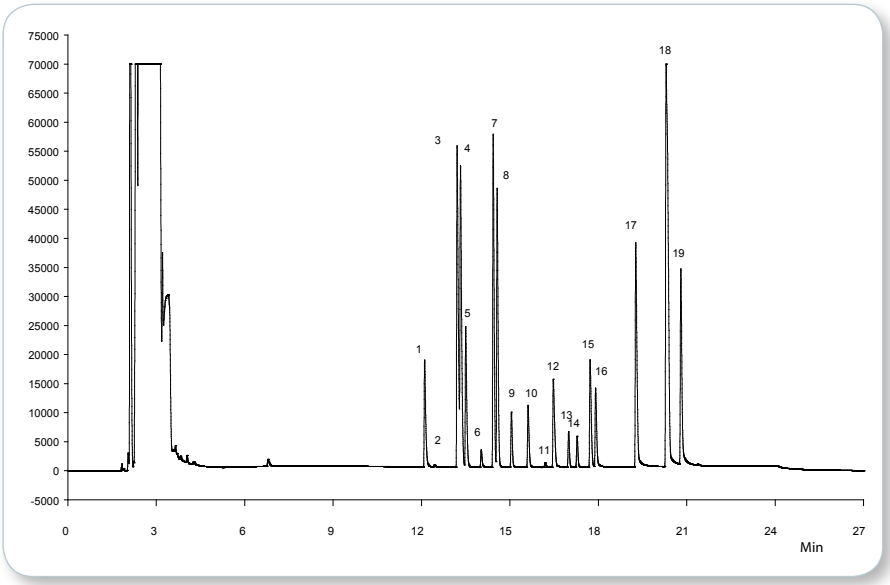


Figure 9: Typical chromatogram showing a wide range analysis of a liquid sample stream.

The determination of sub to high ppm levels of ethers, alcohols, aldehydes and ketones in different hydrocarbon matrices is a recurring challenge in the petroleum refining and petrochemical industry. The Scion Low Level Oxygenates Analyzer is an easy to use solution to meet this challenge and is according ASTM D7423.

The Low Level Oxygenates Analyzer is designed and optimized to quantify ppm and sub ppm levels of ethers (e.g. DME, MTBE, ETBE, DIPE), alcohols (e.g. methanol, ethanol, propanol), ketones (e.g. acetone, MEK) and aldehydes in various hydrocarbon matrices. In general, all oxygenated components with a boiling point of up to 100°C can be analyzed and the sample can be a gas, LPG or liquid under ambient conditions with a final boiling point up to 250°C.

The system is comprised of a Scion GC configured with gas and liquid sampling valves, two high performance capillary analysis columns, digitally controlled pneumatics including a 'fluidic' switch and Flame Ionization Detector (FID). An optional 'pressure station' can be added to eliminate the possibility of losing sample due to evaporation when analyzing LPG. The GC is controlled via the CompassCDS Chromatography Data Handling Software, which acquires data, processes it and generates analyses reports.

Peak Identification

1. Diethylether
2. Acetaldehyde
3. Ethyl tert. Butyl ether
4. Methyl tert. Butyl ether
5. Diisopropylether
6. Propanal
7. tert amyl methyl ether
8. Propylether
9. Isobutyraldehyde
10. Butyraldehyde
11. Methanol
12. Acetone
13. Isovaleraldehyde
14. Valeraldehyde
15. 2-Butanone
16. Ethanol
17. 1-Propanol
18. tert Butyl alcohol & Isobutanol
19. 1-Butanol

Scion 4815 GC Oxygenates Analyzer

The Scion 4815 GC Analyzer provides a highly cost effective solution for the analysis of oxygenates in gasoline, according to the widely used industry standard method ASTM D4815. The combination of Scion's reliable GC hardware, powerful software and industry leading pre- and post-sales support teams make this analyzer package the most comprehensive solution available today.

Oxygenated compounds can be present in various hydrocarbon matrices either because they were purposely added (e.g. into gasoline), because they are naturally present, or formed during catalytic processes such as polymer production. In gasoline, oxygenated compounds are added as 'anti-knock' agents to increase the octane number and decrease emissions by replacing organo-lead compounds.

The type and concentration of oxygenated compounds must be measured in reformulated gasolines as part of ongoing product quality assessment, and to confirm the oxygenated components have been added in the correct amounts according to regulatory requirements (e.g. California Air Resources Board).

ASTM D4815 is frequently chosen as the standard method for the determination of oxygenated compounds. Individual ethers and alcohols are quantified in gasoline including: MTBE, ETBE, TAME, DIPE, C1-C4 alcohols and tert-amylalcohol. Individual ether components are measured from 0.1 to 20.0 mass %.The individual alcohols are measured from 0.1 to 12.0 mass %.

456-GC with Sampler

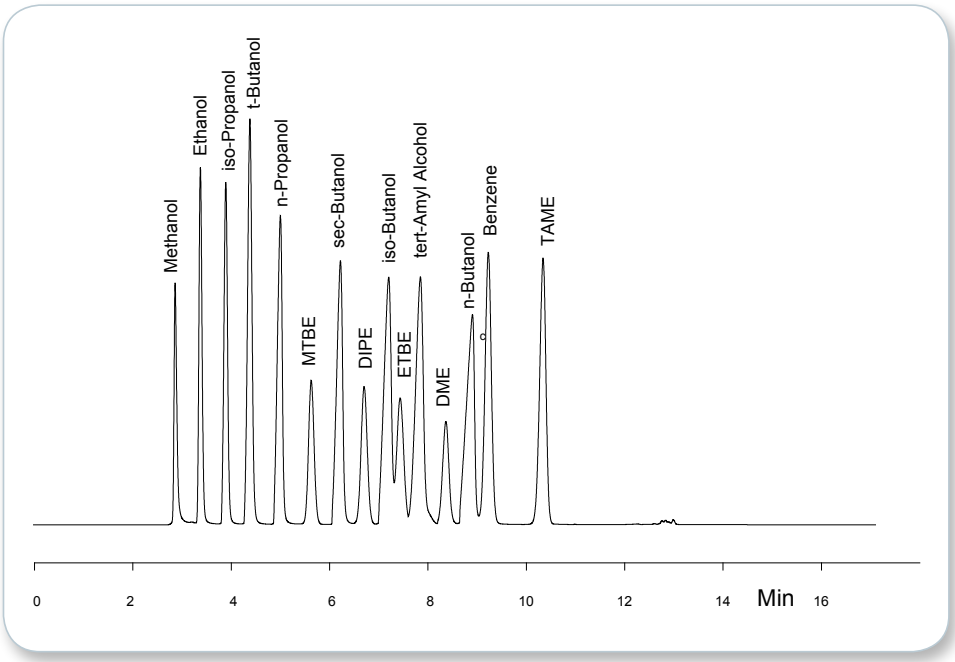


Figure 10 : Typical Chromatogram of the test sample.

Trace Impurity Analyzers

Sulfur Components in LPGs

Low level analysis of sulfur containing components such as H_2S, COS and mercaptanes is extremely challenging and a configured GC offers the solution.

Firstly, the system employs a micro-gasifier enabling the direct coupling of an LPG stream. Secondly, an inert steel sample path ensures a trouble free analysis of sulfur containing components at low concentrations. Finally, a two channel PFPD/ two column approach permits the analysis of all components of interest in one run whatever the LPG matrix. Two differing columns ensures quenching of PFPD signal by the matrix is overcome and full sulfur component analysis is achieved. Figures 11 and 12 show chromatograms obtained in a propane matrix and illustrates the novel benefits of the 2 channel approach.

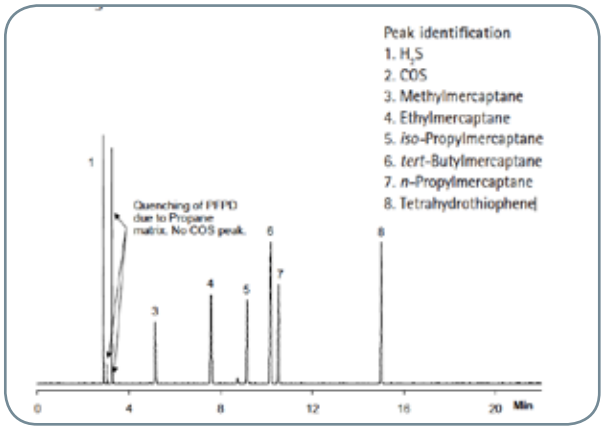


Figure 11: Sulfur components in propane, BR-1 column.

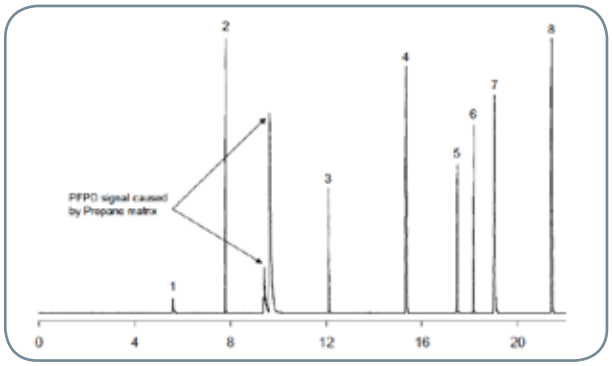


Figure 12: Sulfur components in propane, BR-Q PLOT.

Permanent Gases in LPGs

Impurities such as CO, CO_2, H_2, O_2 and N_2 need to be determined at low levels in LPGs. Complete separation of these components is done using a two channel single detector (PDHID) system. The GC employs a permanent gas channel for analyzing H_2, O_2, N_2, CH_4 and CO and a specific second channel for the analysis of CO_2. A gasifier is used as a sample introduction device thus giving the capability of handling LPG samples C2 through C4.

Detection limits are at the ppb level (Figure 13), depending on the component of interest.

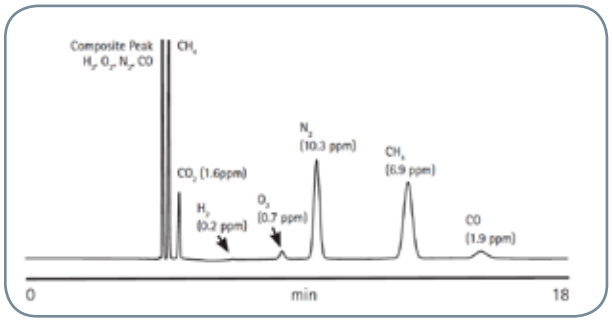


Figure 13: LPG sample.

Total Characterization of Ethylene Impurities

For a total characterization of impurities in ethylene and also propylene six GC channels are required. By coupling two Scion GCs with three channels each, a comprehensive solution is available for analyzing these components. The channels used in this analyzer are analytical tools principally developed for the determination of different gases in various hydrocarbon types of gaseous matrices.

GC-1

- H_2 Channel (TCD)
- O_2/N_2 Channel (TCD)
- CO, CO_2 Channel (Methanizer/FID)

GC-2

- Light Hydrocarbon Channel (FID)
- Oxygenates Channel (FID)
- Sulfur Channel (PFPD)

The results (see figures 14 to 19) demonstrate how this 6 channel system is perfectly suited for the total characterization of ethylene and its impurities.

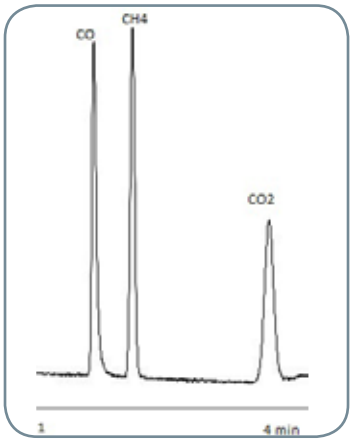


Figure 14: CO, CH_4 and CO_2 on GC-1.

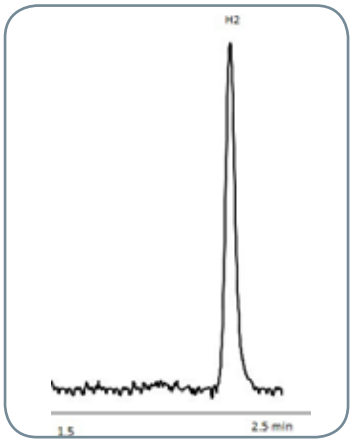


Figure 15: H_2 on GC-1.

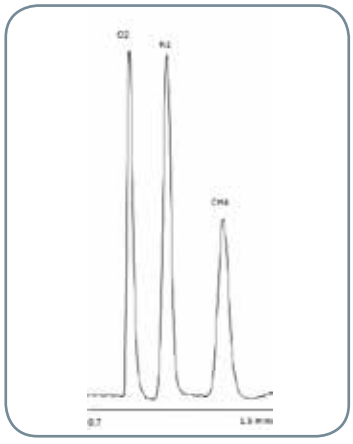


Figure 16: O_2 and N_2 on GC-1.

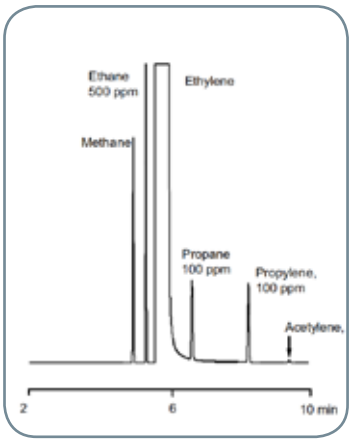


Figure 17: Light hydrocarbons on GC-2.

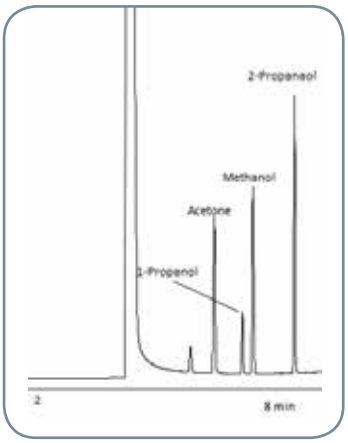


Figure 18: Oxygenates on GC-2.

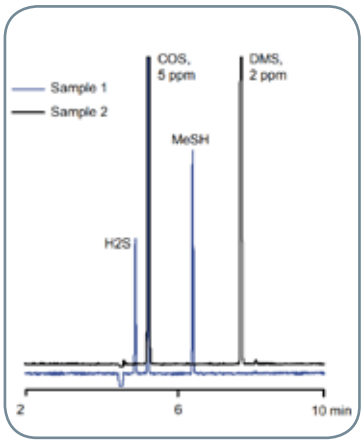
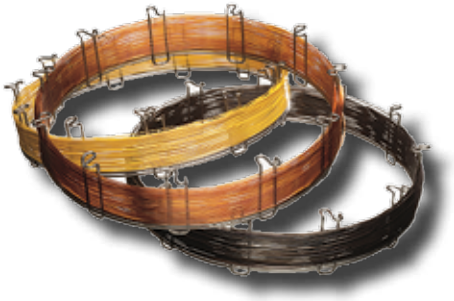


Figure 19: Sulfur components on GC-2.

Scion-Certified Consumables for Your SCION GC Series

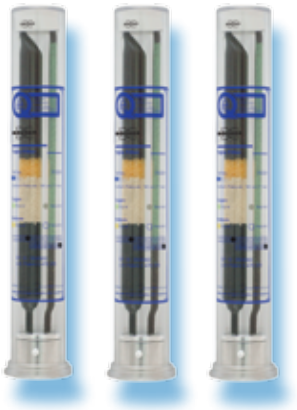
Scion GC columns span a broad range of column diameters, stationary phases, and capillary column materials: Fused Silica (FS) and Inert Steel (IS). Ideal for either routine or research type analyses. Scion GC column offerings bridge across many important applications and include a number of offerings such as:



- Standard WCOT (Wall Coated Open Tubular)
- Solid Stationary Phase PLOT (Porous Layer Open Tubular)
- Inert Steel Micro-Packed and Packed

Super Clean™ Gas Filters

Scion Gas Purification Systems have the range to satisfy your needs from individual to combination filters, from Ultra purity combined with Ultra capacity, to all in one solution kits. Innovative features designed into the product yield extensive benefits to the user.



- Ultra-high capacity for long life, less change and improved productivity
- High-purity output ensures 99.9999% Pure Gas
- "Quick connect" fittings for easy, leak-tight filter changes
- Glass internals prevent diffusion; plastic externally for safety
- Easy-to-read indicators for planned maintenance and improved up-time

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