



## PIONA Analysis using VUV



- EN 18015, ASTM D8071, EN 228
- 13 oxygenates included
- Identification by distinct UV spectra
- PIONA, Jet fuel and diesel/biodiesel in one instrument
- Cost per analysis substantially reduced

*Get ready for tomorrow's analytics*

**EN 15018 and ASTM 8071 provide complete PIONA compound class characterisation for European fuel specifications such as EN 228, as an alternative to ASTM D6839. Spectroscopy Detection (GC-VUV) from VUV Analytics offers relative simple instrumentation and automated analysis software with short runtimes and robust and reliable results.**

## The power of VUV spectra

Hydrocarbon analysis that previously required complex chromatographic separation can be simplified and shortened due to the ability to deconvolve overlapping spectral responses (figure 1). VUV absorbance spectra are typically highly structured and distinct for individual compounds, yet exhibit the intrinsic property of having similar features when measuring related compound classes, see figure 2. GC-VUV absorbance data is inherently three dimensional (time, absorbance, wavelength) and specific to the compound chemical structure.

## Unmistakable spectral information

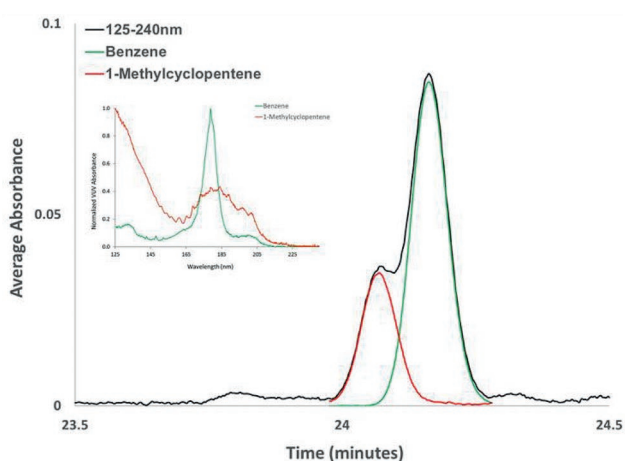
Due to the distinct spectra, the method is not dependent on very precise retention times (normally needed for DHA) or cutting times (column switching systems), which often leads to error-prone results. VUV offers accurate individual compound speciation and bulk compound class characterisation (PIONA).

## Lucid instrument configuration

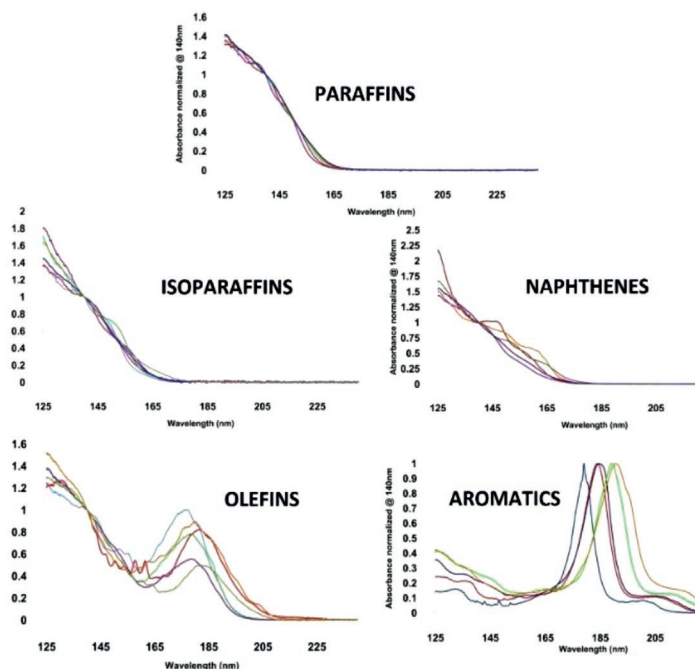
GC-VUV uses uncomplicated instrumentation: Thermo Trace GC 1600 gas chromatograph, a single capillary column and VUV-VGA detector (figure 9). No traps, pre-column tuning or calibration requirements are needed. Method setup is easy, operational costs are low and time-consuming manual data review is no longer required.

## 13 Oxygenates included

EN 18015 describes method applicability including the analysis individual components. Besides the compound classes, 13 oxygenated components are covered in the GC-VUV method. See figure 7,8.



**Figure 1**  
Example GC-VUV chromatogram of gasoline. Benzene and 1-methylcyclopentene are not well separated (black). Relative proportion of both components is displayed after deconvolution by VUV software (red/green).



**Figure 2**  
Distinct spectra for PIONA component classes. VUV spectra are highly stable and independent of instrument settings. Reliable identification is also offered for paraffins and iso-paraffins, which apparently have small spectral differences.

# Results

## PIONA - ASTM D8071, D18015, EN 228

GC-VUV provides PIONA classification according to ASTM D8071, EN 18015 and EN 228. Besides compound class characterisation, individual compounds benzene, toluene, ethylbenzene, xylenes, methanol, ethanol, MTBE, ETBE, TAME, TAEE, oxygen, isopropanol, isobutanol, tert-butanol, propanol, acetone, tert-pentanol, DIPE, isooctane, naphthalenes are analysed. Excellent equivalence with existing methods D5443 & D6839 (Reformulyzer) is proven after completing an extensive Interlaboratory Study (ILS).

D8071 also shows correlations equations for aromatics (D5769 & D1319), benzene (D3606 & D5769), olefins (D1319 & D6550), and ethanol (D5599), providing five ASTM methods in one. PIONA-VUV is fast: only 34 minutes runtime.

### Four more methods (same instrument, same column):

ASTM D8267 : Jet fuel  
 ASTM D8368 : Diesel/Biodiesel  
 ASTM D8071 : Gasoline range products  
 EN 18015 : Finished petrol products

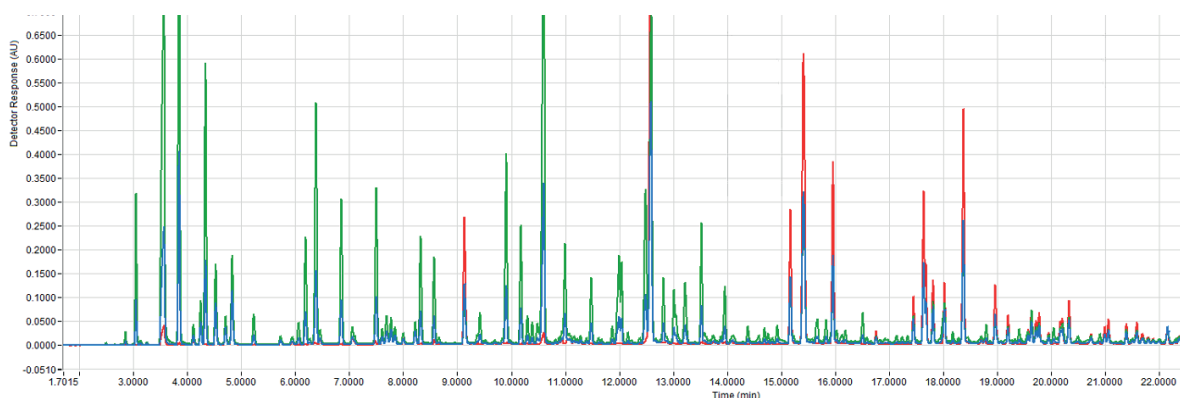
### Volume %

C#	P	I	O	N	A	Oxy	Total
C1							
C2						10.24	10.24
C3			0.00				0.00
C4	1.45	0.09	0.05				1.59
C5	3.43	7.15	4.02	0.06			14.66
C6	2.16	8.07	2.37	1.67	0.67		14.94
C7	1.33	5.83	0.91	1.71	3.22		13.00
C8	0.61	18.46	0.64	1.70	4.84		26.26
C9	0.37	3.36	0.19	0.73	5.28		9.93
C10	0.20	1.01	1.02	0.70	2.27		5.21
C11	0.05	0.84	0.41	0.39	1.08		2.78
C12		0.23	0.28	0.01	0.36		0.89
C13		0.18	0.10		0.16		0.45
C14		0.06					0.06
C15		0.00					0.00
Total	9.62	45.29	10.00	6.96	17.88	10.24	100.00

**Figure 3**  
 PIONA report in volume %. Mass % and mole % are also available.

Report Name	Category	Retention Time (min)	Mass %	Volume %	Mole %	C#
Methanol						
Ethanol	Alcohol	2.77	11.04	10.24	21.12	2
iso-octane	Isoparaffin	6.09	7.31	7.73	5.64	8
Naphthalene	Aromatic	23.55	0.21	0.15	0.14	10
Methylnaphthalenes	Aromatic		0.25	0.18	0.15	11
Benzene	Aromatic	4.93	0.80	0.67	0.90	6
Toluene	Aromatic	9.03	3.82	3.22	3.65	7
Ethylbenzene	Aromatic	14.27	1.02	0.86	0.84	8
Xylenes	Aromatic		4.73	3.98	3.93	8

**Figure 4**  
 Example report of individual species like oxygenates, aromatics and iso-paraffins. Results in mass %, volume % and mole %.



**Figure 5**  
 Example chromatogram by VUV-Analyze™ engine, showing spectral filters 170-200 nm (red, aromatics) and 125-160 nm (yellow, saturates). The blue graph represents the total signal. The runtime is 34 minutes.

# Specification

Standardised method:

**ASTM D8071 - EN 18015 - EN228**

Application:

Characterisation of PIONA+ (Paraffins, Iso-paraffins, Olefins, Naphthenes, Aromatics, Oxygenates) compounds in various hydrocarbon mixtures.

Analysis Time:

34 minutes

Column type:

Restek Rtx-1, 30m\*0.25mm, df=0.25u

GC oven temperature program ASTM D8071:

35 °C (2 min) - 15 °C/min - 200 °C.

GC oven temperature program EN15018:

5 °C (5 min) - 7.5 °C/min - 200 °C.

Property	
Saturates	ETBE
Olefins	TAME
Aromatics	TAAE
Benzene	Oxygen
Toluene	Isopropanol
Ethylbenzene	Isobutanol
Xylenes	tert-Butanol
Methanol	Propanol
Ethanol	Acetone
MTBE	tert-Pentanol
	DIPE

Figure 7 EN 18015 analysed properties

Property	Applicable Range (% (V/V))
Saturates	22 to 92
Olefins	0,5 to 42
Aromatics	2.7 to 63
Benzene	0,07 to 2,5
Toluene	0,4 to 31
Ethylbenzene	0,1 to 3,6
Xylenes	0,4 to 19
Methanol	0,06 to 15
Ethanol	0,04 to 25
MTBE	0,25 to 22
ETBE	0,25 to 23
TAME	0,25 to 22
TAAE	0,25 to 8,5
Oxygen	0,05 to 7,5 %(m/m)

Figure 8 EN 18015 ranges of method applicability.



Figure 9 VUV Analytics VGA-100 + Thermo Trace GC 1600

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