

Co-Optimization of Fuels & Engines

Properties of Co-Optima Core Research Gasolines

August 2018



About the Co-Optimization of Fuels and Engines Initiative

This is one of a series of reports produced as a result of the Co-Optimization of Fuels & Engines (Co-Optima) initiative, a Department of Energy (DOE)–sponsored effort initiated to simultaneously investigate advanced engine designs and the enabling fuel properties. This first-of-its-kind effort is designed to provide American industry with the scientific underpinnings needed to maximize vehicle performance and efficiency, leverage domestic fuel resources, boost U.S. jobs, and enhance energy security.

Co-Optima brings together DOE’s Office of Energy Efficiency & Renewable Energy (EERE), 9 national laboratories, 13 universities, and numerous industry and government stakeholders in a collaboration exploring solutions with potential for near-term improvements to the types of fuels and engines found in most vehicles currently on the road, as well as to the development of revolutionary engine technologies for a longer-term, higher-impact series of solutions.

In addition to the EERE Vehicle Technologies and Bioenergy Technologies Offices, the Co-Optima team includes representatives from the National Renewable Energy Laboratory and Argonne, Idaho, Lawrence Berkeley, Lawrence Livermore, Los Alamos, Oak Ridge, Pacific Northwest, and Sandia National Laboratories. More details on the project—as well as the full series of reports—can be found at www.energy.gov/fuel-engine-co-optimization.

Availability

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Report Contributors and Roles

Authors

Lisa Fouts, Gina M. Fioroni, Earl Christensen, Matthew Ratcliff, Robert L. McCormick, Bradley T. Zigler – National Renewable Energy Laboratory
Scott Sluder, James P. Szybist – Oak Ridge National Laboratory
John E. Dec, Paul C. Miles – Sandia National Laboratories
Steve Ciatti – Argonne National Laboratory
J. Timothy Bays – Pacific Northwest National Laboratory
William Pitz, Marco Mehl – Lawrence Livermore National Laboratory

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Steven Chalk, Deputy Assistant Secretary for Transportation

Bioenergy Technologies Office

Jonathan Male, Director

Alicia Lindauer, Technology Manager

Vehicle Technologies Office

Michael Berube, Director

Gurpreet Singh, Program Manager, Advanced Combustion Systems and Fuels R&D

Kevin Stork, Technology Manager, Fuel Technologies and Deployment

Mike Weismiller, Technology Development Manager

The national laboratory project management team consisted of:

John Farrell (Technical Monitor), National Renewable Energy Laboratory (NREL)

John Holladay, Pacific Northwest National Laboratory (PNNL)

Robert Wagner, Oak Ridge National Laboratory (ORNL)

Christopher Moen, Sandia National Laboratories (SNL)

List of Acronyms and Abbreviations

ASTM	ASTM International
Co-Optima	Co-Optimization of Fuels & Engines
¹³ C	carbon-13
DHA	detailed hydrocarbon analysis
¹ H	proton
HOV	heat of vaporization
MON	motor octane number
NMR	nuclear magnetic resonance
PMI	particulate matter index
ppm	parts per million
RON	research octane number
wt%	percent by weight

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Introduction

The U.S. Department of Energy's Co-Optimization of Fuels & Engines (Co-Optima) initiative is conducting research to accelerate the introduction of affordable, scalable, and sustainable fuels and high-efficiency, low-emission engines. The Co-Optima initiative is focused on identifying the fuel properties and engine design characteristics needed to maximize performance and affordability while cutting pollutant emissions. The outcome of this effort will be new tools, data, and knowledge to pave the way for future generations of fuel and vehicle innovations.

In the area of spark-ignition engines and fuels, Co-Optima researchers have focused on identifying fuel properties that can enable market introduction of aggressively downsized and turbocharged engines in the 2025 timeframe. Researchers are mapping the relationships between production pathways, molecular structure, fuel chemical/physical properties, and engine performance. Because the Co-Optima initiative is being conducted across nine national laboratories (the National Renewable Energy Laboratory, Argonne, Idaho, Lawrence Berkeley, Lawrence Livermore, Los Alamos, Oak Ridge, Pacific Northwest, and Sandia National Laboratories) researchers required a set of common spark-ignition engine fuels having similar properties but produced from a wide range of fuel chemistries. These fuels are known as the Co-Optima Core Research Gasolines. They include alkylate, aromatic, olefin, and naphthene hydrocarbon chemistries as well as ethanol. This brief report provides an easily available tabulation of the properties of these fuels and may be updated with additional fuel property data as it becomes available.

Co-Optima researchers have already begun to utilize the Core Research Gasolines, with results published in several studies [1-7].

Methods

The Core Research Gasolines were custom blended by Gage Products to have a nominal research octane number (RON) of 98 and a motor octane number (MON) of 88, yielding an octane sensitivity (the difference between RON and MON) of 10. For the alkylate gasoline, having a high octane sensitivity is precluded by fuel chemistry and the target value was zero. Each sample was prepared to meet the targeted composition, such as high aromatic, high alkylate, high olefinic, high cycloalkane, and E30.

ASTM International (ASTM) methods were performed as written, unless otherwise noted. Detailed hydrocarbon analysis (DHA) was conducted by ASTM D6729. Compound identifications were verified with mass spectrometry using the same gas chromatography parameters in the ASTM DHA method. Oxygenate (ethanol) content was measured using ASTM D5599. Based on the DHA, the particulate matter index (PMI), originally introduced by researchers at Honda [8], was implemented using the approach described by Ratcliff et al. [9]. The heat of vaporization (HOV) was measured by differential scanning calorimetry/thermogravimetric analysis and calculated from the DHA using methods described in Chupka et al. [10]. True vapor pressure was measured on an Eralytics Eravap using the automated triple expansion method of ASTM D6378, extending the temperature range to -20°C to 120°C.

Index of refraction measurements were conducted at room temperature using a digital refractometer (VEE GEE MDX-101) at Sandia National Laboratories [4]. Nuclear magnetic resonance (NMR) spectra were recorded at Pacific Northwest National Laboratory on Agilent 500 MHz instruments using sample volumes of approximately 1 mL. $^{13}\text{C}\{^1\text{H}\}$ NMR spectra were recorded using chromium (III) acetylacetonate as a relaxation agent, which can result in slight NMR chemical shift differences from those reported in some databases. Details for sample preparation and data acquisition can be found in Appendix A.

Results

Basic Fuel Properties

Commonly measured fuel properties are shown in Table 1, including octane numbers, heating value, HOV, and PMI. Yield sooting index was supplied by Yale University [11]. Table 2 lists the composition of the Core Research Gasolines, derived from compound class measurements, elemental composition, and oxygenate (ethanol) content.

Table 1. Fuel Properties of Co-Optima Core Research Gasolines

		Olefinic	E30	Aromatic	Alkylate	High cycloalkane
Specific gravity	D4052	0.7231	0.7529	0.7575	0.6969	0.7557
Density @ 15 °C (g/mL)	D4052	0.7229	0.7527	0.7572	0.6968	0.7555
Index of refraction @ 20 °C [4]		1.409	1.401	1.431	1.391	1.426
RON (R)	D2699	98.2	97.4	98.1	98.0	98.0
MON (M)	D2700	88.0	86.6	87.8	96.6	87.1
Octane rating	R+M/2	93.1	92.0	93.0	97.3	92.6
Octane sensitivity	R-M	10.2	10.8	10.3	1.4	10.9
Reid vapor pressure (psi)	D5191	6.10	7.66	7.17	4.15	8.00
Gross heating value (MJ/kg)	D4809	47.148	41.096	45.735	47.877	46.018
Net heating value (MJ/kg)	D4809	44.071	38.170	42.952	44.524	43.208
HOV (measured) (kJ/kg)		337	565	412	309	393
HOV (calc. from DHA) (kJ/kg)		330	532	361	308	370
PMI		1.004	1.275	1.803	0.221	1.491
Yield sooting index [11]		80.95	47.86	114.9	60.91	97.92

Table 2. Composition Information on Co-Optima Core Research Gasolines

			Olefinic	E30	Aromatic	Alkylate	High cyclo-alkane
Aromatic content	D1319	vol%	10.6	8.1	30.8	0	28.2
Olefin content	D1319	vol%	31.3	5	4.2	0	1.5
Saturate content	D1319	vol%	58.1	57.1	65	100	70.3
Aromatic content	D5580	vol%			35.8		
Sulfur	D2622	mass %	<0.001	<0.001	<0.001	<0.001	<0.001
Carbon	D5291	mass%	85.40	74.78	87.22	83.75	87.08
Hydrogen	D5291	mass%	14.50	13.79	13.12	15.80	13.24
Oxygenates							
Ethanol	D5599	vol%	<0.1	30.59	<0.1	<0.1	<0.1
Total oxygen	D5599	vol%	<0.1	11.19	<0.1	<0.1	<0.1

Nuclear Magnetic Resonance Functional Group Analysis

NMR functional group analyses were performed using ^1H and $^{13}\text{C}\{^1\text{H}\}$ NMR spectroscopy. Summaries of chemical functional groups, including carbon types and chemical substructures, are presented in Tables 3 through 5. Table 3 provides a higher-level grouping of carbon types while Tables 4 and 5 provide more detailed hydrogen and carbon type descriptions, respectively. ^1H and $^{13}\text{C}\{^1\text{H}\}$ spectra for each fuel are shown in Appendix A.

Table 3. Summary of Selected Chemical Structure Characteristics from $^{13}\text{C}\{^1\text{H}\}$ NMR, Normalized by Total Carbon Content (Mole % Carbon)

Structure Groupings	Mole % Carbon				
	Olefinic	E30	Aromatic	Alkylate	High Cyclo-alkane
General Carbon Types					
Aromatic/Olefinic Carbon	18.4	13.6	33.3	0.3	29.5
Aliphatic Carbon	81.6	86.3	66.4	99.5	70.4
CH Carbon (60 – 40 ppm)	7.8	14.1	3.5	11.5	2.2
CH ₂ Carbon (40 – 22 ppm)	56.3	40.0	40.3	78.4	50.0
CH ₃ Carbon (22 – 5 ppm)	17.5	32.2	22.6	9.6	18.2
Aromatic/Olefinic Carbon Breakdown					
Phenolic Carbon	0.1	0	0	0.1	0.2
CH ₂ /CH Substituted Aromatic Carbon	5.0	2.4	5.8	0	4.5
Naphthene Substituted Aromatic Carbon	0.4	0.5	1.2	0	0.6
CH ₃ Substituted Aromatic Carbon	1.1	0.7	1.4	0	0.9
Internal (Bridgehead) Aromatic Carbon	0.3	0.3	0.7	0	0.3
Peripheral Unsubstituted Aromatic Carbon	8.4	8.9	23.3	0.1	22.2
Other or Heteroaromatic Carbon	3.1	0.8	0.9	0.1	0.8
Total Aromatic/Olefinic Carbons	18.4	13.6	33.3	0.3	29.5

ppm: parts per million

Table 4. Summary of Chemical Structure Characteristics from ¹H NMR, Normalized by Total Hydrogen Content (Mole % Hydrogen)

Chemical Shift Range (ppm)	Chemical Meaning	Mole % Hydrogen				High Cyclo-alkane
		Olefinic	E30	Aromatic	Alkylate	
10.7 - 9.00	Polyaromatics, Aldehydes	0	0	0	0	0
9.000 - 8.200	Tri-ring aromatics	0	0	0.06	0	0.05
8.200 - 7.551	Di-ring aromatics	0.16	0.23	0.28	0	0.26
7.551 - 7.182	Di-ring aromatics	2.89	2.98	0.04	0.06	6.39
7.182 - 7.130	Mono-ring aromatics	3.44	2.09	9.19	0.07	8.87
7.130 - 6.972	Mono-ring aromatics	1.54	2.00	6.63	0.06	2.63
6.972 - 6.785	Substituted mono-ring aromatics	0.57	0.87	2.34	0.02	1.07
6.785 - 6.425	Highly substituted mono-ring aromatics	0.01	0.02	0.01	0	0.04
6.425 - 5.1	Olefinic CH, aromatic alcohols	1.37	0.70	0.83	0.01	0.13
5.1 - 4.8	Olefinic CH ₂ , aromatic alcohols	4.01	1.46	1.56	0.01	0.23
4.8 - 4.184	Olefinic CH ₂	2.87	0	0.01	0	0
4.184 - 3.306	Bridged CH ₂ groups in fluorene types, ethers, alcohols, including diols	0	9.35	0.04	0	0.01
3.306 - 2.883	aromatic α-CH	0.05	0.19	0.23	0	0.12
2.883 - 2.641	aromatic α-CH ₂	0.14	0.19	0.40	0	0.23
2.641 - 2.292	aromatic α-CH ₂ + α-CH ₃	2.43	2.22	7.57	0.06	5.31
2.292 - 2.040	aromatic α-CH ₃	1.03	1.67	3.36	0.03	1.51
2.040 - 1.963	Allylic groups	0.64	0.57	0.58	0.01	0.14
1.963 - 1.570	CH and CH ₂ groups of naphthenes	16.40	11.05	3.15	8.29	2.74
1.570 - 1.391	CH groups of iso-paraffins	4.55	6.71	18.52	2.85	38.22
1.39 - 1.11	CH ₂ groups of paraffins (n- and iso-)	13.24	31.50	13.85	12.75	10.38
1.115 - 0.941	CH ₂ groups of paraffins (n- and iso-)	7.23	3.33	2.56	5.28	1.91
0.941 - 0.254	CH ₃ groups of paraffins (n- and iso-)	37.43	22.87	28.79	70.50	19.76

Table 5. Summary of Chemical Structure Characteristics from $^{13}\text{C}\{^1\text{H}\}$ NMR, Normalized by Total Carbon Content (Mole % Carbon)

Chemical Shift Range (ppm)	Structure Definition	Mole % Carbon				High Cyclo-alkane
		Olefinic	E30	Aromatic	Alkylate	
220–202	Ketone Carbonyl	0	0	0	0	0
202–195	Aldehyde Carbonyl	0	0	0	0.1	0
195–182	Quinone Carbonyl	0	0.1	0.1	0.1	0.1
182–176	Acid Carboxyl	0	0	0	0	0
176–165	Ester or Amide Carboxyl	0	0	0.2	0	0
165–143	Alkyl (other than methyl), or heteroatom (N, O, S) substituted aromatic	2.8	0.2	0.5	0.1	0.6
143–137	Tertiary carbon in alkyl substituted aromatic rings	2.2	2.1	5.2	0	4.4
137–131	Tertiary carbon in naphthalene units and methyl substituted aromatic rings	1.6	1.4	3.0	0	1.7
131–127.5	Protonated and internal aromatic carbon, substituted carbon in alkenes ($\text{R}_2\text{C}=\text{CR}_2$), ortho and meta CH in toluene	6.3	6.2	16.3	0.1	16.1
127.5–124	Protonated and internal aromatic carbon, substituted carbon in alkenes ($\text{RHC}=\text{CR}_2$), para CH in toluene	2.3	2.9	7.3	0	6.0
124–115	Protonated aromatic carbon, substituted carbon in alkenes ($\text{RHC}=\text{CR}_2$)	0.2	0	0.1	0	0
115–95	Unsubstituted carbon in alkenes ($\text{CH}_2=\text{CR}_2$)	3.0	0.8	0.9	0.1	0.7
70–60	CH_2 adjacent to oxygen and C in tertiary alcohols	0.2	0	0	0.2	0.0
60–45	CH adjacent to tertiary and isopropyl groups. CH_3 in ether linkage	5.8	12.0	2.2	9.8	1.0
45–40	CH in allylic and benzylic groups and in joining tetralin ring	1.8	2.1	1.3	1.5	1.2
40–36	CH_2 adjacent to substituted double bonds and tertiary carbon	2.0	2.8	1.8	1.2	2.7
36–33.5	CH, CH_2 β from secondary carbon and in cyclopentyl and cyclohexyl rings	3.6	4.4	2.3	1.7	2.5

Chemical Shift Range (ppm)	Structure Definition	Mole % Carbon				
		Olefinic	E30	Aromatic	Alkylate	High Cyclo-alkane
33.5–31	CH, CH ₂ γ from CH ₃ . CH ₂ α to allylic and β to aromatic groups	7.4	6.7	4.4	2.6	3.7
31–28.5	C in open chains. CH ₂ benzylic and CH ₂ not adjacent to CH in alkyl group	22.7	9.0	12.5	38.9	11.2
28.5–26.5	CH, CH ₂ in open chains. CH ₂ in cyclohexyl groups and CH ₃ in tert-butyl ether	2.5	2.4	1.5	1.6	1.6
26.5–24.5	Some naphthenic CH ₂ . CH ₂ β in propyl, indan and cyclopentyl groups	9.9	5.7	11.8	20.1	23.4
24.5–22	CH ₂ β from terminal CH ₃ . CH ₂ β in unsubstituted tetralin	8.2	9.0	6.0	12.3	4.9
22–20	CH ₃ α in hydroaromatics and alkyls not shielded by adjacent rings or groups	4.5	5.8	10.0	1.9	7.8
20–18	CH ₃ α in hydroaromatics and alkyls shielded by adjacent rings or groups	3.5	13.1	3.0	2.1	2.4
18–15	CH ₃ in cyclohexanes and β in ethyl aromatics and ethers	2.0	3.5	2.3	1.8	1.2
15–12.5	CH ₃ γ to an aromatic ring or shielded by two adjacent rings or groups, chain α-CH ₃	5.3	7.2	4.3	1.9	3.7
12.5–5	CH ₃ γ to aromatic rings or ethyl substituted cyclohexanes	2.2	2.6	3.0	1.9	3.1

Detailed Hydrocarbon Analysis

DHA was performed by gas chromatograph-flame ionization detection using ASTM method D6729. The summary compound class information is shown in Table 6, and the detailed results are presented in Appendix B.

The aromatic and alkylate fuels used broad mixtures of aromatic and isoparaffinic compounds, respectively, for blending. For the high-olefin fuel, the added olefin was a mixture of two isomers of di-isobutylene (2,4,4-trimethylpent-1-ene and 2,2,4-trimethyl-3-pentene). As the DHA shows, these two molecules constitute 27 percent by weight (wt%) of the fuel. Since the total olefin content of the fuel is 32 wt%, only 5 wt% of the fuel is other olefins. Similarly, the high-cycloalkane fuel is 20 wt% cyclopentane, while the total cycloalkane content is 24 wt%, so only 4 wt% is other cycloalkanes.

Table 6. Detailed hydrocarbon analysis by ASTM D6729, values in wt%

	Olefinic	E30	Aromatic	Alkylate	High cycloalkane
Average molecular weight, g/mole	102.9	72.9	96.0	111.0	89.0
Paraffins	9.6	11.1	6.7	2.5	6.9
Iso-paraffins	39.6	25.5	33.9	96.0	28.7
Aromatics	15.1	16.1	45.8	1.0	38.4
Cycloalkanes	2.9	7.2	7.9	0.0	24.0
Olefins	32.1	5.2	41.0	0.1	1.5
Unidentified	0.8	2.9	1.6	0.4	0.5
Oxygenates	0	32.0	0	0	0

Volatility

Distillation

The distillation curve is a critical set of properties for gasoline, related to driveability, lube oil dilution, and fine particle formation. The distillation curves for the Core Research Gasolines are reported in Figure 1 and Table 7.

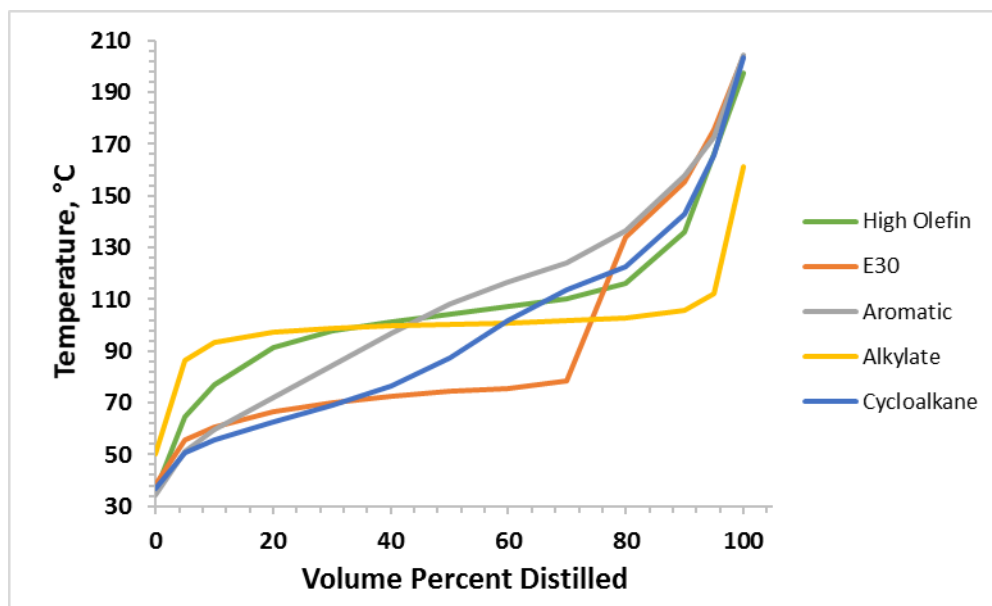


Figure 1. Distillation curves (D86) for the Co-Optima Core Research Gasolines

Table 7. Distillation Data (D86) for the Co-Optima Core Research Gasolines

Volume Percent Distilled	Olefinic	E30	Aromatic	Alkylate	High cycloalkane
	Temperature, °C				
Initial Boiling Point	35.7	38.2	34.4	50.3	36.7
5%	64.4	55.4	51.1	86.2	50.6
10%	77.1	60.7	59.4	93.1	55.7
20%	91.1	66.6	72.2	97.4	62.4
30%	97.7	70.2	84.6	98.9	68.9
40%	101.4	72.6	96.8	99.7	76.6
50%	104.3	74.3	108.1	100.3	87.4
60%	107	75.7	116.4	100.9	101.7
70%	110.4	78.6	124	101.6	113.8
80%	116.1	134.2	136.3	102.7	122.7
90%	136.2	155.2	157.9	105.9	142.7
95%	166.1	175.9	172.8	112.3	165.8
Final Boiling Point	197.7	204.1	204.4	161.3	203.5

True Vapor Pressure

The dry vapor pressure equivalent—the modern equivalent of Reid vapor pressure—is the vapor pressure at 37.8°C. This measurement is used to control gasoline vapor pressure to limit evaporative emissions, to ensure adequate vapor pressure for cold starting and warmup in cold weather, and to avoid the potential for vapor lock and similar hot weather driveability problems [12]. Having a measurement of the actual vapor pressure at engine operating conditions should prove to be more informative in terms of revealing the fundamental physical property basis for driveability issues. Additionally, for direct injection engines, flash boiling of the spray can occur whenever the saturation pressure of the gasoline is higher than the in-cylinder temperature into which the gasoline is injected [13]. Results for true vapor pressure measurements for the Core Research Gasolines are reported in Figure 2 and Table 8.

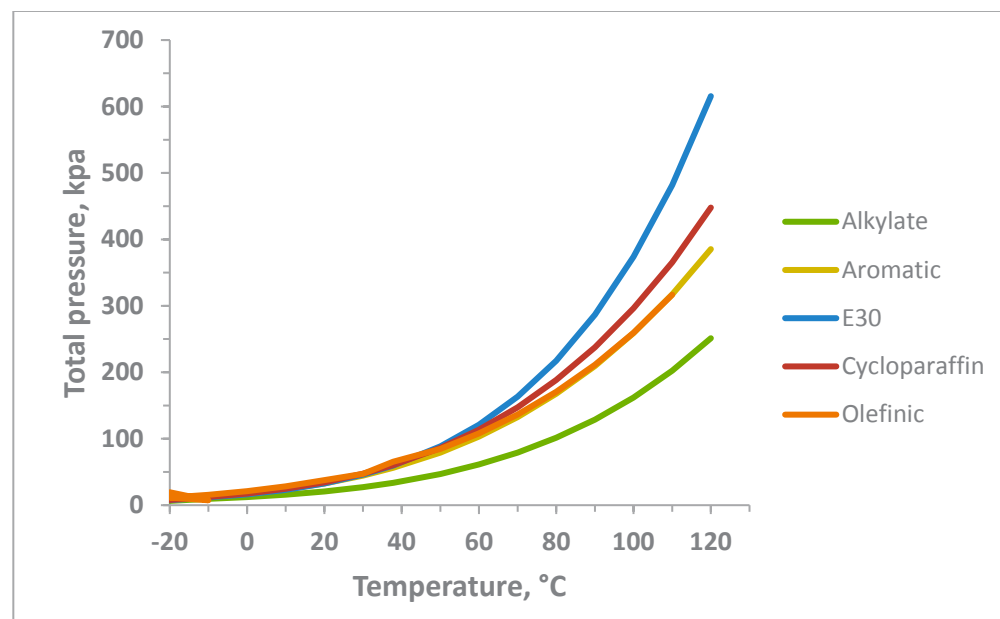


Figure 2. True vapor pressure as a function of temperature for the Co-Optima Core gasolines

Table 8. True Vapor Pressure at Different Temperatures for the Co-Optima Core Gasolines

Temp, °C	Vapor Pressure, psi					Vapor Pressure, kPa				
	Olefinic	E30	Aromatic	Alkylate	High Cyclo- alkane	Olefinic	E30	Aromatic	Alkylate	High Cyclo- alkane
-20	1.07	1.09	1.1	0.94	1.14	7.4	7.5	7.6	6.5	7.9
-10	1.68	1.71	1.78	1.38	1.82	11.6	11.8	12.3	9.5	12.5
0	2.27	2.38	2.48	1.77	2.54	15.7	16.4	17.1	12.2	17.5
10	3.06	3.35	3.44	2.28	3.57	21.1	23.1	23.7	15.7	24.6
20	4.1	4.73	4.74	2.98	4.97	28.3	32.6	32.7	20.5	34.3
30	5.48	6.65	6.46	3.93	6.86	37.8	45.9	44.5	27.1	47.3
37.8	6.83	8.64	8.15	4.88	8.74	47.1	59.6	56.2	33.6	60.3
50	9.5	12.83	11.48	6.81	12.5	65.5	88.5	79.2	47.0	86.2
60	12.28	17.55	14.97	8.89	16.48	84.7	121.0	103.2	61.3	113.6
70	15.68	23.69	19.23	11.49	21.37	108.1	163.3	132.6	79.2	147.3
80	19.8	31.53	24.32	14.71	27.32	136.5	217.4	167.7	101.4	188.4
90	24.75	41.6	30.39	18.67	34.46	170.6	286.8	209.5	128.7	237.6
100	30.65	54.21	37.58	23.51	42.99	211.3	373.8	259.1	162.1	296.4
110	37.62	69.88	46.01	29.35	53.02	259.4	481.8	317.2	202.4	365.6
120	45.93	89.28	55.89	36.44	64.96	316.7	615.6	385.4	251.2	447.9

Summary

Extensive data on the Co-Optima Core Research Gasolines have been developed and are reported here. These include basic fuel properties as well as results of DHA and NMR. This report may be updated in the future as additional property measurements or simulations become available.

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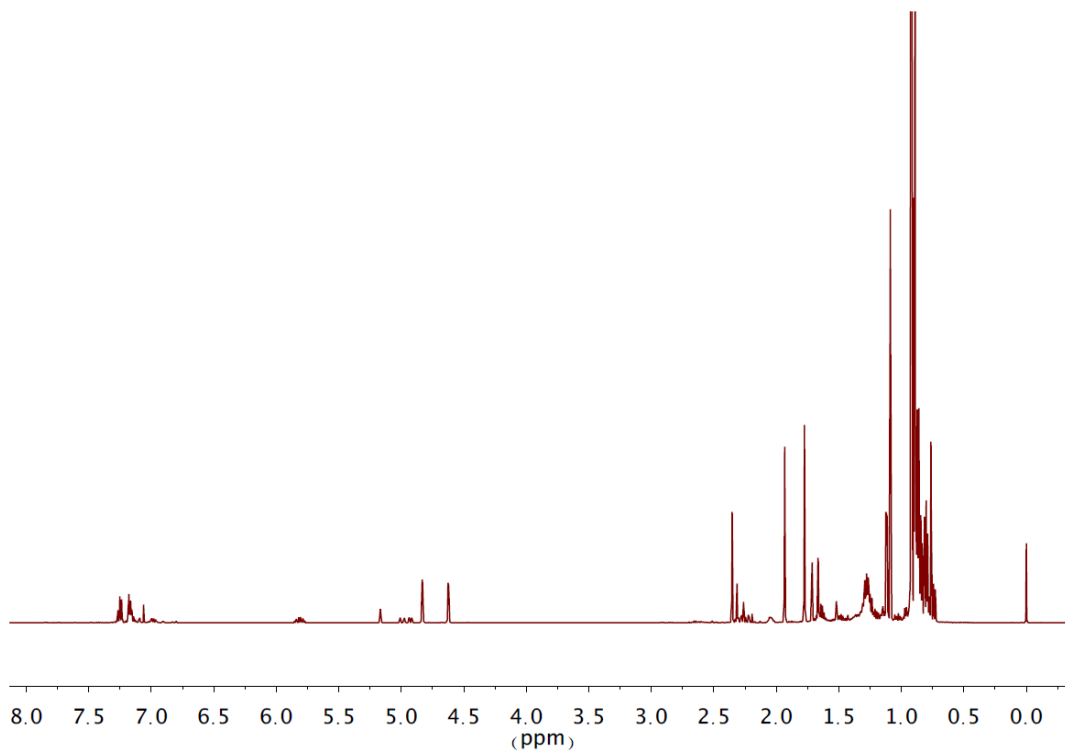
Appendix A. NMR Spectroscopy

All ^1H NMR and $^{13}\text{C}\{^1\text{H}\}$ NMR spectra were acquired at 499.67 and 125.65 MHz, respectively, on an Agilent Inova or VNMRS System at 21° – 25°C in 5-mm o.d. NMR tubes, spinning at 20 Hz.

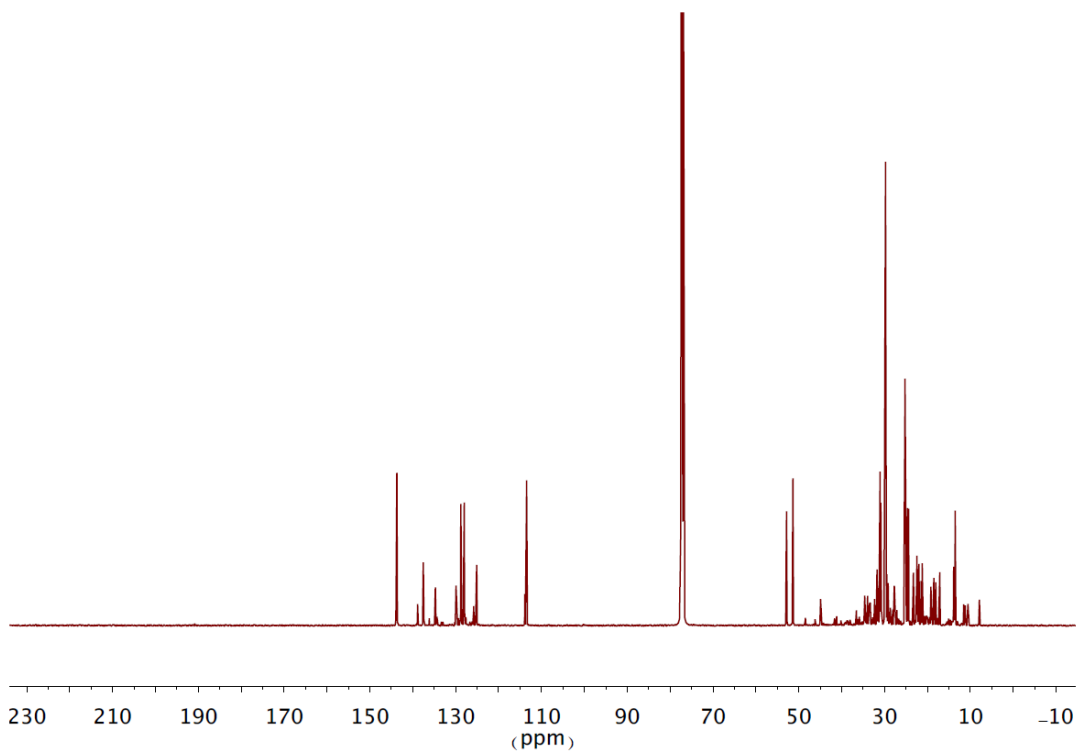
Quantitative $^{13}\text{C}\{^1\text{H}\}$ spectra were acquired using a 45° observe pulse; acquisition and relaxation delay times of 3 and 5 seconds, respectively, with ^1H Waltz decoupling during the acquisition delay period for nuclear Overhauser enhancement suppression; and 0.05 M $\text{Cr}(\text{acac})_3$ for T_1 reduction and quenching of any residual nuclear Overhauser enhancement, where $\text{Cr}(\text{acac})_3$ is chromium (III) acetylacetonate. These conditions lead to an average integral uncertainty of about ± 2 percent (in carbon aromaticity). Chemical shifts were referenced to CDCl_3 (77.16 ppm) [14]. A total of 1,500 to 6,000 scans were collected. Samples consisted of 0.20 mL of fuel diluted to 1.00 mL in CDCl_3 (99.9% D, Cambridge Isotope Laboratories) with 0.05 M $\text{Cr}(\text{acac})_3$ (Aldrich). Line broadening of 2.5 Hz was used for processing spectra to improve the signal-to-noise ratio.

Quantitative ^1H spectra were acquired using a 30° observe pulse with acquisition and relaxation delays of 3 and 8 seconds, respectively, for an 11-second recycle time. Samples consisted of 50.0 μL of fuel in 0.75 mL of 99.96% D CDCl_3 with 0.03% (v/v) tetramethylsilane (TMS) purchased from Cambridge Isotope Laboratories, Inc. Chemical shifts were referenced to TMS or to residual CHCl_3 in solvent CDCl_3 (7.26 ppm) [14]. Spectra resulted from 128 scans. Line broadening was not used.

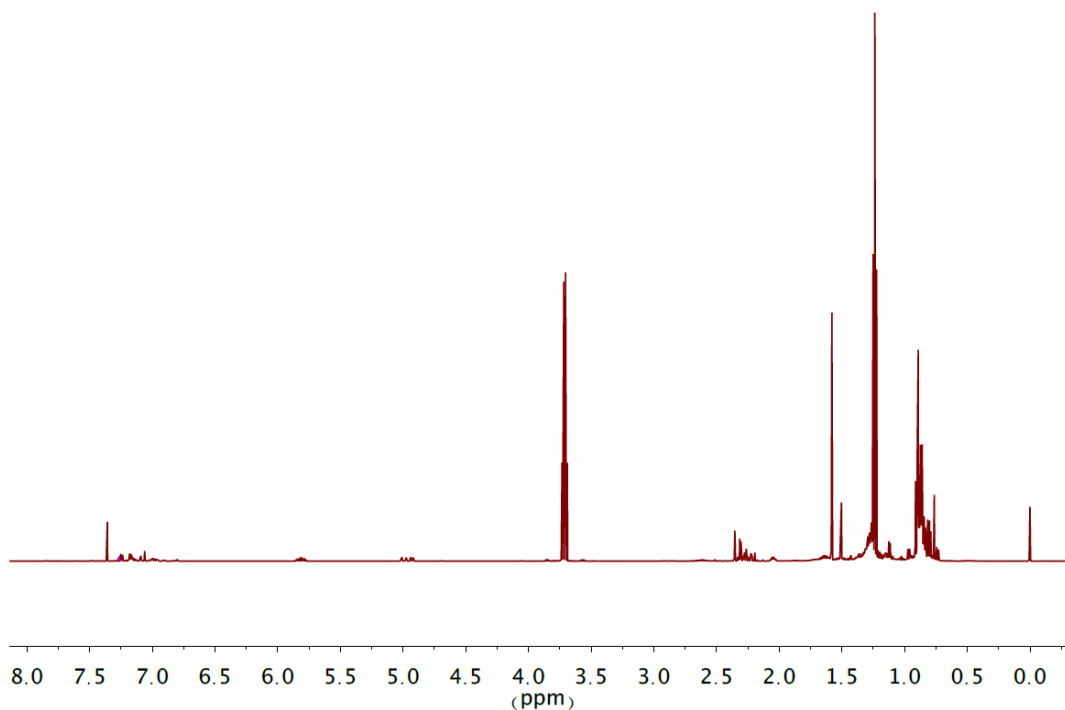
NMR spectra were processed using analysis tools from Agilent VNMRJ Version 4.2 software or MestReNova Version 8.1.0-11315 software. Spectral range assignments and interpretation of NMR results are based on ranges and methods presented by Altgelt and Boduszynski [15]. Proton and ^{13}C NMR spectra for each of the gasolines are shown below, chemical shift ranges for specific organic functional groups are specified in Tables 3 and 4 in the main body of this report.



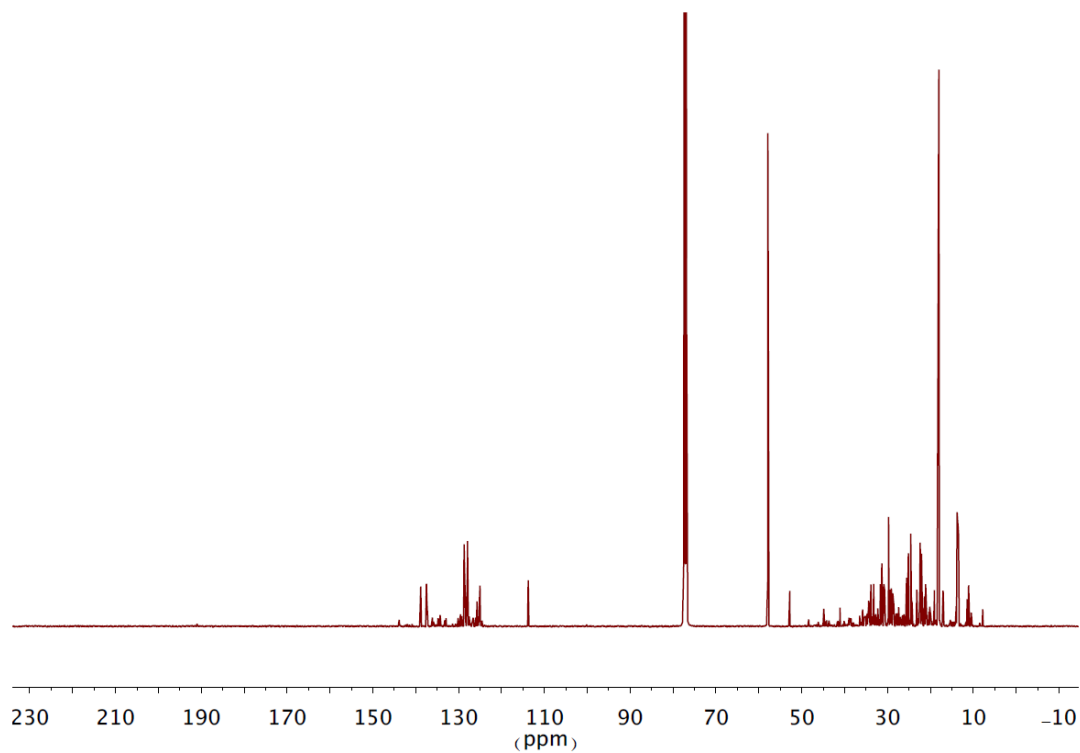
^1H NMR Spectrum of the Olefinic Co-Optima Core Research Gasoline



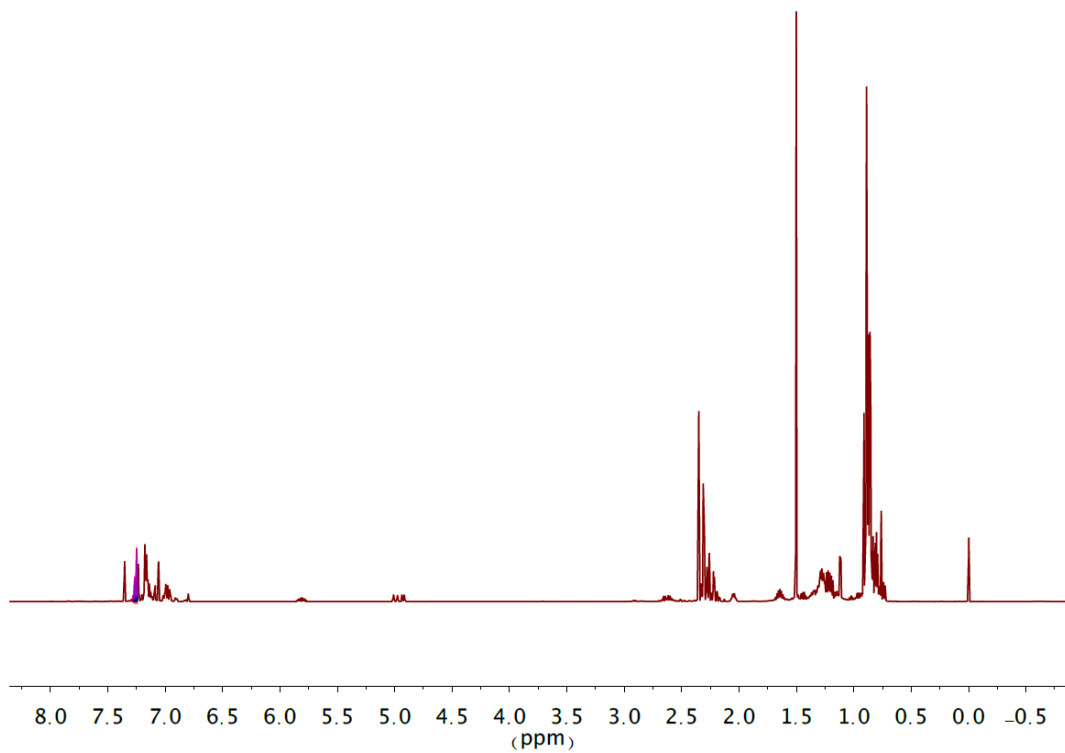
$^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of the Olefinic Co-Optima Core Research Gasoline



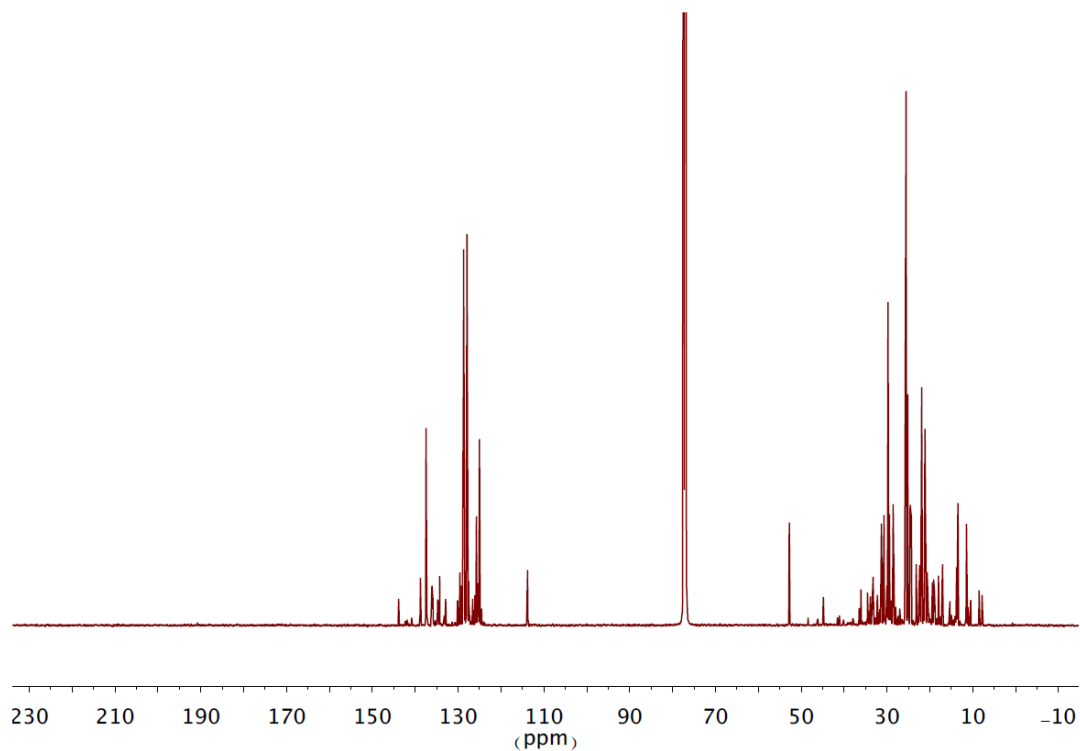
¹H NMR spectrum of the E30 Co-Optima Core Research Gasoline



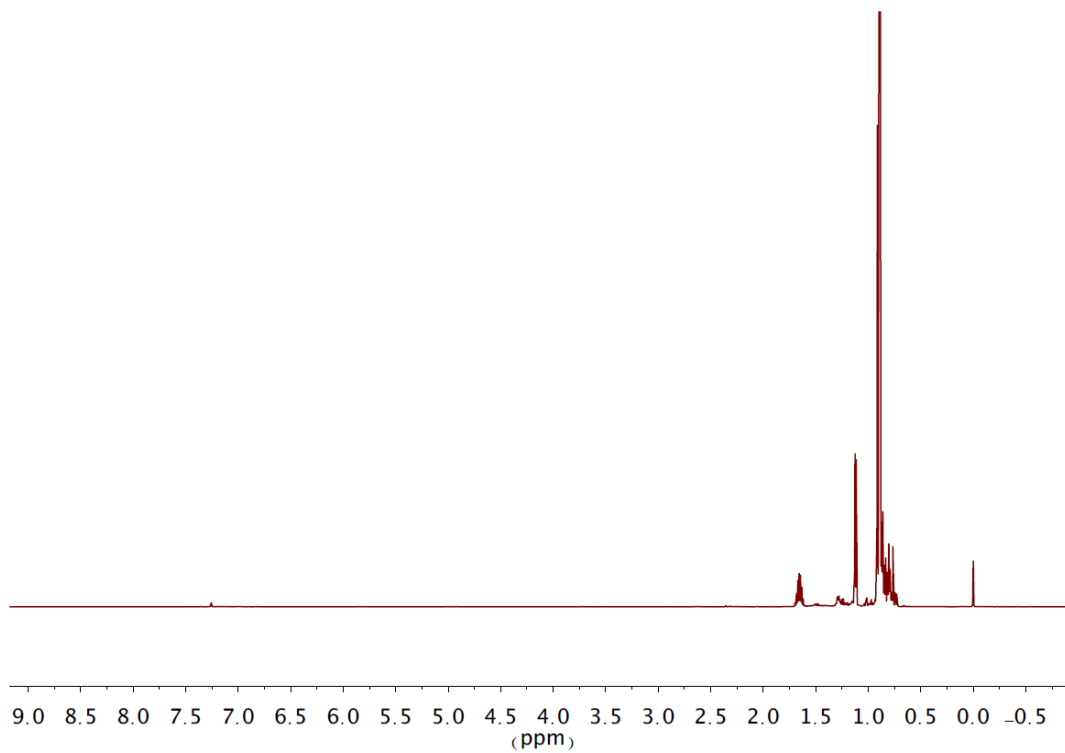
¹³C{¹H} NMR spectrum of the E30 Co-Optima Core Research Gasoline



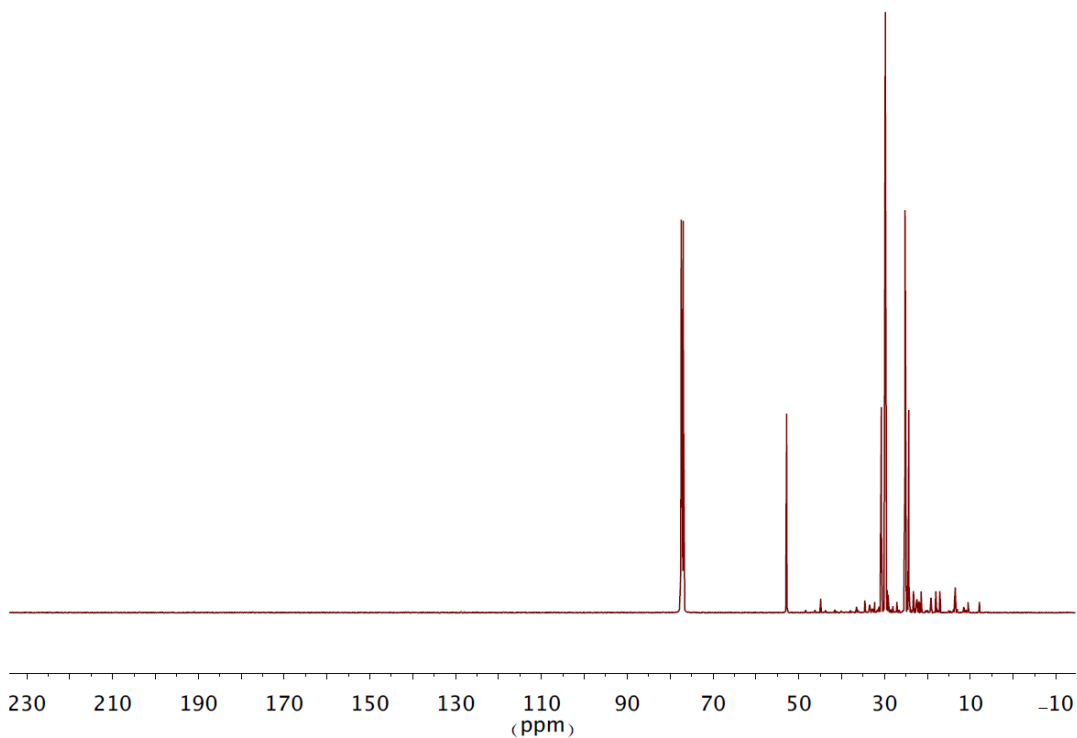
^1H NMR spectrum of the Aromatic Co-Optima Core Research Gasoline



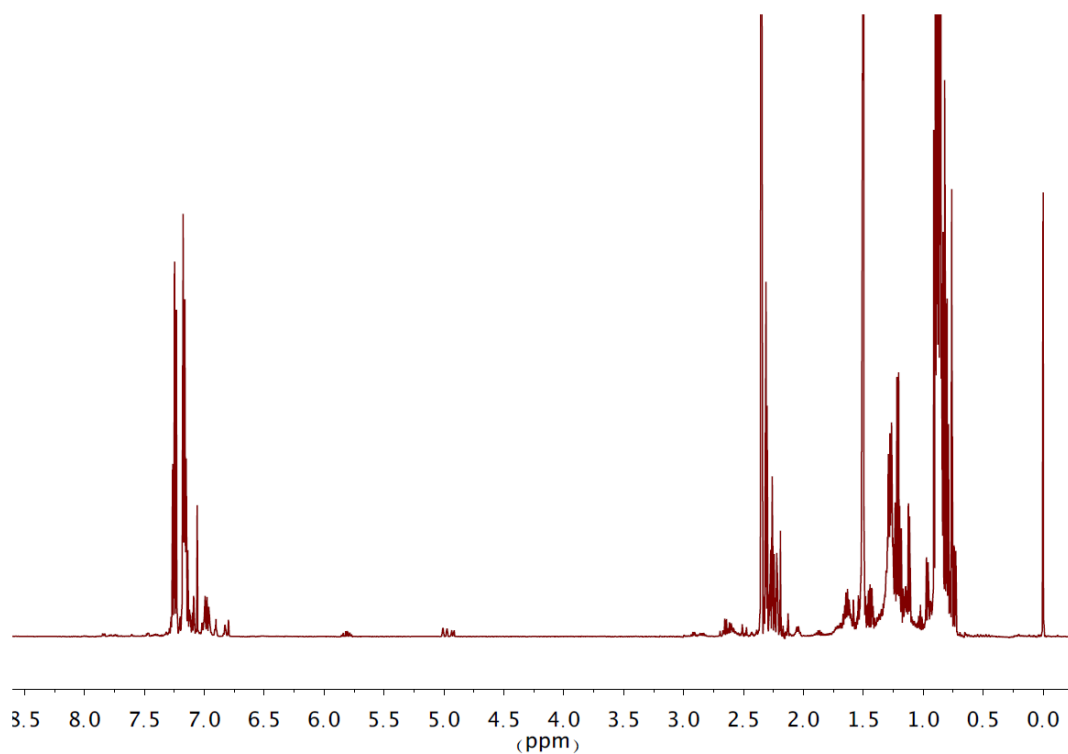
$^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of the Aromatic Co-Optima Core Research Gasoline



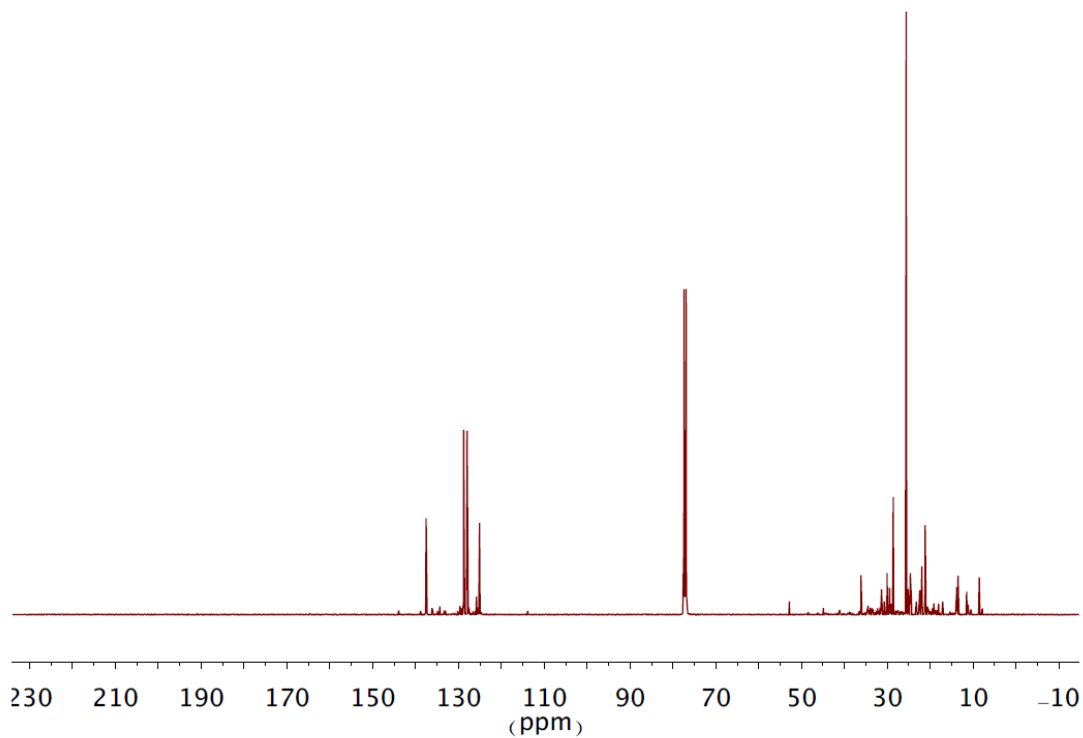
^1H NMR spectrum of the Alkylate Co-Optima Core Research Gasoline



$^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of the Alkylate Co-Optima Core Research Gasoline



^1H NMR spectrum of the High Cycloalkane Co-Optima Core Research Gasoline



$^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of the High Cycloalkane Co-Optima Core Research Gasoline

Appendix B. Detailed Hydrocarbon Analysis

Alkylate						
<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>	
Paraffin	106-97-8	n-Butane	2.417	2.892	4.610	
	109-66-0	n-Pentane	0.004	0.005	0.006	
	110-54-3	n-Hexane	0.003	0.003	0.004	
	111-84-2	n-Nonane	0.073	0.070	0.063	
	124-18-5	n-Decane	0.023	0.021	0.018	
	1120-21-4	n-Undecane	0.019	0.017	0.013	
	112-40-3	n-Dodecane	0.003	0.003	0.002	
	629-50-5	n-Tridecane	0.001	0.001	0.001	
	629-59-4	n-Tetradecane	0.002	0.002	0.001	
	I-Paraffins	463-82-1	2,2-Dimethylpropane	0.005	0.006	0.008
		78-78-4	i-Pentane	1.204	1.345	1.849
79-29-8		2,3-Dimethylbutane	1.019	1.067	1.311	
107-83-5		2-Methylpentane	0.295	0.313	0.380	
96-14-0		3-Methylpentane	0.152	0.159	0.196	
108-08-7		2,4-Dimethylpentane	0.876	0.902	0.969	
464-06-2		2,2,3-Trimethylbutane	0.064	0.064	0.071	
591-76-4		2-Methylhexane	0.597	0.610	0.661	
589-34-4		3-Methylhexane	0.063	0.064	0.070	
540-84-1		2,2,4-Trimethylpentane	75.561	75.632	73.330	
590-73-8		2,2-Dimethylhexane	0.954	0.950	0.926	
564-02-3		2,2,3-Trimethylpentane	1.258	1.217	1.221	
592-13-2		2,5-Dimethylhexane	1.080	1.078	1.048	
589-43-5		2,4-Dimethylhexane	0.944	0.934	0.916	
563-16-6		3,3-Dimethylhexane	0.006	0.006	0.006	
565-75-3		2,3,4-Trimethylpentane	3.970	3.824	3.853	
560-21-4		2,3,3-Trimethylpentane	4.016	3.830	3.897	
584-94-1		2,3-Dimethylhexane	0.809	0.787	0.785	
592-27-8		2-Methylheptane	0.031	0.031	0.030	
589-53-7		4-Methylheptane	0.080	0.078	0.077	
583-48-2		3,4-Dimethylhexane	0.080	0.077	0.078	
589-81-1		3-Methylheptane	0.024	0.024	0.023	
3522-94-9		2,2,5-Trimethylhexane	1.249	1.223	1.080	
		C9-Isoparaffin-x	0.031	0.029	0.027	
1069-53-0		2,3,5-Trimethylhexane	0.178	0.171	0.154	
1071-26-7		2,4-Dimethylheptane	0.021	0.021	0.018	
1072-05-5		2,6-Dimethylheptane	0.033	0.032	0.028	
		2,5-Dimethylheptane	0.079	0.076	0.068	
3221-61-2		2-Methyloctane	0.002	0.002	0.001	
		C10 - IsoParaffin - 1	0.167	0.159	0.130	
14720-74-2		2,2,4-trimethylheptane	0.113	0.108	0.088	
		C10-isoparaffin-x	0.000	0.000	0.000	
		2,3-Dimethyloctane	0.047	0.045	0.037	
15869-87-1	2,2-Dimethyloctane	0.012	0.011	0.009		
15869-89-3	2,5-Dimethyloctane	0.008	0.008	0.006		
2040-95-1	2,7-Dimethyloctane	0.003	0.003	0.003		
2051-30-1	2,4-Dimethyloctane	0.021	0.020	0.016		

Alkylate (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
I-Paraffins		2,6-Dimethyloctane	0.007	0.007	0.006
		2,2,6-Trimethyloctane	0.263	0.251	0.205
		C11-Isoparaffin-1	0.019	0.017	0.013
		C10 - IsoParaffin - 5	0.037	0.035	0.028
	62016-30-4	2,3,3-trimethyloctane	0.039	0.036	0.027
		C11-Isoparaffin-3	0.013	0.012	0.009
		C11 Isoparaffin-4	0.005	0.005	0.003
		2,5,6-Trimethyloctane	0.233	0.217	0.165
		C11-Isoparaffin-7	0.079	0.073	0.056
		C11-Isoparaffin-9	0.024	0.022	0.017
		C11- Isoparaffin-10	0.027	0.025	0.019
		C11- Isoparaffin-11	0.129	0.120	0.091
		C11- Isoparaffin - 12	0.061	0.057	0.043
		C12 - IsoParaffin - 1	0.010	0.009	0.007
		C12 - IsoParaffin - 2	0.007	0.007	0.005
		C12 - IsoParaffin - 4	0.006	0.006	0.004
	Aromatics <i>Mono-Aromatics</i>	108-38-3	m-Xylene	0.004	0.003
106-42-3		p-Xylene	0.024	0.019	0.025
95-47-6		o-Xylene	0.014	0.011	0.015
103-65-1		n-Propylbenzene	0.004	0.003	0.003
620-14-4		1-Methyl-3-ethylbenzene	0.003	0.002	0.003
95-63-6		1,2,4-Trimethylbenzene	0.023	0.018	0.021
538-93-2		i-Butylbenzene	0.014	0.011	0.011
526-73-8		1,2,3-Trimethylbenzene	0.002	0.002	0.002
535-77-3		1-Methyl-3-i-propylbenzene	0.002	0.002	0.002
99-87-6		1-Methyl-4-i-propylbenzene	0.033	0.027	0.027
1074-43-7		1-Methyl-3-n-propylbenzene	0.187	0.151	0.155
135-01-3		1,2-Diethylbenzene	0.019	0.015	0.016
1074-17-5		1-Methyl-2-n-propylbenzene	0.028	0.022	0.023
874-41-9		1,3-Dimethyl-4-ethylbenzene	0.157	0.124	0.130
934-80-5		1,2-Dimethyl-4-ethylbenzene	0.018	0.014	0.015
2870-04-4		1,3-Dimethyl-2-ethylbenzene	0.175	0.136	0.145
		1-Ethyl-3-i-propylbenzene	0.036	0.028	0.027
4218-48-8		1-Ethyl-4-i-propylbenzene	0.026	0.020	0.019
		1,2,4,5-Tetramethylbenzene	0.009	0.007	0.007
527-53-7		1,2,3,5-Tetramethylbenzene	0.004	0.003	0.003
		C11 - Aromatic - 2	0.004	0.003	0.003
		C11 - Aromatic - 3	0.028	0.022	0.021
		1,2-Di-i-propylbenzene	0.003	0.002	0.002
1595-16-0		1-methyl-4-(1-methylpropyl)be	0.003	0.002	0.002
5161-04-6		Benzene, 1-methyl-4-(2-methylp	0.005	0.004	0.004
538-68-1		n-Pentylbenzene	0.001	0.001	0.001
577-55-9		1-Methyl-2-n-butylbenzene	0.005	0.004	0.004
	C11 - Aromatic - 7	0.007	0.006	0.005	
	C11 - Aromatic - 11	0.002	0.001	0.001	

Alkylate (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Mono-Aromatics</i>		C12 - Aromatic - 1	0.004	0.003	0.003
		C12 - Aromatic - 10	0.004	0.003	0.003
	877-44-1	1,2,4-Triethylbenzene	0.009	0.007	0.006
		C12 - Aromatic - 11(1)	0.002	0.001	0.001
		1-Methyl-3-Hexylbenzene	0.013	0.010	0.008
<i>Naphthalenes</i>	91-20-3	Naphthalene	0.020	0.014	0.017
	3877-19-8	Naphthalene, 1,2,3,4-tetrahydr	0.003	0.002	0.002
	91-57-6	2-Methylnaphthalene	0.004	0.003	0.003
	90-12-0	1-Methylnaphthalene	0.001	0.000	0.000
<i>Naphtheno/Olefin</i>		Indan	0.006	0.005	0.006
		2-Methylindan	0.023	0.017	0.020
	874-35-1	5-Methylindan	0.003	0.002	0.002
	824-22-6	4-Methylindan	0.002	0.002	0.002
	824-63-5	2-Methylindan(1)	0.003	0.002	0.003
		4,7-Dimethyl Indane	0.006	0.004	0.004
		1,1-Dimethyl Indane	0.001	0.001	0.001
		Dimethyl Indane - 1	0.004	0.003	0.003
		Dimethyl Indane - 4	0.003	0.002	0.002
		Trimethyl Indane - 4	0.003	0.002	0.002
	<i>Indenes</i>				
<i>Naphthenes</i>					
<i>Mono-Naphthene</i>	7667-60-9	1c,2t,4t-Trimethylcyclohexane	0.009	0.008	0.008
	4926-90-3	1,1-Methylethylcyclohexane	0.002	0.002	0.002
	696-29-7	1-Methyl-2-propyl-cyclopentan	0.001	0.001	0.001
		C10 - MonoNaph - 2	0.004	0.003	0.003
<i>Di/Bicyclo-Napht</i>					
<i>Olefins</i>					
<i>n-Olefins</i>	693-61-8	2-Undecene, (E)-	0.018	0.017	0.014
		5-Undecene	0.036	0.034	0.029
<i>Iso-Olefins</i>		C8 - IsoOlefin - 7	0.012	0.010	0.011
	19549-87-2	2,4-Dimethylheptene-1	0.004	0.004	0.003
		C9-IsoOlefin-3	0.004	0.004	0.004
		C10-IsoOlefin-4	0.001	0.001	0.001
<i>Naphtheno-Olefin</i>		C9 Naph-Olefin -1	0.014	0.013	0.013
<i>Di-Olefins</i>					
<i>Oxygenates</i>					
Unidentified		Unidentified	0.000	0.000	0.000
		Unidentified	0.031	0.039	0.060
		Unidentified	0.053	0.042	0.056
		Unidentified	0.004	0.003	0.003

Alkylate (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
Unidentified		Unidentified	0.006	0.005	0.006
		Unidentified	0.046	0.043	0.033
		Unidentified	0.013	0.010	0.012
		Unidentified	0.019	0.018	0.015
		Unidentified	0.001	0.001	0.001
		Unidentified	0.004	0.003	0.004
		Unidentified	0.048	0.039	0.040
		Unidentified	0.020	0.019	0.014
		Unidentified	0.008	0.007	0.006
		Unidentified	0.018	0.014	0.014
		Unidentified	0.003	0.002	0.002
		Unidentified	0.008	0.006	0.007
		Unidentified	0.013	0.012	0.008
		Unidentified	0.010	0.008	0.007
		Unidentified	0.030	0.028	0.020
		Unidentified	0.005	0.003	0.004
		Unidentified	0.001	0.000	0.000
		Unidentified	0.003	0.002	0.002
		Unidentified	0.004	0.003	0.003
		Unidentified	0.002	0.002	0.001
		Unidentified	0.008	0.007	0.004
		Unidentified	0.003	0.002	0.002
		Unidentified	0.008	0.007	0.004
		Unidentified	0.003	0.002	0.002
		Unidentified	0.002	0.002	0.001
		Unidentified	0.004	0.003	0.002
		Unidentified	0.006	0.004	0.004
		Unidentified	0.001	0.001	0.001

Aromatics

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
Paraffin	106-97-8	n-Butane	3.178	4.156	5.229
	109-66-0	n-Pentane	1.697	2.051	2.249
	110-54-3	n-Hexane	0.827	0.950	0.918
	142-82-5	n-Heptane	0.008	0.009	0.008
	111-65-9	n-Octane	0.226	0.243	0.189
	111-84-2	n-Nonane	0.281	0.297	0.210
	124-18-5	n-Decane	0.174	0.180	0.117
	1120-21-4	n-Undecane	0.215	0.219	0.132
	112-40-3	n-Dodecane	0.040	0.040	0.022
	629-62-9	n-Pentadecane	0.014	0.014	0.006
	I-Paraffins	463-82-1	2,2-Dimethylpropane	0.008	0.010
78-78-4		i-Pentane	6.615	8.081	8.770
75-83-2		2,2-Dimethylbutane	2.806	3.272	3.115
79-29-8		2,3-Dimethylbutane	0.876	1.003	0.973
107-83-5		2-Methylpentane	0.692	0.801	0.768
96-14-0		3-Methylpentane	0.539	0.614	0.599
108-08-7		2,4-Dimethylpentane	0.748	0.842	0.714
464-06-2		2,2,3-Trimethylbutane	0.055	0.060	0.052
562-49-2		3,3-Dimethylpentane	0.033	0.036	0.032
591-76-4		2-Methylhexane	0.685	0.764	0.654
589-34-4		3-Methylhexane	0.184	0.203	0.175
540-84-1		2,2,4-Trimethylpentane	11.429	12.502	9.570
590-73-8		2,2-Dimethylhexane	0.071	0.077	0.059
564-02-3		2,2,3-Trimethylpentane	0.501	0.529	0.419
592-13-2		2,5-Dimethylhexane	0.884	0.965	0.740
589-43-5		2,4-Dimethylhexane	0.759	0.820	0.635
565-75-3		2,3,4-Trimethylpentane	2.626	2.765	2.199
584-94-1		2,3-Dimethylhexane	0.674	0.717	0.565
592-27-8		2-Methylheptane	0.067	0.073	0.056
589-53-7		4-Methylheptane	0.081	0.087	0.067
583-48-2		3,4-Dimethylhexane	0.066	0.070	0.056
589-81-1		3-Methylheptane	0.054	0.058	0.045
619-99-8		3-Ethylhexane	0.048	0.051	0.040
3522-94-9		2,2,5-Trimethylhexane	1.033	1.106	0.770
		C9-Isoparaffin-x	0.035	0.036	0.026
1069-53-0		2,3,5-Trimethylhexane	0.154	0.162	0.115
1071-26-7		2,4-Dimethylheptane	0.035	0.037	0.026
1072-05-5		2,6-Dimethylheptane	0.073	0.078	0.055
		2,5-Dimethylheptane	0.101	0.107	0.076
		3,5-Dimethylheptane	0.009	0.010	0.007
2216-34-4		4-Methyloctane	0.055	0.058	0.041
3221-61-2	2-Methyloctane	0.069	0.073	0.051	
15869-80-4	Heptane, 3-ethyl-	0.015	0.016	0.011	
2216-33-3	3-Methyloctane	0.138	0.145	0.103	
	C10 - IsoParaffin - 1	0.165	0.172	0.111	
14720-74-2	2,2,4-trimethylheptane	0.133	0.138	0.089	

Aromatics (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
I-Paraffins		C10-isoparaffin-x	0.000	0.000	0.000
		2,3-Dimethyloctane	0.051	0.053	0.034
	15869-87-1	2,2-Dimethyloctane	0.018	0.018	0.012
	15869-89-3	2,5-Dimethyloctane	0.023	0.024	0.016
	2040-95-1	2,7-Dimethyloctane	0.012	0.013	0.008
	2051-30-1	2,4-Dimethyloctane	0.028	0.030	0.019
		2,6-Dimethyloctane	0.042	0.043	0.028
		3-Methyl-5-ethylheptane	0.019	0.020	0.013
	15869-85-9	5-Methylnonane	0.019	0.020	0.013
	17301-94-8	4-Methylnonane	0.043	0.044	0.029
		2,2,6-Trimethyloctane	0.245	0.256	0.165
	5881-17-4	3-Ethyloctane	0.009	0.009	0.006
	5911-04-6	3-Methylnonane	0.039	0.041	0.026
	61868-42-6	Heptane, 2,2,3,5-tetramethyl-	0.021	0.016	0.013
		C11-Isoparaffin-1	0.045	0.046	0.027
		C11-Isoparaffin-2	0.024	0.024	0.015
		C10 - IsoParaffin - 5	0.026	0.026	0.017
	62016-30-4	2,3,3-trimethyloctane	0.033	0.033	0.020
		C11-Isoparaffin-3	0.010	0.010	0.006
		C11 Isoparaffin-4	0.010	0.011	0.006
		C11-Isoparaffin-5	0.033	0.034	0.020
		2,5,6-Trimethyloctane	0.204	0.208	0.125
		C11-Isoparaffin-7	0.079	0.081	0.048
		C11-Isoparaffin-8	0.008	0.008	0.005
		C11-Isoparaffin-9	0.029	0.030	0.018
		C11- Isoparaffin-10	0.023	0.024	0.014
		C11- Isoparaffin-11	0.122	0.124	0.075
		C11- Isoparaffin - 12	0.052	0.053	0.032
		C11- IsoParaffin - 13	0.017	0.017	0.010
		C12 - Isoparaffin - 1	0.039	0.039	0.022
		C12 - Isoparaffin - 2	0.050	0.051	0.028
		C12 - Isoparaffin - 3	0.015	0.015	0.008
		C12 - Isoparaffin - 4	0.028	0.028	0.015
		C14 - Isoparaffin-1	0.006	0.006	0.003
Aromatics					
<i>Mono-Aromatics</i>					
	71-42-3	Benzene	0.708	0.610	0.867
	108-88-3	Toluene	19.341	16.884	20.076
	100-41-4	Ethylbenzene	2.081	1.817	1.875
	108-38-3	m-Xylene	5.462	4.784	4.921
	106-42-3	p-Xylene	2.350	2.066	2.117
	95-47-6	o-Xylene	1.973	1.697	1.778
	98-82-8	i-Propylbenzene	0.043	0.038	0.034
	103-65-1	n-Propylbenzene	0.499	0.438	0.397
	620-14-4	1-Methyl-3-ethylbenzene	1.921	1.681	1.528
	622-96-8	1-Methyl-4-ethylbenzene	0.885	0.778	0.704
	108-67-8	1,3,5-Trimethylbenzene	1.059	0.927	0.843

Aromatics (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>	
<i>Mono-Aromatics</i>	611-14-3	1-Methyl-2-ethylbenzene	0.625	0.537	0.497	
	95-63-6	1,2,4-Trimethylbenzene	3.114	2.691	2.478	
	538-93-2	i-Butylbenzene	0.075	0.067	0.053	
	526-73-8	1,2,3-Trimethylbenzene	0.560	0.474	0.445	
	535-77-3	1-Methyl-3-i-propylbenzene	0.019	0.016	0.013	
	99-87-6	1-Methyl-4-i-propylbenzene	0.028	0.025	0.020	
	141-93-5	1,3-Diethylbenzene	0.099	0.086	0.070	
	1074-43-7	1-Methyl-3-n-propylbenzene	0.408	0.359	0.291	
	105-05-5	1,4-Diethylbenzene	0.215	0.189	0.153	
	934-74-7	1,3-Dimethyl-5-ethylbenzene	0.234	0.201	0.167	
	135-01-3	1,2-Diethylbenzene	0.038	0.033	0.027	
	1074-17-5	1-Methyl-2-n-propylbenzene	0.073	0.063	0.052	
	1758-88-9	1,4-Dimethyl-2-ethylbenzene	0.133	0.114	0.094	
	874-41-9	1,3-Dimethyl-4-ethylbenzene	0.144	0.124	0.102	
	934-80-5	1,2-Dimethyl-4-ethylbenzene	0.340	0.295	0.243	
	2870-04-4	1,3-Dimethyl-2-ethylbenzene	0.192	0.163	0.137	
			1-Methyl-4-t-butylbenzene	0.043	0.038	0.028
	933-98-2	1,2-Dimethyl-3-ethylbenzene	0.151	0.128	0.107	
	4218-48-8	1-Ethyl-4-i-propylbenzene	0.085	0.072	0.055	
			1,2,4,5-Tetramethylbenzene	0.290	0.248	0.207
	527-53-7	1,2,3,5-Tetramethylbenzene	0.379	0.322	0.270	
			C11 - Aromatic - 2	0.010	0.008	0.006
			C11 - Aromatic - 3	0.081	0.069	0.052
			1,2-Di-i-propylbenzene	0.052	0.045	0.031
	1595-16-0	1-methyl-4-(1-methylpropyl)be	0.098	0.084	0.063	
			C11 - Aromatic - 4	0.068	0.058	0.044
	538-68-1	n-Pentylbenzene	0.023	0.019	0.015	
			tert-Pentylbenzene	0.084	0.072	0.054
	577-55-9	1-Methyl-2-n-butylbenzene	0.028	0.024	0.018	
			C11 - Aromatic - 7	0.051	0.046	0.033
	100-18-5	1,4-Di-i-propylbenzene	0.053	0.045	0.031	
			C12-Aromatic-1	0.010	0.009	0.006
			C11 - Aromatic - 10	0.012	0.011	0.008
			1,3-Di-n-propylbenzene	0.027	0.023	0.016
			C11 - Aromatic - 11	0.010	0.009	0.007
			C11 - Aromatic - 12	0.007	0.007	0.005
			C11 - Aromatic - 13	0.004	0.004	0.003
			C11 - Aromatic - 14	0.005	0.004	0.003
			C12 - Aromatic - 1	0.012	0.010	0.007
			C12 - Aromatic - 11	0.006	0.005	0.003
	877-44-1	1,2,4-Triethylbenzene	0.012	0.011	0.007	
	700-12-9	Pentamethylbenzene	0.042	0.032	0.027	
		1-Methyl-3-Hexylbenzene	0.006	0.005	0.003	
		C13 - Aromatic - 2	0.006	0.005	0.003	
<i>Naphthalenes</i>	91-20-3	Naphthalene	0.144	0.106	0.107	
	91-57-6	2-Methylnaphthalene	0.273	0.202	0.182	

Aromatics (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Naphthalenes</i>	90-12-0	1-Methylnaphthalene	0.133	0.098	0.089
		Dimethylnaphthalene-3	0.022	0.018	0.014
		Dimethylnaphthalene-4	0.022	0.017	0.014
		Dimethylnaphthalene-5	0.055	0.043	0.034
		Dimethylnaphthalene - 6	0.026	0.020	0.016
		Dimethylnaphthalene-5(1)	0.019	0.015	0.012
		Dimethylnaphthalene-6	0.013	0.010	0.008
<i>Naphtheno/Olefin</i>		Indan	0.211	0.166	0.171
		2-Methylindan	0.044	0.034	0.032
	874-35-1	5-Methylindan	0.146	0.124	0.105
	824-22-6	4-Methylindan	0.182	0.154	0.131
	824-63-5	2-Methylindan(1)	0.152	0.129	0.110
		1,1-Dimethyl Indane	0.010	0.008	0.007
		Dimethyl Indane - 1	0.005	0.004	0.003
		C2 Indane - 1	0.006	0.005	0.004
		4,7-DimethylIndane	0.021	0.017	0.014
		Dimethyl Indane - 3	0.014	0.011	0.009
		Dimethyl Indane - 4	0.006	0.005	0.004
		C3 Indane - 6	0.026	0.021	0.016
	<i>Indenes</i>				
<i>Naphthenes</i> <i>Mono-Naphthene</i>	287-92-3	Cyclopentane	6.796	6.901	9.268
	96-37-7	Methylcyclopentane	0.361	0.365	0.410
	110-82-7	Cyclohexane	0.040	0.039	0.045
	1759-58-6	1t,3-Dimethylcyclopentane	0.009	0.009	0.009
	2532-58-3	1c,3-Dimethylcyclopentane	0.008	0.008	0.008
	822-50-4	1t,2-Dimethylcyclopentane	0.018	0.018	0.017
	108-87-2	Methylcyclohexane	0.020	0.020	0.020
	4850-28-6	1c,2t,4-Trimethylcyclopentane	0.007	0.007	0.006
	15890-40-1	1t,2c,3-Trimethylcyclopentane	0.008	0.008	0.007
		1,3-dimethyl-t-cyclohexane	0.119	0.117	0.102
		3c-Ethylmethylcyclopentane	0.029	0.029	0.025
	2207-01-4	1c,2-Dimethylcyclohexane	0.028	0.027	0.024
	1678-91-7	Ethylcyclohexane	0.153	0.148	0.131
	7094-27-1	1,1,4-Trimethylcyclohexane	0.010	0.010	0.008
	3073-66-3	1,1,3-Trimethylcyclohexane	0.018	0.017	0.014
		C9 - MonoNaph - 4	0.022	0.022	0.017
	3728-57-2	Cyclopentane, 1-methyl-2-propyl	0.039	0.034	0.036
		trans-1,3-Diethylcyclopentane	0.078	0.067	0.059
	4926-90-3	1,1-Methylethylcyclohexane	0.043	0.040	0.032
		1-ethyl-4-t-methylcyclohexane	0.011	0.010	0.008
	696-29-7	1-Methyl-2-propyl-cyclopentan	0.003	0.002	0.002
		1,2,3,5-t-Tetramethylcyclohex	0.027	0.026	0.020
	1678-98-4	i-Butylcyclohexane	0.017	0.016	0.011
		n-ButylCyclohexane	0.014	0.013	0.010

Aromatics (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Mono-Naphthene</i>					
<i>Di/Bicyclo-Napht</i>					
Olefins					
<i>n-Olefins</i>					
	592-41-6	Hexene-1	3.572	3.988	4.059
	4050-45-7	t-Hexene-2	0.008	0.009	0.009
		C9-isoolefin	0.059	0.066	0.045
	20063-92-7	t-Nonene-3	0.013	0.015	0.010
		C10-n-Olefin	0.009	0.009	0.006
	693-61-8	2-Undecene, (E)-	0.027	0.027	0.018
		5-Undecene	0.034	0.035	0.023
<i>Iso-Olefins</i>					
	625-27-4	2-Methylpentene-2	0.003	0.003	0.003
	922-62-3	3-Methyl-c-pentene-2	0.004	0.004	0.004
		C8 - Diolefin - 1	0.004	0.004	0.003
		C8 - IsoOlefin - 7	0.011	0.010	0.009
	4485-16-9	3-Heptene, 4-methyl-	0.067	0.066	0.057
		C8 - IsoOlefin - 10	0.004	0.004	0.003
		C9 - IsoOlefin - 1	0.004	0.003	0.003
	33933-74-4	3-Heptene, 4-ethyl-	0.005	0.005	0.004
	19549-87-2	2,4-Dimethylheptene-1	0.011	0.012	0.008
	16993-86-4	2-Methyloctene-2	0.007	0.008	0.005
	3074-64-4	2,3-Dimethylheptene-2	0.004	0.005	0.003
		C10-IsoOlefin-4	0.003	0.003	0.002
		C10 Iso-olefin - 5	0.016	0.018	0.011
		C10 Iso-olefin - 6	0.003	0.003	0.002
		C10-IsoOlefin-7	0.010	0.011	0.007
		C10-IsoOlefin-12	0.010	0.011	0.007
	69405-42-1	3-Nonene, 3-methyl-, (E)-	0.002	0.003	0.002
<i>Naphtheno-Olefin</i>					
	1068-19-5	1-Ethyl-2-Methylcyclopentene	0.077	0.080	0.067
		C9 Naph-Olefin -1	0.118	0.122	0.091
		C9 - NaphOlefin - 2	0.014	0.015	0.011
		C9-NaphthenoOlefin-6	0.000	0.000	0.000
<i>Di-Olefins</i>					
Oxygenates					
Unidentified					
		Unidentified	0.000	0.001	0.001
		Unidentified	0.030	0.041	0.050
		Unidentified	0.006	0.006	0.010
		Unidentified	0.003	0.003	0.003
		Unidentified	0.080	0.084	0.077
		Unidentified	0.018	0.018	0.015
		Unidentified	0.010	0.010	0.009
		Unidentified	0.877	0.865	0.747
		Unidentified	0.005	0.005	0.004
		Unidentified	0.009	0.009	0.007
		Unidentified	0.010	0.011	0.007

Aromatics (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
Unidentified		Unidentified	0.009	0.010	0.007
		Unidentified	0.016	0.016	0.012
		Unidentified	0.033	0.034	0.024
		Unidentified	0.008	0.008	0.005
		Unidentified	0.004	0.004	0.003
		Unidentified	0.004	0.004	0.003
		Unidentified	0.004	0.003	0.003
		Unidentified	0.003	0.003	0.002
		Unidentified	0.006	0.006	0.004
		Unidentified	0.003	0.003	0.002
		Unidentified	0.030	0.026	0.024
		Unidentified	0.130	0.112	0.093
		Unidentified	0.008	0.008	0.005
		Unidentified	0.032	0.029	0.020
		Unidentified	0.044	0.038	0.032
		Unidentified	0.019	0.016	0.012
		Unidentified	0.010	0.010	0.006
		Unidentified	0.014	0.014	0.008
		Unidentified	0.022	0.023	0.013
		Unidentified	0.004	0.004	0.002
		Unidentified	0.001	0.001	0.001
		Unidentified	0.003	0.002	0.002
		Unidentified	0.004	0.004	0.002
		Unidentified	0.003	0.002	0.002
		Unidentified	0.005	0.005	0.003
		Unidentified	0.007	0.007	0.004
		Unidentified	0.019	0.019	0.009
		Unidentified	0.002	0.002	0.001
		Unidentified	0.003	0.003	0.001
		Unidentified	0.004	0.004	0.002
		Unidentified	0.004	0.003	0.002
		Unidentified	0.013	0.014	0.007
		Unidentified	0.003	0.003	0.002
		Unidentified	0.009	0.009	0.004
		Unidentified	0.007	0.007	0.003
		Unidentified	0.004	0.004	0.002
		Unidentified	0.004	0.004	0.002
		Unidentified	0.012	0.012	0.006
		Unidentified	0.010	0.010	0.005
		Unidentified	0.002	0.002	0.001
		Unidentified	0.006	0.006	0.003
		Unidentified	0.006	0.006	0.003
		Unidentified	0.005	0.005	0.002
		Unidentified	0.002	0.002	0.001
		Unidentified	0.006	0.006	0.003
		Unidentified	0.005	0.005	0.002
		Unidentified	0.010	0.010	0.004
		Unidentified	0.005	0.005	0.002
		Unidentified	0.007	0.007	0.003

Cycloalkane

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
Paraffin	106-97-8	n-Butane	2.638	3.437	4.060
	109-66-0	n-Pentane	0.830	0.999	1.028
	110-54-3	n-Hexane	2.066	2.363	2.145
	142-82-5	n-Heptane	0.066	0.073	0.059
	111-65-9	n-Octane	0.463	0.497	0.362
	111-84-2	n-Nonane	0.674	0.708	0.470
	124-18-5	n-Decane	0.140	0.144	0.088
	1120-21-4	n-Undecane	0.045	0.045	0.025
	112-40-3	n-Dodecane	0.003	0.003	0.001
	I-Paraffins	75-28-5	i-Butane	0.023	0.032
78-78-4		i-Pentane	4.100	4.989	5.082
75-83-2		2,2-Dimethylbutane	8.515	9.892	8.838
79-29-8		2,3-Dimethylbutane	0.597	0.680	0.619
107-83-5		2-Methylpentane	0.927	1.070	0.962
96-14-0		3-Methylpentane	0.935	1.061	0.970
108-08-7		2,4-Dimethylpentane	0.606	0.680	0.541
464-06-2		2,2,3-Trimethylbutane	0.045	0.049	0.040
562-49-2		3,3-Dimethylpentane	0.072	0.078	0.064
591-76-4		2-Methylhexane	0.936	1.040	0.835
589-34-4		3-Methylhexane	0.430	0.472	0.384
617-78-7		3-Ethylpentane	0.024	0.026	0.021
540-84-1		2,2,4-Trimethylpentane	4.010	4.371	3.140
564-02-3		2,2,3-Trimethylpentane	0.288	0.303	0.226
592-13-2		2,5-Dimethylhexane	0.561	0.610	0.440
589-43-5		2,4-Dimethylhexane	0.484	0.522	0.379
563-16-6		3,3-Dimethylhexane	0.005	0.005	0.004
565-75-3		2,3,4-Trimethylpentane	1.648	1.728	1.291
584-94-1		2,3-Dimethylhexane	0.455	0.482	0.357
592-27-8		2-Methylheptane	0.178	0.192	0.139
589-53-7		4-Methylheptane	0.097	0.104	0.076
583-48-2		3,4-Dimethylhexane	0.044	0.046	0.035
589-81-1		3-Methylheptane	0.133	0.143	0.105
619-99-8		3-Ethylhexane	0.152	0.160	0.119
3522-94-9		2,2,5-Trimethylhexane	0.677	0.722	0.472
		C9-Isoparaffin-x	0.029	0.029	0.020
1069-53-0		2,3,5-Trimethylhexane	0.116	0.121	0.081
1071-26-7		2,4-Dimethylheptane	0.074	0.078	0.052
1072-05-5		2,6-Dimethylheptane	0.178	0.189	0.124
		2,5-Dimethylheptane	0.170	0.179	0.118
		3,5-Dimethylheptane	0.033	0.034	0.023
2216-32-2		4-Ethylheptane	0.051	0.053	0.035
2216-34-4		4-Methyloctane	0.170	0.178	0.119
3221-61-2		2-Methyloctane	0.207	0.218	0.144
2216-33-3		3-Methyloctane	0.428	0.448	0.298
		C10 - IsoParaffin - 1	0.103	0.107	0.065
14720-74-2	2,2,4-trimethylheptane	0.172	0.179	0.108	

Cycloalkane (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>	
I-Paraffins		C10-isoparaffin-x	0.000	0.000	0.000	
		2,3-Dimethyloctane	0.054	0.057	0.034	
	15869-87-1	2,2-Dimethyloctane	0.022	0.023	0.014	
	15869-89-3	2,5-Dimethyloctane	0.029	0.030	0.018	
	2040-95-1	2,7-Dimethyloctane	0.011	0.012	0.007	
	2051-30-1	2,4-Dimethyloctane	0.033	0.034	0.021	
		2,6-Dimethyloctane	0.040	0.041	0.025	
		3-Methyl-5-ethylheptane	0.023	0.024	0.015	
	15869-85-9	5-Methylnonane	0.017	0.017	0.010	
	17301-94-8	4-Methylnonane	0.037	0.038	0.023	
		2,2,6-Trimethyloctane	0.156	0.162	0.098	
	5881-17-4	3-Ethyl-octane	0.008	0.009	0.005	
	5911-04-6	3-Methylnonane	0.030	0.031	0.019	
		C11-Isoparaffin-1	0.051	0.051	0.029	
		C11-Isoparaffin-2	0.017	0.017	0.010	
		C10 - IsoParaffin - 5	0.023	0.024	0.015	
	62016-30-4	2,3,3-trimethyloctane	0.026	0.026	0.015	
		C11-Isoparaffin-3	0.008	0.009	0.005	
		C11 Isoparaffin-4	0.009	0.009	0.005	
		C11-Isoparaffin-5	0.040	0.041	0.023	
		2,5,6-Trimethyloctane	0.128	0.130	0.073	
		C11-Isoparaffin-7	0.055	0.056	0.032	
		C11-Isoparaffin-8	0.005	0.005	0.003	
		C11-Isoparaffin-9	0.018	0.018	0.010	
		C11- Isoparaffin-11	0.076	0.077	0.043	
		C11- Isoparaffin - 12	0.031	0.031	0.018	
		C11- IsoParaffin - 13	0.007	0.007	0.004	
		C12 - IsoParaffin - 1	0.008	0.008	0.004	
		C12 - IsoParaffin - 2	0.023	0.024	0.012	
		C12 - IsoParaffin - 4	0.007	0.007	0.003	
		C14-Isoparaffin-1	0.003	0.003	0.001	
	Aromatics <i>Mono-Aromatics</i>	71-42-3	Benzene	0.004	0.003	0.005
		108-88-3	Toluene	24.436	21.252	23.720
100-41-4		Ethylbenzene	1.017	0.885	0.857	
108-38-3		m-Xylene	2.545	2.221	2.144	
106-42-3		p-Xylene	1.247	1.092	1.051	
95-47-6		o-Xylene	1.078	0.923	0.908	
98-82-8		i-Propylbenzene	0.015	0.013	0.011	
103-65-1		n-Propylbenzene	0.177	0.154	0.131	
620-14-4		1-Methyl-3-ethylbenzene	0.652	0.569	0.485	
622-96-8		1-Methyl-4-ethylbenzene	0.310	0.271	0.230	
108-67-8		1,3,5-Trimethylbenzene	0.389	0.339	0.290	
611-14-3		1-Methyl-2-ethylbenzene	0.230	0.197	0.171	
95-63-6		1,2,4-Trimethylbenzene	1.134	0.976	0.844	
538-93-2		i-Butylbenzene	0.040	0.036	0.027	

Cycloalkane (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>	
<i>Mono-Aromatics</i>	526-73-8	1,2,3-Trimethylbenzene	0.215	0.181	0.160	
	535-77-3	1-Methyl-3-i-propylbenzene	0.005	0.005	0.003	
	99-87-6	1-Methyl-4-i-propylbenzene	0.017	0.015	0.011	
	141-93-5	1,3-Diethylbenzene	0.040	0.035	0.027	
	1074-43-7	1-Methyl-3-n-propylbenzene	0.225	0.197	0.150	
	105-05-5	1,4-Diethylbenzene	0.125	0.109	0.083	
	934-74-7	1,3-Dimethyl-5-ethylbenzene	0.120	0.103	0.080	
	135-01-3	1,2-Diethylbenzene	0.023	0.020	0.016	
	1074-17-5	1-Methyl-2-n-propylbenzene	0.050	0.043	0.034	
	1758-88-9	1,4,Dimethyl-2-ethylbenzene	0.117	0.101	0.078	
	874-41-9	1,3-Dimethyl-4-ethylbenzene	0.221	0.190	0.147	
	934-80-5	1,2-Dimethyl-4-ethylbenzene	0.341	0.294	0.227	
	2870-04-4	1,3-Dimethyl-2-ethylbenzene	0.105	0.089	0.070	
			1-Methyl-4-t-butylbenzene	0.044	0.039	0.026
		933-98-2	1,2-Dimethyl-3-ethylbenzene	0.151	0.127	0.100
		4218-48-8	1-Ethyl-4-i-propylbenzene	0.037	0.031	0.022
			C11 - Aromatic - 1	0.006	0.005	0.004
			1,2,4,5-Tetramethylbenzene	0.384	0.326	0.256
		527-53-7	1,2,3,5-Tetramethylbenzene	0.549	0.465	0.366
			C11 - Aromatic - 2	0.007	0.006	0.004
			C11 - Aromatic - 3	0.076	0.065	0.046
			1,2-Di-i-propylbenzene	0.075	0.064	0.041
		1595-16-0	1-methyl-4-(1-methylpropyl)be	0.112	0.095	0.067
			C11 - Aromatic - 4	0.055	0.047	0.033
		5161-04-6	Benzene, 1-methyl-4-(2-methylp	0.076	0.064	0.046
		538-68-1	n-Pentylbenzene	0.032	0.027	0.019
			tert-Pentylbenzene	0.114	0.096	0.069
		577-55-9	1-Methyl-2-n-butylbenzene	0.052	0.044	0.031
			C11 - Aromatic - 7	0.067	0.059	0.040
		100-18-5	1,4-Di-i-propylbenzene	0.092	0.078	0.051
			C12-Aromatic-1	0.006	0.006	0.003
			C11 - Aromatic - 10	0.012	0.010	0.007
			1,3-Di-n-propylbenzene	0.038	0.032	0.021
			C11 - Aromatic - 11	0.020	0.018	0.012
			C11 - Aromatic - 12	0.010	0.009	0.006
			C11 - Aromatic - 13	0.002	0.002	0.001
			C12 - Aromatic - 1	0.006	0.005	0.004
			C12 - Aromatic - 11	0.005	0.005	0.003
		877-44-1	1,2,4-Triethylbenzene	0.006	0.005	0.003
		700-12-9	Pentamethylbenzene	0.027	0.020	0.016
		C13 - Aromatic - 2	0.003	0.002	0.001	
<i>Naphthalenes</i>	91-20-3	Naphthalene	0.136	0.100	0.095	
	91-57-6	2-Methylnaphthalene	0.239	0.177	0.149	
	90-12-0	1-Methylnaphthalene	0.110	0.081	0.069	
		Dimethylnaphthalene-3	0.018	0.014	0.010	
		Dimethylnaphthalene-4	0.020	0.015	0.011	

Cycloalkane (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Naphthalenes</i>		Dimethylnaphthalene-5	0.045	0.035	0.026
		Dimethylnaphthalene - 6	0.027	0.021	0.016
		Dimethylnaphthalene-5(1)	0.020	0.016	0.012
		Dimethylnaphthalene-6	0.012	0.009	0.007
<i>Naphtheno/Olefin</i>		Indan	0.085	0.066	0.064
		2-Methylindan	0.026	0.020	0.018
	874-35-1	5-Methylindan	0.199	0.168	0.134
	824-22-6	4-Methylindan	0.256	0.217	0.173
	824-63-5	2-Methylindan(1)	0.175	0.148	0.118
		4,7-Dimethyl Indane	0.016	0.013	0.010
		1,1-Dimethyl Indane	0.016	0.012	0.010
		Dimethyl Indane - 1	0.007	0.005	0.004
		C2 Indane - 1	0.004	0.003	0.002
		4,7-DimethylIndane	0.014	0.011	0.009
		Dimethyl Indane - 3	0.010	0.008	0.006
		Dimethyl Indane - 4	0.008	0.006	0.005
		C3 Indane - 6	0.021	0.017	0.012
	<i>Indenes</i>				
<i>Naphthenes</i> <i>Mono-Naphthene</i>	287-92-3	Cyclopentane	19.960	20.191	25.455
	96-37-7	Methylcyclopentane	0.974	0.982	1.036
	110-82-7	Cyclohexane	0.121	0.117	0.128
	1759-58-6	1t,3-Dimethylcyclopentane	0.037	0.037	0.034
	2532-58-3	1c,3-Dimethylcyclopentane	0.033	0.033	0.030
	822-50-4	1t,2-Dimethylcyclopentane	0.043	0.043	0.039
	108-87-2	Methylcyclohexane	0.154	0.151	0.140
	4516-69-2	1,1,3-Trimethylcyclopentane	0.017	0.017	0.014
	1640-89-7	Ethylcyclopentane	0.014	0.014	0.013
	4850-28-6	1c,2t,4-Trimethylcyclopentane	0.036	0.036	0.029
	15890-40-1	1t,2c,3-Trimethylcyclopentane	0.042	0.041	0.033
		1,3-dimethyl-t-cyclohexane	0.390	0.382	0.311
		3c-Ethylmethylcyclopentane	0.034	0.033	0.027
	624-29-3	1c,4-Dimethylcyclohexane	0.221	0.213	0.176
	2207-01-4	1c,2-Dimethylcyclohexane	0.092	0.087	0.073
	1678-91-7	Ethylcyclohexane	0.490	0.471	0.391
		C9 - MonoNaph - 1	0.250	0.244	0.177
	7094-27-1	1,1,4-Trimethylcyclohexane	0.031	0.031	0.022
	3073-66-3	1,1,3-Trimethylcyclohexane	0.056	0.053	0.040
	7667-60-9	1c,2t,4t-Trimethylcyclohexane	0.312	0.302	0.221
		C9 - MonoNaph - 4	0.059	0.058	0.042
		1c,2t,4c-Trimethylcyclohexane	0.079	0.077	0.056
		Cyclohexane, 1,2,4-trimethyl-,	0.055	0.054	0.039
	3728-57-2	Cyclopentane, 1-methyl-2-propy	0.096	0.082	0.081
		trans-1,3-Diethylcyclopentane	0.213	0.183	0.151
	4926-90-3	1,1-Methylethylcyclohexane	0.113	0.106	0.080

Cycloalkane (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>	
<i>Mono-Naphthene</i>		1-ethyl-4-t-methylcyclohexane	0.029	0.027	0.020	
	696-29-7	1-Methyl-2-propyl-cyclopentan	0.006	0.005	0.004	
		1,2,3,5-t-Tetramethylcyclohex	0.049	0.048	0.035	
	1678-98-4	i-Butylcyclohexane n-ButylCyclohexane	0.026 0.016	0.025 0.015	0.017 0.010	
<i>Di/Bicyclo-Napht Olefins</i>		<i>n-Olefins</i>				
		<i>n-Olefins</i>				
	624-64-6	t-Butene-2	0.003	0.004	0.005	
	592-41-6	Hexene-1	0.814	0.905	0.865	
	4050-45-7	t-Hexene-2	0.006	0.006	0.006	
	14919-01-8	t-Octene-3	0.003	0.003	0.002	
	20063-92-7	t-Nonene-3	0.032	0.036	0.023	
		C10-n-Olefin	0.008	0.008	0.005	
	693-61-8	2-Undecene, (E)- 5-Undecene	0.011 0.011	0.011 0.011	0.007 0.007	
	<i>Iso-Olefins</i>	625-27-4	2-Methylpentene-2	0.005	0.005	0.005
		922-62-3	3-Methyl-c-pentene-2	0.003	0.004	0.004
		C8 - Diolefin - 1	0.015	0.015	0.012	
		C8 - IsoOlefin - 7	0.007	0.007	0.006	
4485-16-9		3-Heptene, 4-methyl-	0.214	0.211	0.171	
14850-22-7		C8-IsoOlefin-9	0.016	0.016	0.013	
		2,3,3-Trimethylhexene-1	0.013	0.014	0.009	
		C9 - IsoOlefin - 1	0.012	0.012	0.010	
2213-23-2		2,3-Dimethyl-3-heptene	0.016	0.018	0.011	
4588-18-5		2-Methyloctene-1	0.032	0.035	0.023	
33933-74-4		3-Heptene, 4-ethyl-	0.014	0.014	0.010	
19549-87-2		2,4-Dimethylheptene-1	0.022	0.025	0.016	
		C9-IsoOlefin-3	0.025	0.024	0.018	
16993-86-4		2-Methyloctene-2	0.019	0.021	0.013	
3074-64-4		2,3-Dimethylheptene-2	0.012	0.014	0.009	
		C10-IsoOlefin-4	0.006	0.006	0.004	
		C10 Iso-olefin - 5	0.050	0.054	0.032	
		C10 Iso-olefin - 6	0.007	0.008	0.005	
		C10-IsoOlefin-7	0.011	0.012	0.007	
		C10-IsoOlefin-12	0.014	0.015	0.009	
69405-42-1	3-Nonene, 3-methyl-, (E)-	0.005	0.005	0.003		
<i>Naphtheno-Olefin</i>	693-89-0	1-Methylcyclopentene	0.007	0.007	0.007	
		C9 - NaphOlefin - 2	0.040	0.041	0.029	
		C9-NaphthenoOlefin-6	0.000	0.000	0.000	
<i>Di-Olefins</i>						
Oxygenates						
Unidentified		Unidentified	0.005	0.005	0.004	
		Unidentified	0.029	0.028	0.023	

Cycloalkane (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
Unidentified		Unidentified	0.052	0.051	0.041
		Unidentified	0.006	0.006	0.005
		Unidentified	0.003	0.002	0.002
		Unidentified	0.011	0.011	0.008
		Unidentified	0.021	0.021	0.015
		Unidentified	0.083	0.086	0.060
		Unidentified	0.017	0.018	0.011
		Unidentified	0.006	0.006	0.004
		Unidentified	0.004	0.004	0.002
		Unidentified	0.032	0.035	0.021
		Unidentified	0.003	0.003	0.002
		Unidentified	0.033	0.028	0.025
		Unidentified	0.006	0.005	0.003
		Unidentified	0.007	0.006	0.004
		Unidentified	0.008	0.007	0.005
		Unidentified	0.023	0.019	0.014
		Unidentified	0.004	0.004	0.002
		Unidentified	0.013	0.011	0.007
		Unidentified	0.001	0.001	0.000
		Unidentified	0.009	0.009	0.004
		Unidentified	0.001	0.001	0.001
		Unidentified	0.012	0.012	0.005
		Unidentified	0.010	0.010	0.004
		Unidentified	0.002	0.002	0.001
		Unidentified	0.016	0.016	0.007
		Unidentified	0.011	0.010	0.004
		Unidentified	0.003	0.003	0.001
		Unidentified	0.011	0.010	0.004
		Unidentified	0.010	0.010	0.004
		Unidentified	0.005	0.005	0.002
		Unidentified	0.005	0.005	0.002
		Unidentified	0.003	0.003	0.001
		Unidentified	0.006	0.006	0.003
		Unidentified	0.002	0.002	0.001
		Unidentified	0.005	0.005	0.002
		Unidentified	0.004	0.004	0.002
		Unidentified	0.004	0.004	0.002
		Unidentified	0.002	0.002	0.001
		Unidentified	0.006	0.006	0.003
		Unidentified	0.002	0.002	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.002	0.001	0.001

E30

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
Paraffin	106-97-8	n-Butane	2.715	3.513	3.411
	109-66-0	n-Pentane	2.642	3.161	2.675
	110-54-3	n-Hexane	2.655	3.015	2.250
	142-82-5	n-Heptane	0.044	0.048	0.032
	111-65-9	n-Octane	0.887	0.945	0.567
	111-84-2	n-Nonane	1.182	1.234	0.673
	124-18-5	n-Decane	0.439	0.451	0.225
	1120-21-4	n-Undecane	0.411	0.414	0.192
	112-40-3	n-Dodecane	0.078	0.077	0.033
	629-59-4	n-Tetradecane	0.027	0.026	0.010
	629-62-9	n-Pentadecane	0.001	0.001	0.000
	I-Paraffins	463-82-1	2,2-Dimethylpropane	0.005	0.006
78-78-4		i-Pentane	2.042	2.469	2.067
75-83-2		2,2-Dimethylbutane	0.327	0.377	0.277
79-29-8		2,3-Dimethylbutane	0.787	0.891	0.667
107-83-5		2-Methylpentane	1.654	1.897	1.402
96-14-0		3-Methylpentane	1.452	1.637	1.231
108-08-7		2,4-Dimethylpentane	0.706	0.786	0.515
464-06-2		2,2,3-Trimethylbutane	0.054	0.059	0.040
562-49-2		3,3-Dimethylpentane	0.107	0.116	0.078
591-76-4		2-Methylhexane	1.104	1.218	0.805
589-34-4		3-Methylhexane	0.481	0.524	0.350
617-78-7		3-Ethylpentane	0.026	0.028	0.019
540-84-1		2,2,4-Trimethylpentane	4.323	4.680	2.764
564-02-3		2,2,3-Trimethylpentane	0.300	0.314	0.192
592-13-2		2,5-Dimethylhexane	0.615	0.664	0.393
589-43-5		2,4-Dimethylhexane	0.530	0.567	0.339
563-16-6		3,3-Dimethylhexane	0.006	0.006	0.004
565-75-3		2,3,4-Trimethylpentane	1.729	1.801	1.106
560-21-4		2,3,3-Trimethylpentane	1.783	1.839	1.140
584-94-1		2,3-Dimethylhexane	0.495	0.521	0.316
592-27-8		2-Methylheptane	0.285	0.306	0.182
589-53-7		4-Methylheptane	0.143	0.152	0.091
583-48-2		3,4-Dimethylhexane	0.063	0.066	0.040
589-81-1		3-Methylheptane	0.222	0.235	0.142
619-99-8		3-Ethylhexane	0.278	0.292	0.178
3522-94-9		2,2,5-Trimethylhexane	0.775	0.821	0.441
		C9-Isoparaffin-x	0.045	0.046	0.026
1069-53-0		2,3,5-Trimethylhexane	0.118	0.123	0.067
1071-26-7		2,4-Dimethylheptane	0.126	0.133	0.072
16747-25-4		2,2,3-Trimethylhexane	0.010	0.010	0.006
1072-05-5		2,6-Dimethylheptane	0.290	0.307	0.165
		2,5-Dimethylheptane	0.215	0.225	0.122
	3,5-Dimethylheptane	0.058	0.061	0.033	
2216-32-2	4-Ethylheptane	0.100	0.104	0.057	
2216-34-4	4-Methyloctane	0.318	0.331	0.181	

E30 (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>	
I-Paraffins	3221-61-2	2-Methyloctane	0.396	0.416	0.225	
	2216-33-3	3-Methyloctane	0.885	0.920	0.504	
		C10 - IsoParaffin - 1	0.128	0.132	0.066	
	14720-74-2		2,2,4-trimethylheptane	0.279	0.287	0.143
			C10-isoparaffin-x	0.000	0.000	0.000
			2,3-Dimethyloctane	0.084	0.087	0.043
	15869-87-1		2,2-Dimethyloctane	0.042	0.043	0.021
	15869-89-3		2,5-Dimethyloctane	0.066	0.068	0.034
	2040-95-1		2,7-Dimethyloctane	0.017	0.018	0.009
	2051-30-1		2,4-Dimethyloctane	0.058	0.059	0.030
			2,6-Dimethyloctane	0.120	0.123	0.062
			3-Methyl-5-ethylheptane	0.072	0.075	0.037
	15869-85-9		5-Methylnonane	0.053	0.054	0.027
	917301-94-8		4-Methylnonane	0.118	0.121	0.061
			2,2,6-Trimethyloctane	0.218	0.225	0.112
	5881-17-4		3-Ethyloctane	0.029	0.029	0.015
	5911-04-6		3-Methylnonane	0.084	0.086	0.043
			C11-Isoparaffin-1	0.105	0.105	0.049
			C11-Isoparaffin-2	0.033	0.033	0.015
			C10 - IsoParaffin - 5	0.061	0.063	0.032
	62016-30-4		2,3,3-trimethyloctane	0.049	0.049	0.023
			C11-Isoparaffin-3	0.020	0.020	0.009
			C11 Isoparaffin-4	0.038	0.039	0.018
			C11-Isoparaffin-5	0.117	0.118	0.055
			2,5,6-Trimethyloctane	0.175	0.176	0.082
			C11-Isoparaffin-7	0.113	0.114	0.053
			C11-Isoparaffin-8	0.030	0.030	0.014
			C11-Isoparaffin-9	0.051	0.052	0.024
			C11- Isoparaffin-11	0.125	0.126	0.058
			C11- Isoparaffin - 12	0.044	0.044	0.020
			C11- IsoParaffin - 13	0.051	0.052	0.024
		C12 - IsoParaffin - 1	0.079	0.080	0.034	
		C12 - IsoParaffin - 2	0.069	0.070	0.030	
	C12 - Isoparaffin - 3	0.032	0.032	0.014		
	C12 - IsoParaffin - 4	0.048	0.047	0.020		
	C14-Isoparaffin-1	0.004	0.004	0.001		
Aromatics						
<i>Mono-Aromatics</i>						
	71-42-3	Benzene	0.803	0.684	0.751	
	108-88-3	Toluene	4.448	3.842	3.526	
	100-41-4	Ethylbenzene	0.575	0.496	0.395	
	108-38-3	m-Xylene	1.393	1.207	0.958	
	106-42-3	p-Xylene	0.635	0.553	0.437	
	95-47-6	o-Xylene	0.728	0.619	0.501	
	98-82-8	i-Propylbenzene	0.019	0.017	0.012	
	103-65-1	n-Propylbenzene	0.205	0.178	0.125	
	620-14-4	1-Methyl-3-ethylbenzene	0.695	0.602	0.423	

E30 (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Mono-Aromatics</i>	622-96-8	1-Methyl-4-ethylbenzene	0.342	0.298	0.208
	108-67-8	1,3,5-Trimethylbenzene	0.450	0.390	0.274
	611-14-3	1-Methyl-2-ethylbenzene	0.234	0.199	0.142
	95-63-6	1,2,4-Trimethylbenzene	1.107	0.947	0.673
	538-93-2	i-Butylbenzene	0.064	0.056	0.035
	526-73-8	1,2,3-Trimethylbenzene	0.237	0.199	0.144
	535-77-3	1-Methyl-3-i-propylbenzene	0.012	0.011	0.007
	99-87-6	1-Methyl-4-i-propylbenzene	0.029	0.025	0.016
	141-93-5	1,3-Diethylbenzene	0.054	0.047	0.030
	1074-43-7	1-Methyl-3-n-propylbenzene	0.276	0.240	0.150
	105-05-5	1,4-Diethylbenzene	0.106	0.092	0.058
	104-51-8	n-Butylbenzene	0.025	0.022	0.014
	934-74-7	1,3-Dimethyl-5-ethylbenzene	0.130	0.111	0.071
	135-01-3	1,2-Diethylbenzene	0.060	0.051	0.032
	1074-17-5	1-Methyl-2-n-propylbenzene	0.076	0.065	0.041
	1758-88-9	1,4-Dimethyl-2-ethylbenzene	0.106	0.091	0.058
	874-41-9	1,3-Dimethyl-4-ethylbenzene	0.121	0.104	0.066
	934-80-5	1,2-Dimethyl-4-ethylbenzene	0.255	0.219	0.139
	2870-04-4	1,3-Dimethyl-2-ethylbenzene	0.154	0.129	0.084
		1-Methyl-4-t-butylbenzene	0.049	0.043	0.024
		1-Ethyl-3-i-propylbenzene	0.052	0.044	0.026
	933-98-2	1,2-Dimethyl-3-ethylbenzene	0.087	0.073	0.047
	4218-48-8	1-Ethyl-4-i-propylbenzene	0.102	0.086	0.050
		1,2,4,5-Tetramethylbenzene	0.257	0.217	0.140
	527-53-7	1,2,3,5-Tetramethylbenzene	0.305	0.257	0.166
		C11 - Aromatic - 2	0.013	0.011	0.007
		C11 - Aromatic - 3	0.038	0.032	0.019
		1,2-Di-i-propylbenzene	0.045	0.037	0.020
	1595-16-0	1-methyl-4-(1-methylpropyl)be	0.072	0.060	0.035
		C11 - Aromatic - 4	0.083	0.070	0.041
	5161-04-6	Benzene, 1-methyl-4-(2-methylp	0.034	0.029	0.017
	538-68-1	n-Pentylbenzene	0.023	0.019	0.011
		tert-Pentylbenzene	0.063	0.053	0.031
	577-55-9	1-Methyl-2-n-butylbenzene	0.025	0.021	0.012
		C11 - Aromatic - 7	0.059	0.052	0.029
	100-18-5	1,4-Di-i-propylbenzene	0.051	0.043	0.023
		C12-Aromatic-1	0.012	0.011	0.006
		C11 - Aromatic - 10	0.019	0.017	0.010
		1,3-Di-n-propylbenzene	0.034	0.029	0.015
		C11 - Aromatic - 11	0.013	0.012	0.006
		C11 - Aromatic - 12	0.012	0.010	0.006
		C11 - Aromatic - 13	0.004	0.004	0.002
		C11 - Aromatic - 14	0.009	0.008	0.004
		C12 - Aromatic - 1	0.011	0.009	0.005
		C12 - Aromatic - 3	0.001	0.001	0.001
		C12 - Aromatic - 7	0.001	0.001	0.000
		C12 - Aromatic - 8	0.001	0.000	0.000

E30 (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Mono-Aromatics</i>		C12 - Aromatic - 10	0.002	0.002	0.001
	877-44-1	1,2,4-Triethylbenzene	0.010	0.008	0.005
	700-12-9	Pentamethylbenzene	0.039	0.030	0.019
		C13 - Aromatic - 2	0.004	0.003	0.002
<i>Naphthalenes</i>	91-20-3	Naphthalene	0.133	0.097	0.076
	91-57-6	2-Methylnaphthalene	0.256	0.188	0.130
	90-12-0	1-Methylnaphthalene	0.125	0.092	0.064
		Dimethylnaphthalene-4	0.021	0.017	0.010
		Dimethylnaphthalene - 6	0.050	0.039	0.024
		Dimethylnaphthalene-5(1)	0.018	0.014	0.008
		Dimethylnaphthalene-6	0.012	0.010	0.006
<i>Naphtheno/Olefin</i>		Indan	0.114	0.088	0.070
		2-Methylindan	0.071	0.055	0.039
	874-35-1	5-Methylindan	0.120	0.101	0.066
	824-22-6	4-Methylindan	0.158	0.133	0.087
	824-63-5	2-Methylindan(1)	0.098	0.082	0.054
		4,7-Dimethyl Indane	0.024	0.019	0.012
		1,1-Dimethyl Indane	0.011	0.009	0.006
		Dimethyl Indane - 1	0.006	0.005	0.003
		C2 Indane - 1	0.005	0.004	0.003
		C3-Indane-2	0.002	0.001	0.001
		4,7-DimethylIndane	0.021	0.016	0.010
		Dimethyl Indane - 3	0.013	0.010	0.007
		Dimethyl Indane - 4	0.006	0.005	0.003
	<i>Indenes</i>		Diimethyl Indene - 2	0.001	0.000
<i>Naphthenes</i> <i>Mono-Naphthene</i>	287-92-3	Cyclopentane	0.698	0.701	0.727
	96-37-7	Methylcyclopentane	1.155	1.156	1.003
	110-82-7	Cyclohexane	0.134	0.129	0.116
	1759-58-6	1t,3-Dimethylcyclopentane	0.031	0.031	0.023
	2532-58-3	1c,3-Dimethylcyclopentane	0.026	0.027	0.020
	822-50-4	1t,2-Dimethylcyclopentane	0.032	0.032	0.024
	108-87-2	Methylcyclohexane	0.130	0.127	0.097
	4516-69-2	1,1,3-Trimethylcyclopentane	0.016	0.016	0.010
	1640-89-7	Ethylcyclopentane	0.017	0.016	0.012
	4850-28-6	1c,2t,4-Trimethylcyclopentane	0.041	0.040	0.027
	15890-40-1	1t,2c,3-Trimethylcyclopentane	0.049	0.048	0.032
		1c,2t,3-Trimethylcyclopentane	0.008	0.007	0.005
		1,3-dimethyl-t-cyclohexane	0.714	0.695	0.465
		3c-Ethylmethylcyclopentane	0.087	0.085	0.057
		3t-Ethylmethylcyclopentane	0.094	0.092	0.061
	930-89-2	Cyclopentane, 1-ethyl-2-methyl	0.025	0.025	0.016
	2207-01-4	1c,2-Dimethylcyclohexane	0.170	0.160	0.110

E30 (cont.)

Group	CASNO	Component	%Wgt	%Vol	%Mol
<i>Mono-Naphthene</i>	1678-91-7	Ethylcyclohexane	0.922	0.881	0.600
		C9 - MonoNaph - 1	0.462	0.448	0.267
	7094-27-1	1,1,4-Trimethylcyclohexane	0.061	0.059	0.035
	3073-66-3	1,1,3-Trimethylcyclohexane	0.109	0.103	0.063
	7667-60-9	1c,2t,4t-Trimethylcyclohexane	0.650	0.624	0.376
		C9 - MonoNaph - 4	0.133	0.129	0.077
		1c,2t,4c-Trimethylcyclohexane	0.189	0.183	0.109
		Cyclohexane, 1,2,4-trimethyl-,	0.123	0.120	0.071
	3728-57-2	Cyclopentane, 1-methyl-2-propyl	0.215	0.183	0.148
		trans-1,3-Diethylcyclopentane	0.422	0.359	0.244
	4926-90-3	1,1-Methylethylcyclohexane	0.203	0.188	0.117
		1-ethyl-4-t-methylcyclohexane	0.056	0.052	0.032
	696-29-7	1-Methyl-2-propyl-cyclopentan	0.008	0.007	0.005
		1,2,3,5-t-Tetramethylcyclohex	0.112	0.109	0.065
	1678-98-4	i-Butylcyclohexane	0.064	0.060	0.033
	C10 - MonoNaph - 2	0.013	0.012	0.007	
	n-ButylCyclohexane	0.078	0.072	0.041	
<i>Di/Bicyclo-Napht Olefins</i>					
	<i>n-Olefins</i>				
	592-41-6	Hexene-1	3.577	3.952	3.105
	13269-52-8	t-Hexene-3	0.005	0.005	0.004
	4050-45-7	t-Hexene-2	0.014	0.015	0.012
	7688-21-3	c-Hexene-2	0.004	0.004	0.004
	14919-01-8	t-Octene-3	0.005	0.005	0.003
		C9-isoolefin	0.033	0.036	0.019
	20063-92-7	t-Nonene-3	0.069	0.076	0.040
		C10-n-Olefin	0.017	0.017	0.009
	693-61-8	2-Undecene, (E)-	0.035	0.036	0.018
		5-Undecene	0.048	0.049	0.025
	<i>Iso-Olefins</i>				
	625-27-4	2-Methylpentene-2	0.008	0.009	0.007
	922-62-3	3-Methyl-c-pentene-2	0.007	0.007	0.006
	C8 - Diolefin - 1	0.022	0.021	0.014	
	C8 - IsoOlefin - 7	0.008	0.008	0.005	
4485-16-9	3-Heptene, 4-methyl-	0.399	0.391	0.260	
14850-22-7	C8-IsoOlefin-9	0.033	0.032	0.021	
	C8 - IsoOlefin - 10	0.025	0.024	0.016	
	C9 - IsoOlefin - 1	0.022	0.021	0.014	
2213-23-2	2,3-Dimethyl-3-heptene	0.032	0.035	0.018	
4588-18-5	2-Methyloctene-1	0.064	0.070	0.037	
33933-74-4	3-Heptene, 4-ethyl-	0.028	0.027	0.016	
19549-87-2	2,4-Dimethylheptene-1	0.038	0.042	0.022	
	C9-IsoOlefin-3	0.043	0.041	0.025	
16993-86-4	2-Methyloctene-2	0.040	0.044	0.023	
3074-64-4	2,3-Dimethylheptene-2	0.025	0.027	0.014	
	C10-IsoOlefin-4	0.008	0.008	0.004	

E30 (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Iso-Olefins</i>		C10 Iso-olefin - 5	0.083	0.088	0.043
		C10 Iso-olefin - 6	0.012	0.013	0.006
		C10-IsoOlefin-7	0.039	0.042	0.020
		C10 - IsoOlefin - 8	0.012	0.013	0.006
		C10-IsoOlefin-12	0.051	0.054	0.026
		C10-IsoOlefin -15	0.080	0.085	0.042
	69405-42-1	3-Nonene, 3-methyl-, (E)-	0.021	0.021	0.011
<i>Naphtheno-Olefin</i>	693-89-0	1-Methylcyclopentene	0.010	0.010	0.009
		C9 Naph-Olefin -1	0.174	0.178	0.103
		C9 - NaphOlefin - 2	0.088	0.090	0.052
		C9-NaphthenoOlefin-6	0.000	0.000	0.000
<i>Di-Olefins</i>					
Oxygenates	64-17-5	Ethanol	31.989	30.368	50.719
Unidentified		Unidentified	0.000	0.001	0.001
		Unidentified	0.017	0.023	0.022
		Unidentified	0.006	0.006	0.008
		Unidentified	0.008	0.009	0.006
		Unidentified	0.024	0.025	0.016
		Unidentified	0.058	0.056	0.038
		Unidentified	0.947	0.925	0.616
		Unidentified	0.407	0.398	0.265
		Unidentified	0.005	0.005	0.003
		Unidentified	0.021	0.020	0.012
		Unidentified	0.063	0.066	0.036
		Unidentified	0.036	0.035	0.021
		Unidentified	0.204	0.210	0.116
		Unidentified	0.048	0.046	0.028
		Unidentified	0.038	0.039	0.019
		Unidentified	0.003	0.003	0.001
		Unidentified	0.006	0.006	0.004
		Unidentified	0.006	0.007	0.003
		Unidentified	0.006	0.005	0.003
		Unidentified	0.008	0.008	0.005
		Unidentified	0.015	0.015	0.007
		Unidentified	0.015	0.015	0.009
		Unidentified	0.018	0.018	0.009
		Unidentified	0.014	0.015	0.007
		Unidentified	0.011	0.010	0.006
		Unidentified	0.008	0.008	0.004
		Unidentified	0.009	0.008	0.005
		Unidentified	0.022	0.022	0.010
	Unidentified	0.022	0.019	0.012	
	Unidentified	0.008	0.006	0.005	
	Unidentified	0.026	0.026	0.012	

E30 (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
Unidentified		Unidentified	0.102	0.087	0.055
		Unidentified	0.030	0.023	0.017
		Unidentified	0.020	0.020	0.010
		Unidentified	0.016	0.016	0.007
		Unidentified	0.020	0.020	0.010
		Unidentified	0.061	0.056	0.029
		Unidentified	0.016	0.016	0.007
		Unidentified	0.065	0.055	0.036
		Unidentified	0.044	0.037	0.024
		Unidentified	0.042	0.035	0.020
		Unidentified	0.020	0.017	0.010
		Unidentified	0.008	0.007	0.004
		Unidentified	0.027	0.027	0.011
		Unidentified	0.013	0.013	0.006
		Unidentified	0.030	0.030	0.013
		Unidentified	0.008	0.008	0.003
		Unidentified	0.002	0.002	0.001
		Unidentified	0.004	0.003	0.002
		Unidentified	0.002	0.001	0.001
		Unidentified	0.001	0.001	0.000
		Unidentified	0.002	0.001	0.001
		Unidentified	0.004	0.003	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.010	0.010	0.004
		Unidentified	0.002	0.001	0.001
		Unidentified	0.001	0.001	0.000
		Unidentified	0.002	0.002	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.020	0.015	0.009
		Unidentified	0.022	0.017	0.010
		Unidentified	0.004	0.003	0.002
		Unidentified	0.013	0.013	0.005
		Unidentified	0.002	0.002	0.001
		Unidentified	0.009	0.009	0.003
		Unidentified	0.003	0.003	0.001
		Unidentified	0.009	0.008	0.003
		Unidentified	0.008	0.008	0.003
		Unidentified	0.004	0.004	0.001
		Unidentified	0.004	0.004	0.001
		Unidentified	0.012	0.012	0.004
		Unidentified	0.010	0.010	0.004
		Unidentified	0.002	0.002	0.001
		Unidentified	0.007	0.007	0.002
		Unidentified	0.006	0.006	0.002
		Unidentified	0.004	0.004	0.001
		Unidentified	0.006	0.006	0.002
		Unidentified	0.002	0.002	0.001
		Unidentified	0.005	0.005	0.002
		Unidentified	0.004	0.004	0.002
		Unidentified	0.006	0.006	0.002
		Unidentified	0.002	0.002	0.001
		Unidentified	0.004	0.004	0.002
		Unidentified	0.002	0.002	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.003	0.003	0.001
		Unidentified	0.002	0.002	0.001

Olefin

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
Paraffin	106-97-8	n-Butane	4.172	5.608	7.443
	109-66-0	n-Pentane	2.240	2.784	3.220
	110-54-3	n-Hexane	1.717	2.026	2.066
	142-82-5	n-Heptane	0.049	0.056	0.051
	111-65-9	n-Octane	0.275	0.305	0.250
	111-84-2	n-Nonane	0.558	0.605	0.451
	124-18-5	n-Decane	0.371	0.396	0.270
	1120-21-4	n-Undecane	0.174	0.182	0.116
	112-40-3	n-Dodecane	0.032	0.033	0.019
	629-59-4	n-Tetradecane	0.019	0.020	0.010
	I-Paraffins	463-82-1	2,2-Dimethylpropane	0.005	0.007
78-78-4		i-Pentane	1.879	2.360	2.701
75-83-2		2,2-Dimethylbutane	0.014	0.017	0.017
79-29-8		2,3-Dimethylbutane	1.036	1.219	1.247
107-83-5		2-Methylpentane	0.929	1.106	1.117
96-14-0		3-Methylpentane	0.855	1.002	1.029
108-08-7		2,4-Dimethylpentane	0.944	1.092	0.977
464-06-2		2,2,3-Trimethylbutane	0.069	0.078	0.072
562-49-2		3,3-Dimethylpentane	0.058	0.066	0.060
591-76-4		2-Methylhexane	1.042	1.194	1.078
589-34-4		3-Methylhexane	0.377	0.427	0.390
540-84-1		2,2,4-Trimethylpentane	17.116	19.248	15.538
590-73-8		2,2-Dimethylhexane	0.106	0.119	0.097
564-02-3		2,2,3-Trimethylpentane	0.616	0.670	0.559
592-13-2		2,5-Dimethylhexane	1.055	1.184	0.958
589-43-5		2,4-Dimethylhexane	0.898	0.998	0.816
565-75-3		2,3,4-Trimethylpentane	3.189	3.452	2.895
560-21-4		2,3,3-Trimethylpentane	3.335	3.574	3.028
584-94-1		2,3-Dimethylhexane	0.843	0.921	0.766
592-27-8		2-Methylheptane	0.121	0.135	0.110
589-53-7		4-Methylheptane	0.107	0.118	0.097
583-48-2		3,4-Dimethylhexane	0.079	0.086	0.072
589-81-1		3-Methylheptane	0.091	0.101	0.083
619-99-8		3-Ethylhexane	0.084	0.092	0.076
3522-94-9		2,2,5-Trimethylhexane	1.207	1.328	0.976
		C9-Isoparaffin-x	0.037	0.039	0.030
1069-53-0		2,3,5-Trimethylhexane	0.184	0.198	0.148
1071-26-7		2,4-Dimethylheptane	0.054	0.059	0.043
16747-25-4		2,2,3-Trimethylhexane	0.118	0.129	0.096
		2,5-Dimethylheptane	0.140	0.152	0.113
		2-Methyl-4-ethylhexane	0.030	0.033	0.025
3074-71-3		2,3-Dimethylheptane	0.081	0.087	0.066
		3,5-Dimethylheptane	0.017	0.018	0.014
1067-20-5	3,3-Diethylpentane	0.009	0.010	0.008	
2216-34-4	4-Methyloctane	0.091	0.099	0.074	
3221-61-2	2-Methyloctane	0.112	0.122	0.090	

Olefin (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
I-Paraffins	2216-33-3	3-Methyloctane	0.241	0.261	0.195
	922-28-1	3,4-Dimethylheptane	0.048	0.051	0.039
		C10 - IsoParaffin - 1	0.167	0.178	0.121
		C10-isoparaffin-x	0.000	0.000	0.000
		2,3-Dimethyloctane	0.088	0.095	0.064
	15869-87-1	2,2-Dimethyloctane	0.038	0.041	0.027
	15869-89-3	2,5-Dimethyloctane	0.060	0.064	0.044
	2040-95-1	2,7-Dimethyloctane	0.015	0.016	0.011
	2051-30-1	2,4-Dimethyloctane	0.053	0.057	0.039
		2,6-Dimethyloctane	0.104	0.110	0.075
		3-Methyl-5-ethylheptane	0.064	0.068	0.046
	15869-85-9	5-Methylnonane	0.044	0.047	0.032
	17301-94-8	4-Methylnonane	0.099	0.105	0.072
		2,2,6-Trimethyloctane	0.295	0.316	0.215
	5881-17-4	3-Ethyloctane	0.024	0.025	0.018
	5911-04-6	3-Methylnonane	0.068	0.072	0.049
		C11-Isoparaffin-1	0.121	0.127	0.080
		C11-Isoparaffin-2	0.038	0.040	0.025
		C10 - IsoParaffin - 5	0.057	0.061	0.042
	62016-30-4	2,3,3-trimethyloctane	0.059	0.062	0.039
		C11-Isoparaffin-3	0.022	0.023	0.014
		C11 Isoparaffin-4	0.035	0.036	0.023
		C11-Isoparaffin-5	0.104	0.108	0.069
		2,5,6-Trimethyloctane	0.253	0.264	0.168
		C11-Isoparaffin-7	0.132	0.139	0.088
		C11-Isoparaffin-8	0.022	0.023	0.015
		C11-Isoparaffin-9	0.050	0.052	0.033
		C11- Isoparaffin-10	0.027	0.029	0.018
		C11- Isoparaffin-11	0.157	0.164	0.104
		C11- Isoparaffin - 12	0.063	0.066	0.042
		C11- IsoParaffin - 13	0.033	0.035	0.022
		C12 - IsoParaffin - 1	0.030	0.032	0.018
		C12 - IsoParaffin - 2	0.036	0.037	0.022
C12 - Isoparaffin - 3	0.010	0.010	0.006		
C12 - IsoParaffin - 4	0.018	0.019	0.011		
C14-Isoparaffin-1	0.006	0.006	0.003		
Aromatics <i>Mono-Aromatics</i>	108-88-3	Toluene	7.631	6.849	8.589
	100-41-4	Ethylbenzene	0.513	0.461	0.501
	108-38-3	m-Xylene	1.280	1.153	1.251
	106-42-3	p-Xylene	0.580	0.524	0.567
	95-47-6	o-Xylene	0.514	0.454	0.502
	98-82-8	i-Propylbenzene	0.009	0.008	0.008
	103-65-1	n-Propylbenzene	0.101	0.091	0.087
	620-14-4	1-Methyl-3-ethylbenzene	0.304	0.273	0.262
	622-96-8	1-Methyl-4-ethylbenzene	0.162	0.146	0.140

Olefin (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Mono-Aromatics</i>	108-67-8	1,3,5-Trimethylbenzene	0.238	0.214	0.205
	611-14-3	1-Methyl-2-ethylbenzene	0.110	0.097	0.095
	95-63-6	1,2,4-Trimethylbenzene	0.516	0.459	0.445
	538-93-2	i-Butylbenzene	0.050	0.045	0.038
	526-73-8	1,2,3-Trimethylbenzene	0.138	0.120	0.119
	535-77-3	1-Methyl-3-i-propylbenzene	0.027	0.024	0.021
	99-87-6	1-Methyl-4-i-propylbenzene	0.040	0.036	0.031
	141-93-5	1,3-Diethylbenzene	0.027	0.025	0.021
	1074-43-7	1-Methyl-3-n-propylbenzene	0.280	0.253	0.216
	104-51-8	n-Butylbenzene	0.011	0.010	0.009
	934-74-7	1,3-Dimethyl-5-ethylbenzene	0.050	0.044	0.039
	135-01-3	1,2-Diethylbenzene	0.052	0.046	0.040
	1074-17-5	1-Methyl-2-n-propylbenzene	0.043	0.038	0.033
	874-41-9	1,3-Dimethyl-4-ethylbenzene	0.256	0.227	0.198
	934-80-5	1,2-Dimethyl-4-ethylbenzene	0.136	0.121	0.105
	2870-04-4	1,3-Dimethyl-2-ethylbenzene	0.195	0.170	0.150
		1-Methyl-4-t-butylbenzene	0.034	0.031	0.024
		1-Ethyl-3-i-propylbenzene	0.050	0.044	0.035
	933-98-2	1,2-Dimethyl-3-ethylbenzene	0.044	0.039	0.034
	4218-48-8	1-Ethyl-4-i-propylbenzene	0.075	0.066	0.053
		1,2,4,5-Tetramethylbenzene	0.146	0.128	0.113
	527-53-7	1,2,3,5-Tetramethylbenzene	0.187	0.163	0.145
		C11 - Aromatic - 2	0.007	0.007	0.005
		C11 - Aromatic - 3	0.020	0.018	0.014
		1,2-Di-i-propylbenzene	0.027	0.024	0.017
	1595-16-0	1-methyl-4-(1-methylpropyl)be	0.043	0.038	0.030
		C11 - Aromatic - 4	0.038	0.033	0.026
	5161-04-6	Benzene, 1-methyl-4-(2-methylp	0.027	0.023	0.019
	538-68-1	n-Pentylbenzene	0.015	0.013	0.010
		tert-Pentylbenzene	0.039	0.034	0.027
	577-55-9	1-Methyl-2-n-butylbenzene	0.017	0.015	0.012
		C11 - Aromatic - 7	0.034	0.031	0.024
	100-18-5	1,4-Di-i-propylbenzene	0.033	0.029	0.021
		C12-Aromatic-1	0.008	0.008	0.005
		C11 - Aromatic - 10	0.010	0.009	0.007
		1,3-Di-n-propylbenzene	0.021	0.018	0.013
		C11 - Aromatic - 11	0.008	0.007	0.006
		C11 - Aromatic - 12	0.007	0.006	0.005
		C11 - Aromatic - 13	0.004	0.003	0.003
		C11 - Aromatic - 14	0.005	0.004	0.003
		C12 - Aromatic - 1	0.004	0.004	0.003
		C12 - Aromatic -8	0.000	0.000	0.000
		C12 - Aromatic - 10	0.003	0.002	0.002
		C12 - Aromatic - 11	0.005	0.004	0.003
	877-44-1	1,2,4-Triethylbenzene	0.011	0.010	0.007
	700-12-9	Pentamethylbenzene	0.022	0.017	0.016
		C13 - Aromatic - 2	0.006	0.005	0.003

Olefin (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Mono-Aromatics</i>					
<i>Naphthalenes</i>	91-20-3	Naphthalene	0.102	0.078	0.083
	91-57-6	2-Methylnaphthalene	0.151	0.115	0.109
	90-12-0	1-Methylnaphthalene	0.074	0.056	0.054
		Dimethylnaphthalene-3	0.012	0.010	0.008
		Dimethylnaphthalene-4	0.012	0.009	0.008
		Dimethylnaphthalene-5	0.030	0.024	0.020
		Dimethylnaphthalene - 6	0.014	0.011	0.009
		Dimethylnaphthalene-5(1)	0.011	0.009	0.007
		Dimethylnaphthalene-6	0.008	0.006	0.005
<i>Naphtheno/Olefin</i>		Indan	0.077	0.062	0.068
		2-Methylindan	0.055	0.045	0.043
	874-35-1	5-Methylindan	0.071	0.062	0.056
	824-22-6	4-Methylindan	0.092	0.080	0.072
	824-63-5	2-Methylindan(1)	0.061	0.053	0.048
		4,7-Dimethyl Indane	0.023	0.018	0.016
		1,1-Dimethyl Indane	0.007	0.006	0.005
		Dimethyl Indane - 1	0.004	0.003	0.003
		C2 Indane - 1	0.005	0.004	0.004
		4,7-DimethylIndane	0.012	0.010	0.008
		Dimethyl Indane - 3	0.008	0.006	0.006
		Dimethyl Indane - 4	0.004	0.003	0.003
		C3 Indane - 6	0.002	0.002	0.001
<i>Indenes</i>		Diimethyl Indene - 2	0.000	0.000	0.000
<i>Naphthenes</i>					
<i>Mono-Naphthene</i>	287-92-3	Cyclopentane	0.013	0.013	0.019
	96-37-7	Methylcyclopentane	0.805	0.837	0.992
	110-82-7	Cyclohexane	0.099	0.099	0.122
	1759-58-6	1t,3-Dimethylcyclopentane	0.030	0.032	0.032
	2532-58-3	1c,3-Dimethylcyclopentane	0.026	0.027	0.027
	822-50-4	1t,2-Dimethylcyclopentane	0.052	0.054	0.055
	108-87-2	Methylcyclohexane	0.087	0.088	0.092
	4516-69-2	1,1,3-Trimethylcyclopentane	0.010	0.010	0.009
	4850-28-6	1c,2t,4-Trimethylcyclopentane	0.027	0.028	0.025
	15890-40-1	1t,2c,3-Trimethylcyclopentane	0.023	0.024	0.022
		1,3-dimethyl-t-cyclohexane	0.211	0.214	0.195
		3c-Ethylmethylcyclopentane	0.056	0.057	0.052
	624-29-3	1c,4-Dimethylcyclohexane	0.115	0.115	0.107
		C9-Naphthene	0.007	0.007	0.005
	1678-91-7	Ethylcyclohexane	0.264	0.262	0.244
	1795-27-3	1c,3c,5-Trimethylcyclohexane	0.009	0.009	0.008
	2040-96-2	n-Propylcyclopentane	0.135	0.136	0.125
	7094-27-1	1,1,4-Trimethylcyclohexane	0.017	0.017	0.014
		C9 - MonoNaph - 3	0.017	0.017	0.014

Olefin (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Mono-Naphthene</i>		C9 - MonoNaph - 4	0.031	0.031	0.026
		C9 - MonoNaph - 5	0.026	0.026	0.021
		Cyclohexane, 1,2,4-trimethyl-,	0.014	0.014	0.012
	3728-57-2	Cyclopentane, 1-methyl-2-propyl-	0.062	0.055	0.060
	6236-88-0	Cyclohexane, 1-ethyl-4-methyl-	0.154	0.156	0.127
	7094-26-0	1,1,2-Trimethylcyclohexane	0.184	0.179	0.151
		C10 - MonoNaph - 1	0.014	0.014	0.010
	4926-90-3	1,1-Methylethylcyclohexane	0.110	0.106	0.090
		1-ethyl-4-t-methylcyclohexane	0.028	0.027	0.023
	696-29-7	1-Methyl-2-propyl-cyclopentan	0.006	0.005	0.005
		1,2,3,5-t-Tetramethylcyclohex	0.094	0.095	0.078
	1678-98-4	i-Butylcyclohexane	0.058	0.057	0.043
		C10 - MonoNaph - 2	0.027	0.026	0.020
	n-ButylCyclohexane	0.070	0.067	0.051	
<i>Di/Bicyclo-Napht</i>					
<i>Olefins</i>					
<i>n-Olefins</i>					
	592-41-6	Hexene-1	2.151	2.469	2.651
	4050-45-7	t-Hexene-2	0.007	0.008	0.009
	111-66-0	Octene-1	2.064	2.100	1.908
	14919-01-8	t-Octene-3	0.003	0.003	0.003
	111-23-6	t-Octene-2	0.002	0.002	0.002
		C9-isoolefin	0.086	0.099	0.071
	20063-92-7	t-Nonene-3	0.022	0.025	0.018
		C10-n-Olefin	0.014	0.015	0.010
	693-61-8	2-Undecene, (E)-	0.027	0.028	0.020
		5-Undecene	0.032	0.034	0.024
<i>Iso-Olefins</i>					
	625-27-4	2-Methylpentene-2	0.004	0.004	0.005
	922-62-3	3-Methyl-c-pentene-2	0.004	0.004	0.005
	107-39-1	2,2,4-Trimethyl-1-Pentene	21.249	16.534	19.674
	4914-91-4	2-Pentene, 3,4-dimethyl-, (Z)-	0.032	0.035	0.034
	107-40-4	2.2.4-Trimethyl-2-Pentene	5.590	4.350	5.176
		C8 - Diolefin - 1	0.008	0.008	0.007
	4485-16-9	3-Heptene, 4-methyl-	0.118	0.120	0.109
	14850-22-7	C8-IsoOlefin-9	0.009	0.009	0.008
		C8 - IsoOlefin - 10	0.006	0.006	0.006
		C9 - IsoOlefin - 1	0.006	0.006	0.006
	19550-75-6	t-2,2-Dimethylheptene-3	0.052	0.059	0.043
		C9 - IsoOlefin - 2	0.177	0.176	0.145
	33933-74-4	3-Heptene, 4-ethyl-	0.008	0.008	0.006
	19549-87-2	2,4-Dimethylheptene-1	0.014	0.016	0.012
		C9-IsoOlefin-3	0.016	0.016	0.013
	3074-64-4	2,3-Dimethylheptene-2	0.010	0.011	0.008
		C10-IsoOlefin-4	0.006	0.006	0.004
		C10 Iso-olefin - 5	0.049	0.055	0.036
		C10 Iso-olefin - 6	0.009	0.010	0.007

Olefin (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
<i>Iso-Olefins</i>		C10-IsoOlefin-7	0.034	0.038	0.025
		C10 - IsoOlefin - 8	0.009	0.010	0.007
		C10-IsoOlefin-12	0.046	0.051	0.034
		C10-IsoOlefin -15	0.090	0.100	0.067
	69405-42-1	3-Nonene, 3-methyl-, (E)-	0.016	0.017	0.012
<i>Naphtheno-Olefin</i>	693-89-0	1-Methylcyclopentene	0.005	0.005	0.007
		C9 Naph-Olefin -1	0.059	0.062	0.049
		C9 - NaphOlefin - 2	0.021	0.022	0.018
		C9-NaphthenoOlefin-6	0.000	0.000	0.000
<i>Di-Olefins</i>					
Oxygenates					
Unidentified		Unidentified	0.038	0.053	0.068
		Unidentified	0.003	0.004	0.004
		Unidentified	0.004	0.004	0.004
		Unidentified	0.013	0.014	0.013
		Unidentified	0.016	0.016	0.016
		Unidentified	0.024	0.026	0.022
		Unidentified	0.054	0.054	0.050
		Unidentified	0.012	0.012	0.010
		Unidentified	0.015	0.015	0.012
		Unidentified	0.032	0.032	0.026
		Unidentified	0.006	0.006	0.005
		Unidentified	0.006	0.007	0.005
		Unidentified	0.006	0.005	0.005
		Unidentified	0.008	0.008	0.007
		Unidentified	0.012	0.013	0.009
		Unidentified	0.012	0.012	0.010
		Unidentified	0.016	0.017	0.012
		Unidentified	0.013	0.014	0.009
		Unidentified	0.006	0.006	0.005
		Unidentified	0.007	0.007	0.005
		Unidentified	0.015	0.016	0.010
		Unidentified	0.020	0.020	0.013
		Unidentified	0.025	0.026	0.017
		Unidentified	0.092	0.084	0.071
		Unidentified	0.055	0.048	0.047
		Unidentified	0.024	0.019	0.019
		Unidentified	0.010	0.011	0.007
		Unidentified	0.008	0.008	0.005
		Unidentified	0.030	0.029	0.020
		Unidentified	0.006	0.006	0.004
	Unidentified	0.025	0.022	0.020	
	Unidentified	0.027	0.024	0.019	
	Unidentified	0.012	0.011	0.008	
	Unidentified	0.010	0.009	0.007	

Olefin (cont.)

<u>Group</u>	<u>CASNO</u>	<u>Component</u>	<u>%Wgt</u>	<u>%Vol</u>	<u>%Mol</u>
Unidentified		Unidentified	0.008	0.008	0.005
		Unidentified	0.009	0.009	0.005
		Unidentified	0.003	0.003	0.002
		Unidentified	0.002	0.001	0.001
		Unidentified	0.004	0.004	0.003
		Unidentified	0.003	0.003	0.001
		Unidentified	0.005	0.004	0.003
		Unidentified	0.002	0.002	0.001
		Unidentified	0.007	0.007	0.004
		Unidentified	0.010	0.010	0.005
		Unidentified	0.002	0.002	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.003	0.003	0.002
		Unidentified	0.006	0.005	0.004
		Unidentified	0.002	0.002	0.001
		Unidentified	0.007	0.007	0.004
		Unidentified	0.006	0.006	0.003
		Unidentified	0.004	0.004	0.002
		Unidentified	0.005	0.005	0.003
		Unidentified	0.004	0.004	0.002
		Unidentified	0.002	0.002	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.006	0.006	0.003
		Unidentified	0.006	0.006	0.003
		Unidentified	0.002	0.002	0.001
		Unidentified	0.003	0.003	0.002
		Unidentified	0.003	0.003	0.002
		Unidentified	0.002	0.002	0.001
		Unidentified	0.003	0.003	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.002	0.002	0.001
		Unidentified	0.001	0.001	0.001

