

Hydrocarbon Composition of Gasoline Vapor Emissions from Enclosed Fuel Tanks

Draft



EPA

United States
Environmental Protection
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Draft

Assessment and Standards Division
Office of Transportation and Air Quality

and

Human Exposure & Atmospheric Sciences Division
Office of Research and Development

U.S. Environmental Protection Agency

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Introduction

The purpose of this report is for EPA OTAQ (Office of Transportation and Air Quality) to give an initial summary of EPA ORD (Office of Research and Development) work on the composition of hydrocarbon emissions from gasoline, specifically the head space components above gasoline in an enclosed fuel tank. EPA ORD will formally publish this work in a scientific journal but, until that is done, this report will provide details on that work since it is related to EPA regulatory packages such as air quality modeling done for the Renewable Fuel Standards and Light-Duty Vehicle Greenhouse Gas Standards.

Overview and Prior Work

Headspace vapors are those hydrocarbon compounds in gaseous form above a gasoline sample in an enclosed space such as a fuel tank, frequently a fuel storage tank used in the distribution for gasoline. Some of these vapors are emitted to the atmosphere in transport, storage, and utilization of gasoline. The numerous hydrocarbon compounds (about 120 individual hydrocarbons) represent the more volatile and lower molecular weight components of the gasoline. In recent years and even more so in the future, ethanol, as a renewable fuel component, is blended with gasoline generally at the 10% level, which results in 90% gasoline with 10% ethanol. This fuel mixture of 90% gasoline and 10% ethanol (in denatured form) will be referred to as E10 while 100% gasoline with no ethanol added will be referred to as E0. Also, blends of 85% ethanol and 15% gasoline (E85) can be used in specially designed flexible-fueled vehicles but new headspace profiles with E85 have not yet been obtained in this project for E85.

There are, thus, the following three fuel blends of interest

100% gasoline	E0
90% gasoline with 10% ethanol	E10
85% ethanol with 15% gasoline	E85

Originally, two profiles for headspace vapors for E0 and E10 were selected from the SPECIATE data base located at

<http://www.epa.gov/ttn/chief/software/speciate/index.html>

These profiles were profile number 8737 and 8736 for E0 and E10 respectively. The profiles showed the following aromatic and olefin content for the headspace vapors.

	Aromatics	Olefins
E0 blend	4%	13%
E10 blend	2%	4%

Since the use of ethanol, which has high octane properties, in gasoline would replace other high octane components such as aromatics, it is reasonable to expect that the aromatic content of the headspace would decrease as these profiles show. It is not reasonable to expect that use of E10 would so markedly decrease olefin content. Gasoline composition varies widely in-use. The purpose of the air quality modeling using these profiles is to determine the air quality effects of adding ethanol to gasoline in an effort to have the E0 and E10 samples reflect what happens when ethanol is added to gasoline rather than using profiles from samples where the widely varying composition of in-use gasoline obfuscates the results.

Initially, the two profiles from SPECIATE mentioned above were adjusted so that the olefin content of the E10 blend represented addition of 10% ethanol to the base gasoline (from splash-blending). This adjustment was made by decreasing the olefin content of the E0 headspace profiles so that the total olefin content would be about 4% and increasing the other components including the aromatics to make up for the decreased olefin levels. The resulting profile (named 8737b) is shown in the attached table.

In addition to these calculations, measurements were done on an actual splash-blended E10 blend obtaining a speciation profile and comparing it to one obtained on the corresponding base gasoline. Gasoline/ethanol blends now generally utilize the higher octane of ethanol and, thus, as not splash-blended as occurred more in the past. Additional works should and will be done with these newer blends compared to a base gasoline. This future work though should be done on typical (average) E0 and E10 blends. Still, for this work, a base gasoline was used designed to be typical of in-use gasoline.

The base gasoline being used is that from an EPA in-use test program for emissions characterization. The gasoline/ethanol (E10) sample used for headspace analysis was splash blended. The base gasoline (E0) was shipped in two canisters from the EPA Office of Transportation and Quality facility (OTAQ) in Ann Arbor, MI to the EPA Office of Research and Development (ORD) facility in Research Triangle Park, NC. That facility added 10% ethanol to a portion of the gasoline to create a 10% ethanol (E10) blend as described below. This gasoline has relatively low olefin content (about 4%) but more typical aromatic content (about 26%).

Results

The impact on headspace vapors from the addition of 10% ethanol to the base gasoline in this study was to lower the % paraffins and %olefins, and slightly increase the %aromatics. This is shown in the spreadsheet where the 86% paraffins, 7.6% olefins, and 5.1% aromatics in the headspace@25C for the base gasoline compares to 75.6% paraffins, 6.3% olefins, and 5.6% aromatics in the headspace with the added ethanol. Consequently the addition of 10% ethanol to the base fuel did decrease the % olefin content from 7.6 to 6.3% of total VOC observed in the headspace@25C. Note that these are percentages of the total VOC. **This project did not measure how the total VOC emissions changed with addition of ethanol but only the percent change in the VOC itself.** Generally, the addition of ethanol to a base gasoline increases the Reid Vapor Pressure of the resultant blend and, thus, the total VOC emissions on a mass basis. Also note that isopentane is a major constituent of the headspace vapors accounting

for about 40% of the VOC while it accounts for about 10% of the composition of the base gasoline.

The results showed relatively similar aromatic levels for both E0 and E10 which the earlier profiles also showed. The results also showed relatively similar olefin levels for both fuels which the earlier profiles did not show.

These new profiles will be added to SPECIATE (as numbers 8762 and 8763).

Some smog chamber runs have been done with these samples and will be reported separately.

Appendix

Sample Preparation

Both canisters (one for E0 and one for E10) were placed in a fuel shed maintained at 13 degrees C for storage. An approximate 1 liter aliquot of E0 was removed from one of the stored cans and placed in a stainless steel canister in the storage shed facility. The canister was removed from the shed, taken to the laboratory, and placed in a large storage cooler containing ice. After an approximate 2 hour cooling period a 225 ml sample of the cooled gas was taken using a graduated cylinder, then placed in a 500ml stainless steel can that contained 25 ml of 200 proof absolute ethanol. This can was closed, swirled mixed, then placed into the storage cooler that contained the 1 liter can of gasoline (E0 designated as sample 41033). Both cans were stored for a period of about 90 minutes in the cooler. During this time period, and on 2 other occasions, the can containing the 90% gasoline 41033 with 10% ethanol (E10) was swirl mixed for an approximate 15 second period.

Triply distilled water (70 ul) was injected into four recently cleaned and vacuum evacuated six liter SUMMA canisters to condition the canister surface. This small volume of water vaporizes to water vapor coating the internal surfaces of the canister with a monolayer of water vapor to deactivate and condition active surface sites allowing the storage of the hydrocarbons in the gasoline and gasoline head space at 25 degrees C. Without this deactivation, significant losses of hydrocarbon compounds from benzene to the higher molecular weight hydrocarbons would be observed during the sample storage period.

At the end of this process 25 ml aliquots of the E0 and E10 fuels were placed into 50 ml Erlenmeyer flasks then placed into a constant temperature bath containing water and maintained at 25°C. After a 20 minute equilibration time 100 ul aliquots of the headspace vapors were taken from each flask and injected into the canisters which were then filled to 40 psig with ultra high purity helium. The prepared canisters were allowed to equilibrate for a 12 to 15 hour period before performing both GC/FID and GC/MS analyses. Whole fuel samples were prepared by injecting 0.02ul aliquots of the cooled liquid into canisters then filled to 40 psig using ultra high

purity helium. More details of these procedures are published elsewhere. Likewise more detailed concerning the GC/FID and GC/MS methodology are published elsewhere.¹

The results obtained for E0 sent to RTP for headspace analysis using GC/FID techniques are provided in the attached Excel spreadsheet. In the spreadsheet are the results for both the headspace at 25 degrees C and whole fuel analyses of E0 and E10. About 140 compound peaks are presented from the more than 200 compound peaks observed representing approximately 98% of total VOC concentration. The headspace vapors for both E0 and E10 contain 6-7% olefins and about 5% aromatics. Compound name, VOC type, and RTINDEX² for each compound are provided in the first 3 columns to the left. Each sample analysis is identified by file name just above the identification of the sample. The column giving the quantitative levels (in ppb) is the observed peak concentration given as parts-per-billion-carbon (ppbC). At the bottom of the column is the sum of all the listed peaks followed by the sum of all the more than 200 observed peaks. Below these 2 values is the ratio that the sum of listed peaks is of all the observed peaks. This value is typically 98 to 99%. In the rows below these values are the sum and % sum of the various compound groups to the total VOC. There are pairs of these columns for each of the 4 canister sample results. For those 2 canister samples that contained ethanol, the concentration of ethanol was corrected for the reduced FID response due to the presence of the oxygen atom using published values. For ethanol, the carbon atom attached to the hydroxyl (OH) group has about 50% reduced response with the FID compared to other carbon atoms in the compound. Consequently the correction for the 2 carbons in ethanol is given as 2/1.5 or 1.33.

The next column highlighted is the % that each of the listed compounds is of total VOC, (the sum of the more than 200 observed peaks).

The next column highlighted is the ratio of the % of total VOC for each compound peak observed in the headspace@25C sample to that for the similar compounds observed in the whole gasoline analysis. As expected the more volatile compounds contribute a larger % of total VOC in the headspace @25C than in the fuel. From the spreadsheet the ratio of 1.6 observed for ethanol indicates that this substituted hydrocarbon is less volatile than the hydrocarbon compounds, 3-methyl-1-butene and isopentane, eluting just before and after ethanol on the GC column.

Electronic copies of the chromatograms for all 4 samples are available if needed.

Precision and Accuracy of Results

¹ Harley, R.A., S.A. McKeen, M.O. Rodgers, and W.A. Lonneman, Analysis of motor vehicle emissions during the Nashville/Middle Tennessee Ozone Study, J. Geophys. Res., 106, 3559-3567, 2001

² RTINDEX is a technique used to place the elution order and/or location of various VOCs on the GC column. The most common approach is to determine the retention times of a mixture of the C₂-C₁₅ normal paraffins (i.e., ethane through pentadecane) then place other VOCs by retention time where these compounds elute in reference to the normal paraffins. For example the retention time of benzene on an EPA GC column with an RTINDEX value of 651.21 is about half way between the retention times of n-hexane with a defined RTINDEX value of 600.00 and n-heptane with a defined RTINDEX value of 700.00.

Over the years in past analyses of whole gasoline and gasoline headspace@25C samples, ORD has measured both precision and accuracy for these analyses. Repeats for instrumental precision are the more commonly performed with repeatability of 5% or better.

A National Institute of Standards and Technology Standard Reference Material (NIST/SRM) propane in air standard cylinder is used to determine accuracy. The assumption is made (as it is in EPA measurements of motor vehicle exhaust) that all hydrocarbons respond in the flame ionization detector (FID) with a uniform per carbon response. However, ethanol, as well as any other oxygenated hydrocarbons in gasoline, does not respond in this way. As discussed earlier, an adjustment was made for the presence of oxygen in the FID response. In the case of ethanol, the presence of oxygen causes this 2 carbon compound to respond as if has only 1.5 carbons. Consequently, the observed measurement for ethanol is adjusted using a $2/1.5$ or 1.33 correction factor for this compound.

Measurements done by
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Gasoline # 41033 Headspace@25C and Whole Gas Analyses							
		Profile 8762			Profile 8763		
		Headspace Vapors E0			Headspace Vapors E10		
NAME	VOC type	ppb	% of Total VOC	Ratio HS to Whole Gasoline	ppb	% of Total VOC	Ratio HS to Whole Gasoline
Propylene	o	1.420	0.025	5.0	1.200	0.017	3.6
Propane	p	3.090	0.054	8.9	2.740	0.038	6.2
Isobutane	p	17.310	0.303	15.6	16.830	0.236	11.3
Butene-1	o	3.440	0.060	4.8	3.170	0.044	3.3
Isobutylene	o	3.670	0.064	8.3	3.430	0.048	8.7
1,3-Butadiene	o	0.580	0.010	2.5	0.340	0.005	1.0
n-Butane	p	248.950	4.352	11.1	245.340	3.443	9.8
t-Butene-2	o	11.070	0.194	9.6	10.640	0.149	8.6
2,2-Dimethylpropane	p	5.340	0.093	8.7	5.510	0.077	8.3
c-Butene-2	o	10.960	0.192	7.8	10.600	0.149	6.8
3-Methyl-1-Butene	o	6.530	0.114	5.6	6.150	0.086	5.4
Ethanol	ox	0.000	0.000	0.0	773.130	12.756	1.6
Isopentane	p	2564.210	44.829	4.6	2600.840	36.495	4.2
Pentene-1	o	27.510	0.481	4.0	27.640	0.388	3.7
2-Methyl-1-Butene	o	55.880	0.977	3.9	56.860	0.798	3.5
n-Pentane	p	332.580	5.814	3.4	347.780	4.880	3.2
Isoprene	o	1.020	0.018	3.3	0.930	0.013	3.1
trans-2-Pentene	o	70.600	1.234	3.3	72.140	1.012	3.0
Unknown	u	0.940	0.016	3.9	0.750	0.011	2.4
cis-2-Pentene	o	38.470	0.673	3.3	38.880	0.546	3.0
2-Methyl-2-Butene	o	103.970	1.818	3.0	104.510	1.466	2.7
2,2-Dimethylbutane	p	26.870	0.470	2.2	28.860	0.405	2.1
Cyclopentene	o	12.570	0.220	2.4	12.840	0.180	2.2
3-Methyl-1-pentene	o	6.020	0.105	1.9	5.700	0.080	1.7
Cyclopentane	p	19.610	0.343	2.0	20.620	0.289	1.9
2,3-Dimethylbutane	p	264.190	4.619	1.6	285.050	4.000	1.6
2-Methylpentane	p	216.080	3.778	1.5	235.960	3.311	1.5
3-Methylpentane	p	124.530	2.177	1.3	137.510	1.930	1.3
2-Methyl-1-Pentene + Hexene-1	o	10.660	0.186	1.3	12.000	0.168	1.3
n-Hexane	p	61.420	1.074	1.0	69.510	0.975	1.1
trans-3-Hexene	o	5.980	0.105	1.1	6.530	0.092	1.1
trans-2-Hexene	o	8.200	0.143	1.1	8.990	0.126	1.1
2-Methyl-2-Pentene	o	12.760	0.223	1.1	11.130	0.156	1.1
cis-3-Hexene	o	6.500	0.114	1.1	6.970	0.098	1.1
4-Methylcyclopentene	o	1.500	0.026	1.2	1.480	0.021	1.2
cis-2-Hexene	o	4.910	0.086	1.1	5.150	0.072	1.1
cis-3-Methyl-2-pentene	o	8.770	0.153	0.9	9.740	0.137	1.0
2,2-DiMethylpentane	p	3.410	0.060	0.8	3.850	0.054	0.9
Methylcyclopentane	p	56.810	0.993	1.0	63.390	0.889	1.0
2,4-Dimethylpentane	p	153.070	2.676	0.7	179.780	2.523	0.8
2,2,3-TriMethylbutane	p	5.020	0.088	0.7	6.340	0.089	0.9
2,4-DiMethyl-1-Pentene	o	0.390	0.007	0.8	0.400	0.006	0.7
1-Methylcyclopentene	o	5.560	0.097	0.8	6.240	0.088	0.9
Benzene	a	19.710	0.345	0.9	21.280	0.299	0.9
3,3-DiMethylpentane	p	3.190	0.056	0.6	3.600	0.051	0.7
Cyclohexane	p	9.350	0.163	0.8	10.650	0.149	0.8
4-Me-1-Hexene	o	0.350	0.006	0.6	0.470	0.007	0.5
2-Methylhexane	p	30.510	0.533	0.5	38.480	0.540	0.6
2,3-Dimethylpentane	p	208.240	3.641	0.5	255.640	3.587	0.6
1,1-DiMeCyclopentane	p	1.280	0.022	0.7	1.460	0.020	0.7
3-Methylhexane	p	30.730	0.537	0.5	38.420	0.539	0.5
5-Me-2-Hexene	o	0.490	0.009	0.8	0.430	0.006	0.7
c-1,3-DiMeCyclopentane	p	6.210	0.109	0.5	7.660	0.107	0.6
t-1,3,-DiMeCyclopentane	p	8.120	0.142	0.5	10.310	0.145	0.6
2,2,4-TriMethylpentane	p	297.780	5.206	0.4	384.850	5.400	0.5
3-Me-3-Hexene	o	0.890	0.016	1.0	0.820	0.012	0.8
trans-3-Heptene	o	1.230	0.022	0.8	0.900	0.013	0.6
n-Heptane	p	16.330	0.285	0.4	21.620	0.303	0.5
trans-3-Heptene	o	2.790	0.049	0.5	2.730	0.038	0.4
Unknown	u	0.680	0.012	0.5	0.790	0.011	0.6
3-Ethyl-2-Pentene	o	0.430	0.008	0.5	0.590	0.008	0.7
3-Methyl-2-Hextene	o	0.630	0.011	0.4	0.870	0.012	0.5
2,4,4-TriMethyl-1-Pentene	o	0.730	0.013	0.5	1.070	0.015	0.6
cis-2-Heptene	o	0.570	0.010	0.4	0.660	0.009	0.5
MethylCyclohexane	p	9.220	0.161	0.4	11.830	0.166	0.4
Unknown	u	1.090	0.019	0.5	1.360	0.019	0.5
2,5-DiMethylhexane	p	24.690	0.432	0.3	34.810	0.488	0.3
2,4-DiMethylhexane + EthylCyclopentane	p	34.470	0.603	0.3	47.980	0.673	0.4
3,3-DiMethylhexane + 1,2,4-TriMeCyclopentane	p	1.420	0.025	0.3	1.990	0.028	0.4
ctc-1,2,3-TriMeCyclopentane	p	0.640	0.011	0.4	0.770	0.011	0.4

Gasoline # 41033 Headspace@25C and Whole Gas Analyses (continued)							
		Profile 8762			Profile 8763		
		Headspace Vapors E0			Headspace Vapors E10		
NAME	VOC type		% of Total VOC	Ratio HS to Whole Gasoline		% of Total VOC	Ratio HS to Whole Gasoline
		ppb			ppb		
ctc-1,2,3-TriMeCyclopentane	p	0.640	0.011	0.4	0.770	0.011	0.4
2,3,4-TriMethylpentane	p	100.690	1.760	0.3	142.440	1.999	0.3
Toluene	a	189.470	3.312	0.3	255.930	3.591	0.3
2,3-DiMethylhexane	p	19.740	0.345	0.3	28.230	0.396	0.3
2-Methylheptane	p	4.200	0.073	0.2	6.000	0.084	0.3
4-MeHeptane	p	1.920	0.034	0.2	2.810	0.039	0.3
3,4-DiMethylhexane	p	3.740	0.065	0.2	5.310	0.075	0.3
3-Methylheptane	p	5.220	0.091	0.2	7.280	0.102	0.3
ctc-1,2,4-TriMeCyclopentane	p	1.300	0.023	0.4	1.560	0.022	0.4
t-1,4-DiMeCyclohexane	p		0.000	0.0		0.000	0.0
Unknown	u	26.500	0.463	0.2	40.450	0.568	0.2
1,1-DiMethylcyclohexane	p	0.600	0.010	0.3	0.650	0.009	0.2
Unknown	u	0.360	0.006	0.3	0.400	0.006	0.3
2,2,4-TriMethylhexane	p	0.530	0.009	0.2	0.950	0.013	0.3
Unknown	u		0.000	0.0		0.000	0.0
n-Octane	p	2.520	0.044	0.2	3.940	0.055	0.2
cis-2-Octene	o	0.590	0.010	0.2	1.320	0.019	0.3
Isopropylcyclopentane	p		0.000	0.0		0.000	0.0
2,3,5-TriMethylhexane	p	4.650	0.081	0.2	6.910	0.097	0.2
2,4-DiMethylheptane	p	1.190	0.021	0.3	1.950	0.027	0.4
2,6-DiMethylheptane	p	0.900	0.016	0.2	1.800	0.025	0.4
1c2-DiMethylcyclohexane n-Propylcyclopentane	p		0.000	0.0		0.000	0.0
2,5-DiMeHeptane	p	1.770	0.031	0.2	2.680	0.038	0.2
Unknown	u	0.830	0.015	0.5	0.840	0.012	0.4
1,1,4-TriMeCyclohexane	p		0.000	0.0	0.440	0.006	0.6
Ethylbenzene	a	8.630	0.151	0.2	12.820	0.180	0.2
ctt-1,2,4-TriMeCyclohexane	p	0.960	0.017	0.2	1.370	0.019	0.2
m- & p-Xylene	a	27.440	0.480	0.1	40.450	0.568	0.2
3-Methyloctane	p	1.180	0.021	0.2	1.610	0.023	0.2
ctc-1,2,4-TriMeCyclohexane	p	1.700	0.030	0.1	2.790	0.039	0.1
3,3-DiEthylpentane	p	0.450	0.008	0.1	0.810	0.011	0.2
o-Xylene	a	5.670	0.099	0.1	8.430	0.118	0.2
Nonene-1	o	1.540	0.027	0.1	2.700	0.038	0.2
1,1,2-TriMeCyclohexane	p	1.540	0.027	0.1	2.700	0.038	0.2
Nonane	p	0.380	0.007	0.1	0.720	0.010	0.2
trans-2-Nonene	o	0.880	0.015	0.1	1.620	0.023	0.1
Isopropylbenzene	a	1.280	0.022	0.1	2.180	0.031	0.1
3,5-DiMethyloctane	p	0.490	0.009	0.4	0.110	0.002	0.1
2,6-DiMethyloctane	p	0.350	0.006	0.1	0.490	0.007	0.1
n-Propylbenzene	a	3.140	0.055	0.1	4.210	0.059	0.1
m-Ethyltoluene	a	8.750	0.153	0.1	12.220	0.171	0.1
p-Ethyltoluene	a	3.990	0.070	0.1	5.480	0.077	0.1
1,3,5-TriMethylbenzene	a	4.520	0.079	0.1	5.790	0.081	0.1
3-Methylnonane	p	0.120	0.002	0.1	0.170	0.002	0.1
o-Ethyltoluene	a	3.180	0.056	0.1	4.280	0.060	0.1
1,2,4-TriMethylbenzene	a	10.910	0.191	0.1	15.640	0.219	0.1
n-Decane	p	0.340	0.006	0.1	0.720	0.010	0.1
Isobutylbenzene + 1-Me-2-Propylcyclohexane	a	0.210	0.004	0.1	0.450	0.006	0.1
sec-Butylbenzene	a	0.270	0.005	0.1	0.430	0.006	0.1
m-Cymene	a	0.320	0.006	0.1	0.410	0.006	0.1
1,2,3-TriMethylbenzene	a	2.090	0.037	0.1	2.650	0.037	0.1
Indane	n	0.650	0.011	0.1	0.790	0.011	0.1
m-Diethylbenzene	a		0.000			0.000	
1,Me-3-n-Propylbenzene	a	0.640	0.011	0.0	0.960	0.013	0.0
n-Butylbenzene	a	0.850	0.015	0.1	1.520	0.021	0.1
1-Me-2-n-Propylbenzene	a	0.750	0.013	0.1	0.950	0.013	0.1
1,4-DiMe-2-Ethylbenzene	a	0.680	0.012	0.1	0.420	0.006	0.0
Unknown	u		0.000	0.0	0.490	0.007	0.1
1,2-DiMe-4-Ethylbenzene	a	0.680	0.012	0.1	0.990	0.014	0.1
1,3-DiMe-2-Ethylbenzene	a		0.000	0.0		0.000	0.0
n-Undecane	p	0.520	0.009	0.4	0.330	0.005	0.1
1,2-DiMe-3-Ethylbenzene	a		0.000	0.0		0.000	0.0
1,2,4,5-Tetra-Me-Benzene	a	0.400	0.007	0.1	0.280	0.004	0.0
Unknown	u	0.790	0.014	0.1	0.510	0.007	0.0
Unknown	u		0.000	0.0	0.210	0.003	0.0
Methylindane	n	0.350	0.006	0.2		0.000	0.0
n-Pentylbenzene + t-1-Me-2-(4MP)cyclohexane	a		0.000	0.0		0.000	0.0
Unknown	u		0.000	0.0		0.000	0.0
t-1-But-3,5-DiMeBenzene	a		0.000			0.000	
Naphthalene	n	0.000	0.000	0.0	0.180	0.003	0.0
n-Dodecane	p	0.310	0.005	0.3		0.000	0.0

Summary Statistics on Headspace Profiles					
		GasE0 HS@25C			GasE10 HS@2
NAME					
Sum of GC Peaks		5,698			7,000
Sum of ALL GC Peaks		5,720			7,032
%Sum of Peaks are of Total HC		99.610			99.545
Sum of Parafins		4,936.64			5,339.24
% of Total		86.303			75.925
Sum of Aromatics		293.58			397.77
% of Total		5.132			5.656
Sum of Olefins		435.40			443.35
% of Total		7.612			6.304
% Ethanol is of Total HC		0.000			10.994
% Ethanol adjusted for FID Response is of Total HC					12.757
Sum of Unknowns		31.19			45.80
% of Total		0.545			0.651
Sum of Fused Rings		1.00			0.97
% of Total		0.017			0.014

Gasoline # 41033 Headspace@25C and Whole Gas Analyses					
Whole Gasoline Analysis					
NAME	VOC type	E0 Gasoline		E10 Gasoline	
		ppb	% of Total VOC	ppb	% of Total VOC
Propylene	o	0.550	0.005	0.490	0.005
Propane	p	0.680	0.006	0.640	0.006
Isobutane	p	2.170	0.019	2.160	0.021
Butene-1	o	1.396	0.012	1.380	0.013
Isobutylene	o	0.870	0.008	0.575	0.006
1,3-Butadiene	o	0.450	0.004	0.490	0.005
n-Butane	p	43.790	0.391	36.360	0.351
t-Butene-2	o	2.248	0.020	1.800	0.017
2,2-Dimethylpropane	p	1.202	0.011	0.970	0.009
c-Butene-2	o	2.760	0.025	2.270	0.022
3-Methyl-1-Butene	o	2.300	0.021	1.650	0.016
Ethanol	ox	0.000	0.000	601.970	7.731
Isopentane	p	1085.710	9.704	903.320	8.723
Pentene-1	o	13.330	0.119	10.770	0.104
2-Methyl-1-Butene	o	28.050	0.251	23.520	0.227
n-Pentane	p	192.770	1.723	160.060	1.546
Isoprene	o	0.600	0.005	0.430	0.004
trans-2-Pentene	o	42.090	0.376	35.140	0.339
Unknown	u	0.470	0.004	0.460	0.004
cis-2-Pentene	o	23.140	0.207	19.120	0.185
2-Methyl-2-Butene	o	68.840	0.615	56.350	0.544
2,2-Dimethylbutane	p	24.150	0.216	19.820	0.191
Cyclopentene	o	10.240	0.092	8.360	0.081
3-Methyl-1-pentene	o	6.350	0.057	4.890	0.047
Cyclopentane	p	19.010	0.170	15.520	0.150
2,3-Dimethylbutane	p	322.610	2.884	258.910	2.500
2-Methylpentane	p	290.040	2.592	232.290	2.243
3-Methylpentane	p	188.070	1.681	150.340	1.452
2-Methyl-1-Pentene + Hexene-1	o	16.370	0.146	13.650	0.132
n-Hexane	p	115.050	1.028	91.870	0.887
trans-3-Hexene	o	10.440	0.093	8.310	0.080
trans-2-Hexene	o	15.100	0.135	12.000	0.116
2-Methyl-2-Pentene	o	23.100	0.206	14.750	0.142
cis-3-Hexene	o	11.860	0.106	9.430	0.091
4-Methylcyclopentene	o	2.440	0.022	1.870	0.018
cis-2-Hexene	o	8.810	0.079	6.820	0.066
cis-3-Methyl-2-pentene	o	18.110	0.162	14.140	0.137
2,2-DiMethylpentane	p	8.580	0.077	6.470	0.062
Methylcyclopentane	p	114.310	1.022	90.990	0.879
2,4-Dimethylpentane	p	416.280	3.721	328.280	3.170
2,2,3-TriMethylbutane	p	13.600	0.122	10.100	0.098
2,4-DiMethyl-1-Pentene	o	0.900	0.008	0.780	0.008
1-Methylcyclopentene	o	14.230	0.127	10.460	0.101
Benzene	a	43.490	0.389	36.140	0.349
3,3-DiMethylpentane	p	9.730	0.087	7.950	0.077
Cyclohexane	p	23.880	0.213	19.510	0.188
4-Me-1-Hexene	o	1.240	0.011	1.430	0.014
2-Methylhexane	p	121.640	1.087	97.660	0.943
2,3-Dimethylpentane	p	781.810	6.988	622.010	6.006
1,1-DiMeCyclopentane	p	3.800	0.034	3.030	0.029
3-Methylhexane	p	127.490	1.140	102.130	0.986
5-Me-2-Hexene	o	1.270	0.011	0.950	0.009
c-1,3-DiMeCyclopentane	p	24.060	0.215	19.220	0.186
t-1,3-DiMeCyclopentane	p	33.910	0.303	27.110	0.262
2,2,4-TriMethylpentane	p	1454.670	13.002	1163.680	11.237
3-Me-3-Hexene	o	1.790	0.016	1.450	0.014
trans-3-Heptene	o	2.890	0.026	2.330	0.022
n-Heptane	p	83.300	0.745	68.520	0.662
trans-3-Heptene	o	11.360	0.102	8.960	0.087
Unknown	u	2.440	0.022	2.010	0.019
3-Ethyl-2-Pentene	o	1.560	0.014	1.220	0.012
3-Methyl-2-Hextene	o	3.090	0.028	2.560	0.025
2,4,4-TriMethyl-1-Pentene	o	3.140	0.028	2.720	0.026
cis-2-Heptene	o	2.500	0.022	1.942	0.019
MethylCyclohexane	p	47.670	0.426	38.930	0.376
Unknown	u	4.420	0.040	3.620	0.035
2,5-DiMethylhexane	p	177.140	1.583	146.080	1.411
2,4-DiMethylhexane + EthylCyclopentane	p	238.440	2.131	194.880	1.882
3,3-DiMethylhexane + 1,2,4-TriMeCyclopentane	p	9.740	0.087	7.990	0.077
ctc-1,2,3-TriMeCyclopentane	p	3.490	0.031	2.840	0.027

Gasoline # 41033 Headspace@25C and Whole Gas Analyses (continued)					
Whole Gasoline Analysis					
		E0 Gasoline		E10 Gasoline	
NAME	VOC type	ppb	% of Total VOC	ppb	% of Total VOC
2,3,4-TriMethylpentane	p	775.810	6.934	639.310	6.173
Toluene	a	1339.630	11.974	1109.480	10.713
2,3-DiMethylhexane	p	153.750	1.374	133.550	1.290
2-Methylheptane	p	36.440	0.326	30.590	0.295
4-MeHeptane	p	15.540	0.139	13.350	0.129
3,4-DiMethylhexane	p	31.520	0.282	26.630	0.257
3-Methylheptane	p	46.520	0.416	39.710	0.383
ctc-1,2,4-TriMeCyclopentane	p	6.940	0.062	6.150	0.059
t-1,4-DiMeCyclohexane	p	1.700	0.015	1.640	0.016
Unknown	u	282.200	2.522	237.980	2.298
1,1-DiMethylcyclohexane	p	4.290	0.038	3.940	0.038
Unknown	u	2.630	0.024	2.290	0.022
2,2,4-TriMethylhexane	p	6.200	0.055	5.300	0.051
Unknown	u	0.990	0.009	0.910	0.009
n-Octane	p	29.350	0.262	24.980	0.241
cis-2-Octene	o	6.710	0.060	5.740	0.055
Isopropylcyclopentane	p	1.040	0.009	0.900	0.009
2,3,5-TriMethylhexane	p	50.700	0.453	44.620	0.431
2,4-DiMethylheptane	p	7.980	0.071	6.930	0.067
2,6-DiMethylheptane	p	7.970	0.071	6.930	0.067
1c2-DiMethylcyclohexane n-Propylcyclopentane	p	2.090	0.019	1.820	0.018
2,5-DiMeHeptane	p	21.030	0.188	18.550	0.179
Unknown	u	3.310	0.030	2.780	0.027
1,1,4-TriMeCyclohexane	p	1.270	0.011	1.110	0.011
Ethylbenzene	a	106.170	0.949	95.190	0.919
ctt-1,2,4-TriMeCyclohexane	p	11.070	0.099	10.030	0.097
m- & p-Xylene	a	368.860	3.297	335.120	3.236
3-Methyloctane	p	11.280	0.101	10.340	0.100
ctc-1,2,4-TriMeCyclohexane	p	29.860	0.267	27.520	0.266
3,3-DiEthylpentane	p	6.450	0.058	6.140	0.059
o-Xylene	a	85.590	0.765	79.320	0.766
Nonene-1	o	26.390	0.236	23.810	0.230
1,1,2-TriMeCyclohexane	p	26.390	0.236	23.810	0.230
Nonane	p	7.090	0.063	6.900	0.067
trans-2-Nonene	o	17.540	0.157	16.400	0.158
Isopropylbenzene	a	24.030	0.215	23.670	0.229
3,5-DiMethyloctane	p	2.150	0.019	2.500	0.024
2,6-DiMethyloctane	p	6.550	0.059	6.450	0.062
n-Propylbenzene	a	61.570	0.550	64.280	0.621
m-Ethyltoluene	a	203.520	1.819	214.260	2.069
p-Ethyltoluene	a	87.280	0.780	93.290	0.901
1,3,5-TriMethylbenzene	a	111.050	0.993	119.840	1.157
3-Methylnonane	p	1.900	0.017	2.550	0.025
o-Ethyltoluene	a	73.670	0.658	79.500	0.768
1,2,4-TriMethylbenzene	a	285.760	2.554	321.300	3.103
n-Decane	p	10.610	0.095	11.860	0.115
Isobutylbenzene + 1-Me-2-Propylcyclohexane	a	5.960	0.053	6.870	0.066
sec-Butylbenzene	a	5.280	0.047	5.990	0.058
m-Cymene	a	7.010	0.063	8.510	0.082
1,2,3-TriMethylbenzene	a	51.460	0.460	61.020	0.589
Indane	n	14.230	0.127	16.620	0.160
m-Diethylbenzene	a		0.000		0.000
1,Me-3-n-Propylbenzene	a	44.380	0.397	57.420	0.554
n-Butylbenzene	a	31.470	0.281	42.860	0.414
1-Me-2-n-Propylbenzene	a	18.940	0.169	24.990	0.241
1,4-DiMe-2-Ethylbenzene	a	9.310	0.083	13.290	0.128
Unknown	u	8.680	0.078	12.220	0.118
1,2-DiMe-4-Ethylbenzene	a	15.070	0.135	22.170	0.214
1,3-DiMe-2-Ethylbenzene	a	1.190	0.011	1.910	0.018
n-Undecane	p	2.300	0.021	4.290	0.041
1,2-DiMe-3-Ethylbenzene	a	4.320	0.039	6.220	0.060
1,2,4,5-Tetra-Me-Benzene	a	7.150	0.064	11.130	0.107
Unknown	u	10.320	0.092	15.920	0.154
Unknown	u	3.870	0.035	6.550	0.063
Methylindane	n	2.960	0.026	4.600	0.044
n-Pentylbenzene + t-1-Me-2-(4MP)cyclohexane	a	2.610	0.023	4.350	0.042
Unknown	u	1.750	0.016	2.920	0.028
t-1-But-3,5-DiMeBenzene	a		0.000		0.000
Naphthalene	n	4.500	0.040	9.120	0.088
n-Dodecane	p	2.220	0.020	3.890	0.038

Summary Statistics on Whole Gasoline Profiles				
		GasE0 Whole		GasE10 Whole
NAME				
Sum of GC Peaks		11,038		10,039
Sum of ALL GC Peaks		11,189		10,221
%Sum of Peaks are of Total HC		98.654		98.221
Sum of Parafins		7,295.60		5,950.96
% of Total		65.203		58.224
Sum of Aromatics		2,994.77		2,838.12
% of Total		26.765		27.768
Sum of Olefins		405.26		329.93
% of Total		3.622		3.228
% Ethanol is of Total HC		0.000		5.890
% Ethanol adjusted for FID Response is of Total HC				7.264
Sum of Unknowns		321.08		287.66
% of Total		2.870		2.814
Sum of Fused Rings		21.69		30.34
% of Total		0.194		0.297

Calculated Profile for E0 Gasoline Headspace Based on E10 Profile

Compound	Profile 8737B	Compound (CONTINUED)	Profile 8737B
1-METHYLPROPYLBENZENE	0.012%	2,5-DIMETHYLHEXANE	0.227%
2-METHYLPROPYLBENZENE	0.009%	2,6-DIMETHYLHEPTANE	0.028%
1,1,2-TRIMETHYLCYCLOPENTANE	0.000%	2,6-DIMETHYLOCTANE	0.053%
1,1,3-TRIMETHYLCYCLOPENTANE	0.000%	2-BUTYNE	0.000%
1,1-DIMETHYLCYCLOHEXANE	0.002%	2-ETHYL-1-BUTENE	0.000%
1,1-DIMETHYLCYCLOPENTANE	0.002%	2-METHYL-1-BUTENE	0.478%
1,2,3,4-TETRAMETHYLBENZENE	0.000%	2-METHYL-1-PENTENE	0.090%
1,2,3,5-TETRAMETHYLBENZENE	0.000%	2-METHYL-2-BUTENE	0.833%
1,2,3-TRIMETHYLBENZENE	0.066%	2-METHYL-2-HEXENE	0.000%
1,2,3-TRIMETHYLCYCLOPENTANE	0.000%	2-METHYL-2-PENTENE	0.117%
1,2,4,5-TETRAMETHYLBENZENE	0.012%	2-METHYL-2-PROPENAL	0.000%
1,2,4-TRIMETHYLBENZENE	0.267%	2-METHYL-3-ETHYLPENTANE	0.001%
1,2,4-TRIMETHYLCYCLOPENTANE	0.019%	TRANS-2-METHYL-3-HEXENE	0.000%
1,2-DIETHYLBENZENE	0.000%	2-METHYLHEPTANE	0.174%
1,2-DIMETHYL-3-ETHYLBENZENE	0.008%	2-METHYLHEXANE	0.807%
1,2-DIMETHYL-4-ETHYLBENZENE	0.039%	2-METHYLOCTANE	0.043%
PROPADIENE	0.000%	2-METHYLPENTANE	4.607%
1,3,5-TRIMETHYLBENZENE	0.091%	3,3-DIMETHYL-1-BUTENE	0.000%
1,3-BUTADIENE	0.001%	3,3-DIMETHYLHEPTANE	0.000%
CYCLOPENTADIENE	0.000%	3,3-DIMETHYLHEXANE	0.055%
1,3-DIETHYLBENZENE	0.017%	3,3-DIMETHYLPENTANE	0.079%
1,3-DIMETHYL-2-ETHYLBENZENE	0.000%	3,4-DIMETHYLHEPTANE	0.000%
1,3-DIMETHYL-4-ETHYLBENZENE	0.000%	3,4-DIMETHYLHEXANE	0.045%
1,3-DIMETHYL-5-ETHYLBENZENE	0.000%	3,5-DIMETHYLHEPTANE	0.000%
1,4-DIETHYLBENZENE	0.057%	3,5-DIMETHYLOCTANE	0.003%
1,4-DIMETHYL-2-ETHYLBENZENE	0.025%	3,6-DIMETHYLOCTANE	0.003%
1-BUTENE	0.082%	3-ETHYL-2-PENTENE	0.000%
1-BUTYNE	0.000%	3-ETHYLHEXANE	0.000%
1-ETHYL-TERT-BUTYLETHER	0.000%	3-ETHYLPENTANE	0.235%
1-HEPTENE	0.000%	3-METHYL-1-BUTENE	0.114%
1-HEXENE	0.043%	3-METHYL-1-HEXENE	0.000%
1-METHYL-2-ETHYLBENZENE	0.070%	3-METHYL-1-PENTENE	0.058%
1-METHYL-2-ISOPROPYLBENZENE	0.000%	CIS-3-METHYL-2-HEXENE	0.000%
1-METHYL-2-N-BUTYLBENZENE	0.001%	3-METHYL-CIS-2-PENTENE	0.000%
1-METHYL-2-N-PROPYLBENZENE	0.025%	CIS-3-METHYL-3-HEXENE	0.000%
1-METHYL-2-TERT-BUTYLBENZENE	0.000%	3-METHYL-TRANS-2-PENTENE	0.000%
1-METHYL-3-ETHYLBENZENE	0.189%	3-METHYL-TRANS-3-HEXENE	0.000%
1-METHYL-3-ISOPROPYLBENZENE	0.018%	3-METHYLCYCLOPENTENE	0.002%
1-METHYL-3-N-PROPYLBENZENE	0.037%	3-METHYLHEPTANE	0.194%
1-METHYL-4-ETHYLBENZENE	0.073%	3-METHYLHEXANE	0.794%
1-METHYL-4-ISOPROPYLBENZENE	0.010%	3-METHYLNONANE	0.017%
1-METHYL-4-NPROPYLBENZENE	0.000%	3-METHYLOCTANE	0.052%
1-METHYLCYCLOPENTENE	0.045%	3-METHYLPENTANE	2.510%
1-NONENE	0.000%	4,4-DIMETHYL-2-PENTENE	0.000%
1-OCTENE	0.000%	4,4-DIMETHYLHEPTANE	0.004%
1-PENTENE	0.270%	4-METHYL-1-HEXENE	0.007%
1-PROPYNE	0.000%	4-METHYL-1-PENTENE	0.000%
2,2,3-TRIMETHYLBUTANE	0.039%	4-METHYL-CIS-2-PENTENE	0.000%
2,2,3-TRIMETHYLPENTANE	0.000%	4-METHYL-TRANS-2-PENTENE	0.000%
2,2,4-TRIMETHYLHEXANE	0.036%	4-METHYLHEPTANE	0.083%
2,2,4-TRIMETHYLPENTANE	2.542%	4-METHYLOCTANE	0.000%
2,2,5-TRIMETHYLHEXANE	0.000%	TRANS-5-METHYL-2-HEXENE	0.000%
2,2-DIMETHYLBUTANE	1.383%	ACETALDEHYDE	0.000%
2,2-DIMETHYLHEXANE	0.000%	ACETONE	0.000%
2,2-DIMETHYLOCTANE	0.000%	ACETYLENE	0.000%
2,2-DIMETHYLPENTANE	0.072%	ACROLEIN	0.000%
2,2-DIMETHYLPROPANE	0.025%	BENZALDEHYDE	0.000%
2,3,3-TRIMETHYLPENTANE	0.000%	BENZENE	1.202%
2,3,4-TRIMETHYLPENTANE	0.723%	N-BUTYRALDEHYDE	0.000%
2,3,5-TRIMETHYLHEXANE	0.034%	C10H20	0.000%
2,3-DIMETHYL-2-BUTENE	0.000%	C11H16	0.000%
2,3-DIMETHYLBUTANE	1.667%	UNIDENTIFIED C9-C12+	0.000%
2,3-DIMETHYLHEPTANE	0.000%	CIS,TRANS-1,2,4-TRIMETHYLCYCL	0.001%
2,3-DIMETHYLHEXANE	0.203%	CIS-1,2-DIMETHYLCYCLOHEXANE	0.025%
2,3-DIMETHYLPENTANE	0.597%	Cis-1,3-DIMETHYLCYCLOHEXANE	0.000%
2,4,4-TRIMETHYL-1-PENTENE	0.014%	CIS-1,3-DIMETHYLCYCLOPENTAN	0.174%
2,4,4-TRIMETHYL-2-PENTENE	0.000%	1-CIS,2-TRANS,3-TRIMETHYLCYCL	0.005%
2,4-DIMETHYL-1-PENTENE	0.005%	CIS-1,TRANS-2,4-TRIMETHYLCYCL	0.008%
2,4-DIMETHYLHEPTANE	0.032%	CIS-1,TRANS-2,TRANS-4-TRIMETH	0.003%
2,4-DIMETHYLHEXANE	0.413%	1-CIS-2-DIMETHYLCYCLOPENTAN	0.000%
2,4-DIMETHYLOCTANE	0.000%	CIS-1-ETHYL-3-METHYLCYCLOPE	0.000%
2,4-DIMETHYLPENTANE	0.650%	CIS-2-BUTENE	0.208%
2,5-DIMETHYLHEPTANE	0.063%	Cis-2-HEPTENE	0.009%

Compound	Profile 8737B	Compound	Profile 8737E
Cis-2-OCTENE	0.002%	TRANS-4-OCTENE	0.000%
CIS-2-PENTENE	0.327%	HEXALDEHYDE	0.000%
CIS-3-HEXENE	0.055%	VALERALDEHYDE	0.000%
CROTONALDEHYDE	0.000%	P-METHYLSTYRENE	0.000%
CYCLOHEXANE	0.228%	NONANAL	0.000%
CYCLOHEXENE	0.000%	OCTANAL	0.000%
CYCLOPENTANE	0.577%	1-UNDECENE	0.004%
CYCLOPENTENE	0.119%	1-BUTENE+ ISOBUTENE	0.000%
ETHANE	0.056%	1,3-HEXADIENE (TRANS)	0.000%
ETHANOL	0.124%	3-METHYL-2-PENTENE	0.097%
ETHYLBENZENE	0.273%	PROPYLTOLUENE	0.000%
ETHYLCYCLOHEXANE	0.000%	O-TOLUALDEHYDE	0.000%
ETHYLCYCLOPENTANE	0.000%	ISOPROPYLCYCLOPENTANE	0.000%
ETHYLENE	0.000%	C11H14	0.000%
FORMALDEHYDE	0.000%	3-ETHYLPENTENE	0.050%
INDAN	0.037%	DANITOL	0.049%
ISOBUTANE	5.357%	2-BUTENE	0.192%
2-METHYLPROPENE (ISOBUTYLENE)	0.090%	METHYLINDANE	0.031%
M-& P-XYLENE	0.997%	CIS-2-NONENE	0.000%
2-METHYLBUTANE (ISOPENTANE)	27.821%	T-1-BUTYL-2-METHYLBENZENE	0.000%
ISOPRENE	0.022%	2,5-DIMETHYLBENZALDEHYDE	0.000%
2-PROPANOL	0.000%	P-DIETHYLBENZENE &N-BUTYLBEN	0.003%
ISOPROPYLBENZENE (CUMENE)	0.046%	4-METHYLCYCLOPENTENE	0.004%
ISOPROPYLCYCLOHEXANE	0.000%	C10H12	0.000%
ISOVALERALDEHYDE	0.000%	C11H24	0.000%
METHANE	0.000%	C12H26	0.000%
METHANOL	0.000%	2-OCTENE	0.000%
MEK	0.000%	C-3-HEXENE	0.000%
O-METHYLSTYRENE	0.000%	UNIDENTIFIED C6	0.000%
MTBE	0.000%	C6H8	0.000%
METHYLCYCLOHEXANE	0.298%	UNIDENTIFIED C7	0.000%
METHYLCYCLOPENTANE	1.150%	C7H14	0.000%
N-BUTANE	22.649%	C8H14	0.000%
N-BUTYLBENZENE	0.000%	C9H18	0.000%
N-BUTYLCYCLOPENTANE	0.000%	1,5-DIMETHYLCYCLOPENTENE	0.000%
N-DECANE	0.063%	ETHYLCYCLOPENTENE	0.000%
N-DODECANE	0.023%	ISOBUTYRALDEHYDE	0.000%
N-HEPTANE	0.494%	CAMPHERE	0.000%
N-HEXANE	1.684%	METHYLBENZALDEHYDE	0.000%
N-NONANE	0.073%	METHYLCYCLOHEXENE	0.000%
N-OCTANE	0.153%	PENTADIENE	0.000%
N-PENTANE	7.187%	PIPERYLENE	0.000%
N-PENTYLBENZENE	0.000%	1-TERT-BUTYL-3,5-DIMETHYLBEN	0.001%
N-PROPYLBENZENE	0.067%	UNKNOWN	0.000%
N-TRIDECANE	0.000%		
N-UNDECANE	0.040%		
NAPHTHALENE	0.027%		
O-XYLENE	0.312%		
C10H22	0.000%		
C7H12	0.000%		
C8H16	0.000%		
PROPANE	0.342%		
PROPIONALDEHYDE	0.000%		
PROPYLCYCLOHEXANE	0.004%		
N-PROPYLCYCLOPENTANE	0.001%		
PROPYLENE	0.013%		
STYRENE	0.000%		
TOLUALDEHYDE	0.000%		
TOLUENE	2.918%		
TRANS-1,2-DIMETHYLCYCLOHEXANE	0.000%		
TRANS-1,2-DIMETHYLCYCLOPENTANE	0.000%		
TRANS-1,3-DIMETHYLCYCLOHEXANE	0.000%		
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.016%		
TRANS-1,3-PENTADIENE	0.000%		
TRANS-1,4-DIMETHYLCYCLOHEXANE	0.003%		
TRANS-1-ETHYL-3-METHYLCYCLOPENTANE	0.000%		
TRANS-2-BUTENE	0.043%		
TRANS-2-HEPTENE	0.000%		
TRANS-2-HEXENE	0.099%		
TRANS-2-OCTENE	0.003%		
TRANS-2-PENTENE	0.641%		
TRANS-3-HEPTENE	0.013%		
TRANS-3-HEXENE	0.081%		
TRANS-3-NONENE	0.000%		