Organic Gas Speciation Profiles for

Gasoline-Powered Vehicle Hot Soak Evaporations—E6 Fuel (OG2305 & OG2306)

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1 Introduction

Hot soak evaporative losses are produced as fuel evaporates are emitted from a vehicle after a hot engine is turned off, as a result of heating of the fuel tank and fuel system above ambient temperatures. In the current CARB emission inventory, the profiles assigned to the hot soak emissions categories are liquid gasoline profiles for some years when the hot soak profiles are missing. For example, OG681 (E6 summer gasoline) is currently used to describe the hot soak emissions for summers of 2004 through 2009; and OG682 (E6 winter gasoline) is used for the winter seasons. Since the data of hot soak tests are available recently, it is necessary to generate the specific organic gas speciation profiles for hot soak evaporations.

This memo addresses the development of two new speciation profiles for hot soak evaporations for gasoline-powered vehicle running on E6 fuel, OG2305 (for summer) and OG2306 (for winter). The proposed profiles are generated based on the hot soak SHED (Sealed Hosing for Evaporation Emission Determination) tests performed as part of the Seventeenth CARB Vehicle Surveillance Program (VSP-17) conducted in 2005 and 2006 at CARB Haggen-Smit laboratory in El Monte, California. The new speciation profiles will be used to replace the current profiles, OG681 and OG682, for the hot soak and running losses categories (Appendix 1) for calendar years 2004 to 2009, during which period E6 fuel was used in California.

2 Methodology

The VSP-17 was conducted by CARB staff to measure criteria pollutant emissions and speciated TOG emissions for vehicles representative of the California vehicle fleet after the transition to ethanol-containing fuels from MTBE-containing fuels in 2005 and 2006. The test vehicles were fueled with E6 gasoline, including summer grade and winter grade. Hot soak emissions generally occur during the one-hour period after the engine is shut down and they were measured by the SHED tests in the VSP-17 program.

The C_2-C_{12} hydrocarbons collected in the Tedlar bags from the SHED were analyzed by using gas chromatography (MLD Methods 1002/1003) [1, 2]. The methanol and ethanol in the samples were collected by flowing exhaust through deionized water contained in glass impingers and the solutions were analyzed by gas chromatography (MLD Method 1001) [3]. Over one hundred organic compounds were detected in the hot soak samples.

The speciation profile for each test vehicle was obtained by dividing the emissions of each species by the total emissions of all measured species. The new profile OG2305 (for summer) was composited by averaging the fifteen valid speciation profiles developed from individual tests of vehicles running on summer-grade E6 fuel; and the new profile OG2306 (for winter) was composited by averaging the eighteen valid individual speciation profiles for vehicles running on winter-grade E6 fuel.

3 Results

The details of profiles OG2305 (for E6 summer) and OG2306 (for E6 winter) are tabulated in Appendix 2. The ratios of TOG/THC (total organic gases/total hydrocarbon) are 1.263 for OG2305 and 1.142 for OG2306. This ratio can be used to convert THC emission mass to actual weight TOG. The ROG/TOG ratios are 0.9598 and 0.9610 for OG2305 and OG2306, respectively.

- **Summer hot soak profile (OG2305) vs. winter hot soak profile (OG2306)**

The most abundant species in the two hot soak profiles is ethanol. Figure 1 shows a much higher percentage of ethanol in the summer profile (OG2305) than that in the winter profile (OG2306): 32.3% vs. 18.7%. Methanol is higher in the summer profile, too. The differences in alcohol contents between seasons are probably resulted from the increase of ambient temperature in summer. Toluene is about 10% in the summer profiles, a little higher than in the winter profile (8.3%). However, the weight percentage of butane is much lower in the summer hot soak profile (OG2305) than in the winter one (OG2306) (Figure 1). This is consistent with what was observed in the start exhaust profiles (OG2301 & OG2302) and running exhaust profiles (OG2302 & OG2304). This is caused by the lower butane content in the summer fuel (OG681) than in the winter fuel (OG682), due to the requirement of Reid Vapor Pressure (RVP) change.

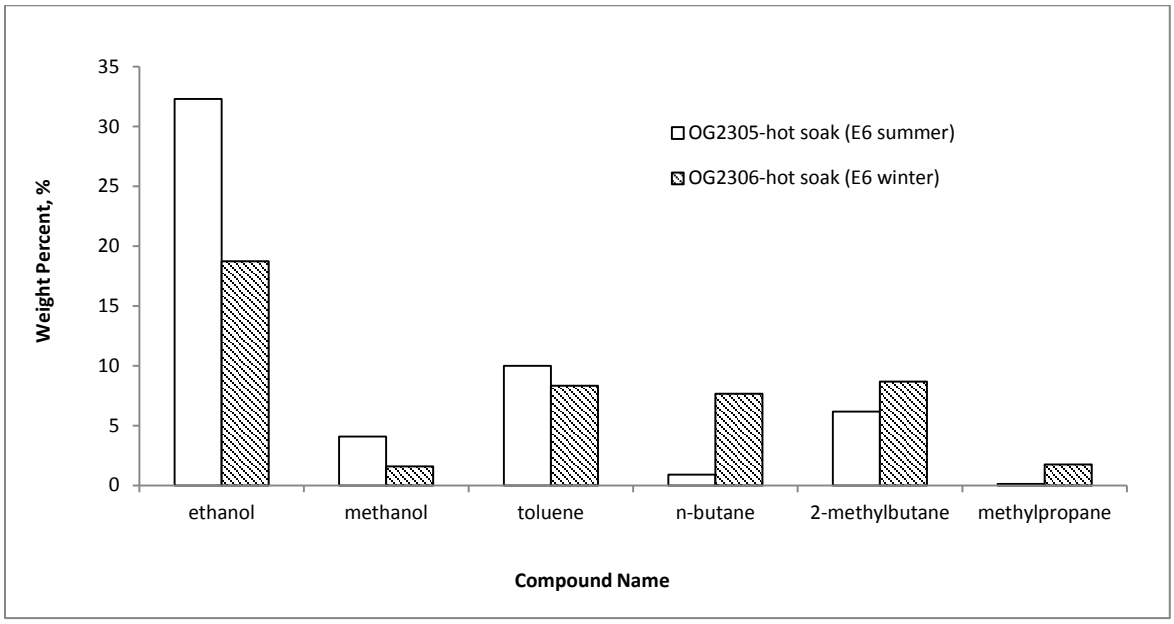

Figure 1. Comparison of selected species between OG2305 and OG2306

- **Hot soak profiles (OG2305 & OG2306) vs. current fuel profiles (OG681 & OG682)**

As mentioned earlier, the current profiles used for hot soak and running evaporations for 2004 through 2009 is OG681 (for summer) and OG682 (for winter). These two liquid gasoline profiles are used for hot soak and running losses emissions when the hot soak profiles are not available. Compared with the fuel profiles (OG681 and OG682), the hot soak profiles (OG2305 and OG2306) have much higher alcohol contents: 18.7-32.3% vs. 6.0-6.3% for ethanol, and 1.6-4.1% vs. zero for methanol. There is also about 4% of methane in the hot soak profiles but none has been detected in the fuel tests.

4 Estimated Impacts of the Profile Update on the Emission Inventory

The newly-developed profiles, OG2305 will replace the current profile OG681 for summer and OG2306 will replace OG682 for winter, for categories associated with on-road gasoline vehicle hot soak and running losses for years 2004 through 2009 as E6 fuel was in use during this time period. The summer profile (OG2305) will be used during the months of RVP regulatory control periods; while the winter profile (OG2306) will be used for the rest months of the year. It should be noted that the control period varies for different air basins [4]. The related EIC/SCC codes for these emission processes are summarized in Appendix 1.

Based on CEPAM [5] data (California 2016 Ozone SIP Baseline Emission Projection, Version 1.00), statewide 2008 annual average TOG emissions of the hot soak profile associated categories are 201.08 tons/day, which is 3.23% of the grand total statewide TOG emissions [5]. According to the ROG/TOG ratios derived from the new profiles OG2305 and OG2306, the statewide 2008 ROG emissions will be 4.36% and 4.24% lower than the ROG estimated based on the current profiles OG681 (ROG/TOG=1.0000) and OG682 (ROG/TOG=1.0000) for summer and winter, respectively. The ozone forming potentials (OFP) calculated based on the SAPRC07 mechanism [6] are 2.81 for OG2305 and 3.02 for OG2306, which are lower than the ones estimated by using the currently in-use profiles (3.05 for OG681, and 3.16 for OG682). However, the use of the new hot soak profiles OG2305 (for summer) will result in 77.33% more benzene emissions and 22.43% more toluene emissions; the use of OG2306 (for winter) will increase the estimated benzene emissions by 31.28% and toluene emissions by 8.98% (Table 1).

Table 1.Changes in 2008 emissions of organic gas species for gasoline-vehicle hot soak and running losses categories

(a) OG2305 (New hot soak) vs. OG681 (Current liquid fuel)

Statewide Annual Ave. Emissions		*OG681 [Current profile] (tons/day)*	*OG2305 [New profile] (tons/day)*	*Change*	
				Emission (tons/day)	*Percentage*
ROG		201.80	193.00	-8.80	-4.36%
Ozone forming potential, MIR (g O3/g ORG)		3.05	2.81	-0.24	-7.87%
Toxics	Benzene	1.72	3.05	+1.33	+77.33%
	Toluene	16.41	20.09	+3.68	+22.43%

(b) OG2306 (New hot soak) vs. OG682 (Current liquid fuel)

Statewide Annual Ave. Emissions		*OG682 [Current profile] (tons/day)*	*OG2306 [New profile] (tons/day)*	*Change*	
				Emission (tons/day)	*Percentage*
ROG		201.80	193.24	-8.56	-4.24%
Ozone forming potential, MIR (g O3/g ORG)		3.16	3.02	-0.14	-4.43%
Toxics	Benzene	1.79	2.35	+0.56	+31.28%
	Toluene	15.37	16.75	+1.38	+8.98%

5 Version Control

This section will be completed after management approval and after the CEIDARS FRACTION table and ORGPROFILE table are updated. Version information from CEIDARS FRACTION table will be copied here.

References:

1. *Method 1002: Determination of C_2 to C_5 Hydrocarbons in Automotive Source Samples by Gas Chromatography* in *Part D of California Non-methane Organic Gas Test Procedures*. 2002, California Air Resources Board: El Monte, California.
2. *Method 1003: Determination of C_6 to C_{12} Hydrocarbons in Automotive Source Samples by Gas Chromatography* in *Part E of California Non-methane Organic Gas Test Procedures*. 2002, California Air Resources Board: El Monte, California.
3. *Method 1001: Determination of Alcohols in Automotive Source Samples by Gas Chromatography* in *Part C of California Non-methane Organic Gas Test Procedures*. 2002, California Air Resources Board: El Monte, California.
4. *Title 13, California Code of Regulations, The California Reformulated Gasoline Regulations, Sections 2250-2273.5*.
5. *CEPAM*, 2014, California Air Resources Board.
6. *Titel 17, California Code of Regulations, Division 3, Chapter 1, Subchapter 8.6, Article 1. Maximum Incremental Reactivity Values, Sections 94700-94701*.

Appendix 1. EICs/SCCs to be associated with hot soak speciation profiles.

EIC/SCC	*Category Name*
6	EMFAC/DTIM-HOT SOAK-GASOLINE-ALL VEHICLES
9	EMFAC/DTIM-RUNNING EVAPORATIVES-GASOLINE-ALL VEHICLES
206	EMFAC/DTIM-HOT SOAK-GASOLINE-LIGHT-MED DUTY (LMV)
209	EMFAC/DTIM-RUNNING EVAPS-GASOLINE-LIGHT-MED DUTY (LMV)
306	EMFAC/DTIM-HOT SOAK-GASOLINE-HEAVY DUTY VEH (HDV)
309	EMFAC/DTIM-RUNNING EVAPORATIVES-GASOLINE-HEAVY DUTY VEH (HDV)
46508	LIGHT DUTY PASSENGER-HOT SOAK-1000 VEHICLE TRIPS
47506	LIGHT DUTY TRUCKS-HOT SOAK-1000 VEHICLE TRIPS
48025	MOTORCYCLES-HOT SOAK--1000 VEHICLE TRIPS
48041	HD GAS TRUCKS-HOT SOAK-1000 VEHICLE TRIPS
54239	MEDIUM DUTY TRUCKS-HOT SOAK-1000 VEHICLE TRIPS
82693	LIGHT DUTY PASSENGER-CAT HOT SOAK--1000 VEHICLE TRIPS
82701	LIGHT DUTY PASSENGER-NON-CAT HOT SOAK--1000 VEHICLE TRIPS
82719	LIGHT/MEDIUM TRUCKS-CAT HOT SOAK--1000 VEHICLE TRIPS
82727	LIGHT/MEDIUM TRUCKS-NON-CAT HOT SOAK--1000 VEHICLE TRIPS
83113	HEAVY GAS TRUCKS-NON-CAT HOT SOAK--1000 VEHICLE TRIPS
83162	HEAVY GAS TRUCKS-CAT HOT SOAK--1000 VEHICLE TRIPS
83386	LIGHT DUTY PASSENGER-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
83394	LIGHT DUTY PASSENGER-NON-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
83402	LIGHT/MEDIUM TRUCKS-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
83410	LIGHT/MEDIUM TRUCKS-NON-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
83428	HD GAS TRUCKS-NON-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
83436	HD GAS TRUCKS-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
83444	MOTORCYCLES-RUNNING EVAP--1000 VEHICLE MILES TRAVEL
84087	LT. DUTY TRUCKS-1-NON-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
84103	LT. DUTY TRUCKS-1-NON-CAT HOT SOAK--1000 VEHICLE TRIPS
84178	LT. DUTY TRUCKS-1-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
84194	LT. DUTY TRUCKS-1-CAT HOT SOAK--1000 VEHICLE TRIPS
84293	MEDIUM TRUCKS-NON-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
84319	MEDIUM TRUCKS-NON-CAT HOT SOAK--1000 VEHICLE TRIPS
84384	MEDIUM TRUCKS-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
84400	MEDIUM TRUCKS-CAT HOT SOAK--1000 VEHICLE TRIPS
84459	LT.HVY.DTY TRUCKS-1-NON-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
84475	LT.HVY.DTY TRUCKS-1-NON-CAT HOT SOAK--1000 VEHICLE TRIPS
84533	LT.HVY.DTY TRUCKS-1-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
84558	LT.HVY.DTY TRUCKS-1-CAT HOT SOAK--1000 VEHICLE TRIPS
84608	MED HVY GAS TRUCKS-NON-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
84624	MED HVY GAS TRUCKS-NON-CAT HOT SOAK--1000 VEHICLE TRIPS
84681	MED HVY GAS TRUCKS-CAT RUNNING EVAP--1000 VEHICLE MILES TRAVEL
84707	MED HVY GAS TRUCKS-CAT HOT SOAK--1000 VEHICLE TRIPS
86157	LT. DUTY TRUCKS-2-NON-CAT EVAPORA-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
86173	LT. DUTY TRUCKS-2-NON-CAT HOT SOA--1000 VEHICLE TRIPS
86249	LT. DUTY TRUCKS-2-CAT EVAPORATIVE-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
86264	LT. DUTY TRUCKS-2-CAT HOT SOAK--1000 VEHICLE TRIPS
86462	LT.HVY.DTY TRUCKS-2-NON-CAT EVAPORA-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL

EIC/SCC	*Category Name*
86488	LT.HVY.DTY TRUCKS-2-NON-CAT HOT SOA--1000 VEHICLE TRIPS
86561	LT.HVY.DTY TRUCKS-2-CAT EVAPORATIVE-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
86587	LT.HVY.DTY TRUCKS-2-CAT HOT SOAK--1000 VEHICLE TRIPS
86694	HEAVY HEAVY DUTY GAS-NON-CAT EVAPORA-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
86710	HEAVY HEAVY DUTY GAS-NON-CAT HOT SOA--1000 VEHICLE TRIPS
86793	HEAVY HEAVY DUTY GAS-CAT EVAPORATIVE-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
86819	HEAVY HEAVY DUTY GAS-CAT HOT SOAK--1000 VEHICLE TRIPS
86983	MOTORCYCLES(MCY)-CAT EVAPORATIVE-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
87007	MOTORCYCLES(MCY)-CAT HOT SOAK--1000 VEHICLE TRIPS
87072	HEAVY DUTY GAS URBAN-NON-CAT EVAPORA-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
87098	HEAVY DUTY GAS URBAN-NON-CAT HOT SOA--1000 VEHICLE TRIPS
87163	HEAVY DUTY GAS URBAN-CAT EVAPORATIVE-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
87189	HEAVY DUTY GAS URBAN-CAT HOT SOAK--1000 VEHICLE TRIPS
87247	SCHOOL BUSES(SB)-NON-CAT EVAPORA-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
87262	SCHOOL BUSES(SB)-NON-CAT HOT SOA--1000 VEHICLE TRIPS
87338	SCHOOL BUSES(SB)-CAT EVAPORATIVE-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
87353	SCHOOL BUSES(SB)-CAT HOT SOAK--1000 VEHICLE TRIPS
87452	MOTOR HOMES (MH)-NON-CAT EVAPORA-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
87478	MOTOR HOMES (MH)-NON-CAT HOT SOA--1000 VEHICLE TRIPS
87544	MOTOR HOMES (MH)-CAT EVAPORATIVE-RUNNING LOSSES-1000 VEHICLE MILES TRAVEL
87569	MOTOR HOMES (MH) -CAT HOT SOAK--1000 VEHICLE TRIPS
71070811000000	LIGHT DUTY PASSENGER (LDA)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
71071211000000	LIGHT DUTY PASSENGER (LDA)-NON-CAT HOT SOAK-GASOLINE
71073611000000	LIGHT DUTY PASSENGER (LDA)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
71074011000000	LIGHT DUTY PASSENGER (LDA)-CAT HOT SOAK-GASOLINE
72070811000000	LIGHT AND MEDIUM DUTY TRUCKS-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
72071211000000	LIGHT AND MEDIUM DUTY TRUCKS-NON-CAT HOT SOAK-GASOLINE
72073611000000	LIGHT AND MEDIUM DUTY TRUCKS-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
72074011000000	LIGHT AND MEDIUM DUTY TRUCKS-CAT HOT SOAK-GASOLINE
72270811000000	LIGHT DUTY TRUCKS-1 (LDT1)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
72271211000000	LIGHT DUTY TRUCKS-1 (LDT1)-NON-CAT HOT SOAK-GASOLINE
72273611000000	LIGHT DUTY TRUCKS-1 (LDT1)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
72274011000000	LIGHT DUTY TRUCKS-1 (LDT1)-CAT HOT SOAK-GASOLINE
72370811000000	LIGHT DUTY TRUCKS-2 (LDT2)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
72371211000000	LIGHT DUTY TRUCKS-2 (LDT2)-NON-CAT HOT SOAK-GASOLINE
72373611000000	LIGHT DUTY TRUCKS-2 (LDT2)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
72374011000000	LIGHT DUTY TRUCKS-2 (LDT2)-CAT HOT SOAK-GASOLINE
72470811000000	MEDIUM DUTY TRUCKS (MDV)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
72471211000000	MEDIUM DUTY TRUCKS (MDV)-NON-CAT HOT SOAK-GASOLINE
72473611000000	MEDIUM DUTY TRUCKS (MDV)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
72474011000000	MEDIUM DUTY TRUCKS (MDV)-CAT HOT SOAK-GASOLINE
73070811000000	HEAVY DUTY GAS TRUCKS (ALL)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
73071211000000	HEAVY DUTY GAS TRUCKS (ALL)-NON-CAT HOT SOAK-GASOLINE
73073611000000	HEAVY DUTY GAS TRUCKS (ALL)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
73074011000000	HEAVY DUTY GAS TRUCKS (ALL)-CAT HOT SOAK-GASOLINE
73270811000000	LIGHT HEAVY DUTY GAS TRUCKS-1 (LHDV1)-NON-CAT EVAP RUNNING LOSSES-GASOLINE
73271211000000	LIGHT HEAVY DUTY GAS TRUCKS-1 (LHDV1)-NON-CAT HOT SOAK-GASOLINE

EIC/SCC	*Category Name*
73273611000000	LIGHT HEAVY DUTY GAS TRUCKS-1 (LHDV1)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
73274011000000	LIGHT HEAVY DUTY GAS TRUCKS-1 (LHDV1)-CAT HOT SOAK-GASOLINE
73370811000000	LIGHT HEAVY DUTY GAS TRUCKS-2 (LHDV2)-NON-CAT EVAP RUNNING LOSSES-GASOLINE
73371211000000	LIGHT HEAVY DUTY GAS TRUCKS-2 (LHDV2)-NON-CAT HOT SOAK-GASOLINE
73373611000000	LIGHT HEAVY DUTY GAS TRUCKS-2 (LHDV2)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
73373611000000	LIGHT HEAVY DUTY GAS TRUCKS-2 (LHDV2)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
73374011000000	LIGHT HEAVY DUTY GAS TRUCKS-2 (LHDV2)-CAT HOT SOAK-GASOLINE
73470811000000	MEDIUM HEAVY DUTY GAS TRUCKS (MHDV)-NON-CAT EVAP RUNNING LOSSES-GASOLINE
73471211000000	MEDIUM HEAVY DUTY GAS TRUCKS (MHDV)-NON-CAT HOT SOAK-GASOLINE
73473611000000	MEDIUM HEAVY DUTY GAS TRUCKS (MHDV)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
73474011000000	MEDIUM HEAVY DUTY GAS TRUCKS (MHDV)-CAT HOT SOAK-GASOLINE
73670811000000	HEAVY HEAVY DUTY GAS TRUCKS (HHDV)-NON-CAT EVAP RUNNING LOSSES-GASOLINE
73671211000000	HEAVY HEAVY DUTY GAS TRUCKS (HHDV)-NON-CAT HOT SOAK-GASOLINE
73673611000000	HEAVY HEAVY DUTY GAS TRUCKS (HHDV)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
73674011000000	HEAVY HEAVY DUTY GAS TRUCKS (HHDV)-CAT HOT SOAK-GASOLINE
75070811000000	MOTORCYCLES (MCY)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
75071211000000	MOTORCYCLES (MCY)-NON-CAT HOT SOAK-GASOLINE
75073611000000	MOTORCYCLES (MCY)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
75074011000000	MOTORCYCLES (MCY)-CAT HOT SOAK-GASOLINE
76270811000000	HEAVY DUTY GAS URBAN BUSES (UB)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
76271211000000	HEAVY DUTY GAS URBAN BUSES (UB)-NON-CAT HOT SOAK-GASOLINE
76273611000000	HEAVY DUTY GAS URBAN BUSES (UB)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
76274011000000	HEAVY DUTY GAS URBAN BUSES (UB)-CAT HOT SOAK-GASOLINE
77070811000000	SCHOOL BUSES (SB)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
77071211000000	SCHOOL BUSES (SB)-NON-CAT HOT SOAK-GASOLINE
77073611000000	SCHOOL BUSES (SB)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
77074011000000	SCHOOL BUSES (SB)-CAT HOT SOAK-GASOLINE
77170811000000	SCHOOL BUSES-GAS (SBG)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
77171211000000	SCHOOL BUSES-GAS (SBG)-NON-CAT HOT SOAK-GASOLINE
77173611000000	SCHOOL BUSES-GAS (SBG)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
77174011000000	SCHOOL BUSES-GAS (SBG)-CAT HOT SOAK-GASOLINE
77670811000000	OTHER BUSES (OB)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
77671211000000	OTHER BUSES (OB)-NON-CAT HOT SOAK-GASOLINE
77673611000000	OTHER BUSES (OB)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
77674011000000	OTHER BUSES (OB)-CAT HOT SOAK-GASOLINE
77770811000000	OTHER BUSES-GAS (OBG)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
77771211000000	OTHER BUSES-GAS (OBG)-NON-CAT HOT SOAK-GASOLINE
77773611000000	OTHER BUSES-GAS (OBG)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
77774011000000	OTHER BUSES-GAS (OBG)-CAT HOT SOAK-GASOLINE
78070811000000	MOTOR HOMES (MH)-NON-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
78071211000000	MOTOR HOMES (MH)-NON-CAT HOT SOAK-GASOLINE
78073611000000	MOTOR HOMES (MH)-CAT EVAPORATIVE RUNNING LOSSES-GASOLINE
78074011000000	MOTOR HOMES (MH)-CAT HOT SOAK-GASOLINE

Appendix 2. OG speciation profiles for hot soak evaporations from gasoline-powered vehicles burning E6 fuels

Species Name	*SAROAD*	*Weight Percentage, %*	
		OG2305 Gasoline-Powered Vehicle Hot Soak (Summer-Grade E6)	*OG2306 Gasoline-Powered Vehicle Hot Soak (Winter-Grade E6)*
(1a,2a,3b)-1,2,3-trimethylcyclopentane	91038	0.007916	0.025709
(1-methylethyl)benzene	98043	0.004576	0.034329
(2-methylpropyl)benzene	45235	0.052912	0.006021
1-(1,1-dimethylethyl)-2-methylbenzene	45244		0.043118
1-(1,1-dimethylethyl)-3,5-dimethylbenzene	45256		0.012255
1,2,3,4-tetramethylbenzene	91109		0.031499
1,2,3,5-tetramethylbenzene	91104		0.082355
1,2,3-trimethylbenzene	45225	0.275033	0.529219
1,2,4,5-tetramethylbenzene	91103		0.053865
1,2,4-trimethylbenzene	45208	1.294377	1.943012
1,2,4-trimethylcyclopentane	43400	0.014136	0.060939
1,2-butadiene	43221		0.384079
1,2-diethylbenzene	98154		0.047834
1,2-dimethyl-3-ethylbenzene	45254		0.098491
1,2-dimethyl-4-ethylbenzene	45252		0.128101
1,3,5-trimethylbenzene	45207	0.489941	0.577860
1,3,5-trimethylcyclohexane	98061		0.013773
1,3-butadiene	43218	0.036839	0.001963
1,3-diethylbenzene	45113	0.013272	0.075459
1,3-dimethyl-2-ethylbenzene	45253	0.005554	0.054385
1,3-dimethyl-4-ethylbenzene	45251		0.060612
1,3-dimethyl-5-ethylbenzene	45257	0.041699	0.137638
1,3-di-n-propylbenzene	45237		0.021038
1,4-diethylbenzene	45114		0.101493
1,4-dimethyl-2-ethylbenzene	45250	0.032866	0.178389
1-butene	43213		0.118258
1-ethyl-2-n-propylbenzene	98179		0.022600
1-ethyl-tert-butyl-ether	99998		0.018161
1-hexene	43245	0.010185	0.029194
1-methyl-2-(1-methylethyl)benzene	91096		0.143540
1-methyl-2-ethylbenzene	99915	0.288364	0.240908
1-methyl-2-n-butylbenzene	45243		0.000653
1-methyl-2-n-propylbenzene	98178	0.014554	0.072088
1-methyl-3-(1-methylethyl)benzene	98153		0.006486
1-methyl-3-ethylbenzene	99912	0.918672	1.168654
1-methyl-3-n-propylbenzene	98152	0.202037	0.203052
1-methyl-4-(1-methylethyl)benzene	91094	0.084344	0.014101
1-methyl-4-ethylbenzene	99914	0.476002	0.593008

Species Name	*SAROAD*	*Weight Percentage, %*	
		OG2305 Gasoline-Powered Vehicle Hot Soak (Summer-Grade E6)	*OG2306 Gasoline-Powered Vehicle Hot Soak (Winter-Grade E6)*
1-methyl-4-ethylcyclohexane	92001	0.010720	0.063582
1-methyl-4-n-propylbenzene	98182	0.010065	0.007822
1-methylcyclopentene	92000	0.017659	0.020830
1-nonene	43267		0.008096
1-octene	43265		0.012330
1-pentene	43224	0.195556	0.191008
2,2,3-trimethylbutane	43160		0.005539
2,2,4-trimethylheptane	98174		0.008825
2,2,4-trimethylhexane	45222	0.004147	0.004968
2,2,4-trimethylpentane	43276	1.772361	1.569484
2,2,5-trimethylheptane	43252	0.036098	0.076214
2,2,5-trimethylhexane	98033	0.330261	0.259962
2,2-dimethylbutane	43291	0.417130	0.352865
2,2-dimethylhexane	98138		0.010031
2,2-dimethyloctane	98175		0.031399
2,2-dimethylpentane	90042	0.049996	0.118154
2,3,3-trimethylpentane	43280		0.104610
2,3,4-trimethylpentane	43279	0.701449	0.747301
2,3,5-trimethylhexane	98141	0.003902	0.040191
2,3-dihydroindene (indan)	98044	0.030502	0.214198
2,3-dimethyl-1-butene	43234		0.010472
2,3-dimethyl-2-pentene	90061		0.014115
2,3-dimethylbutane	98001	0.792083	0.867338
2,3-dimethylheptane	98145		0.153744
2,3-dimethylhexane	98139	0.303235	0.133385
2,3-dimethyloctane	98183		0.009503
2,3-dimethylpentane	43274	0.916847	1.240916
2,4,4-trimethyl-1-pentene	98054	0.009871	0.027123
2,4,4-trimethyl-2-pentene	98055	0.255731	0.038440
2,4,4-trimethylhexane	45223		0.012841
2,4-dimethyl-1-pentene	90063		0.000483
2,4-dimethyl-2-pentene	90062	0.107026	0.040298
2,4-dimethylheptane	98142	0.082146	0.029026
2,4-dimethylhexane	43277	0.477901	0.380127
2,4-dimethyloctane	98149		0.023068
2,4-dimethylpentane	43271	0.644348	0.714552
2,5-dimethylhexane	43278	0.547052	0.281539
2,5-dimethyloctane	98176	0.007594	0.020344
2,6-dimethylheptane	98157	0.069336	0.033361
2,6-dimethyloctane	98177	0.012260	0.161048

Species Name	*SAROAD*	*Weight Percentage, %*	
		OG2305 Gasoline-Powered Vehicle Hot Soak (Summer-Grade E6)	*OG2306 Gasoline-Powered Vehicle Hot Soak (Winter-Grade E6)*
2-methyl-1,3-butadiene	43243	0.022139	0.023230
2-methyl-1-butene	43225	0.420356	0.387261
2-methyl-1-pentene	98040	0.017136	0.367812
2-methyl-2-butene	43228	0.929129	0.896174
2-methyl-2-hexene	90028		0.010223
2-methyl-2-pentene	98004	0.149582	0.134583
2-methylbutane	98132	6.161868	8.678378
2-methylheptane	98140	0.323201	0.456975
2-methylhexane	43275	0.893598	0.966148
2-methylindan	91108		0.045563
2-methylnonane	90047	0.152221	0.428110
2-methylpentane	43229	2.233671	2.500523
2-methylpropene	43215	0.049639	0.209035
2-methyl-trans-3-hexene	91006		0.034830
3,3-dimethyl-1-butene	98169		0.000996
3,3-dimethylhexane	98171		0.004799
3,3-dimethyloctane	98184		0.012341
3,3-dimethylpentane	90040	0.113169	0.015650
3,4-dimethyl-1-pentene	90075		0.004760
3,4-dimethylhexane	98150	0.009656	0.029901
3,5-dimethylheptane	98144	0.209150	0.432336
3-ethyl-2-pentene	98007		0.005461
3-ethylpentane	43300	0.009788	0.048807
3-methyl-1-butene	43223	0.004178	0.024547
3-methyl-1-hexene	90030		0.000937
3-methyl-1-pentene	43211		0.039138
3-methyl-cis-2-hexene	90029	0.009776	0.009344
3-methyl-cis-2-pentene	98163	0.059560	0.052099
3-methylcyclopentene	43272	0.013792	0.034222
3-methylheptane	43298	0.393952	0.531397
3-methylhexane	43295	0.904982	1.041640
3-methyloctane	98172	0.106243	0.117768
3-methylpentane	43230	1.494145	1.302145
3-methyl-trans-2-pentene	43270	0.001728	0.024270
3-methyl-trans-3-hexene	90032		0.006367
4-methyl-1-pentene	98135	0.020192	0.025870
4-methyl-cis-2-pentene	98170	0.071037	
4-methylheptane	43297	0.029356	0.095821
4-methylindan	91107		0.016573
4-methyloctane	98173	0.241491	0.311247

Species Name	*SAROAD*	*Weight Percentage, %*	
		OG2305 Gasoline-Powered Vehicle Hot Soak (Summer-Grade E6)	*OG2306 Gasoline-Powered Vehicle Hot Soak (Winter-Grade E6)*
4-methyl-trans-2-hexene	90031		0.009785
4-methyl-trans-2-pentene	43293	0.022672	0.054403
5-methylindan	91106		0.044278
benzene	45201	1.517855	1.170071
cis-1,2-dimethylcyclohexane	91055	0.008570	0.013466
cis-1,3-dimethylcyclohexane	98180	0.169899	0.179648
cis-1,3-dimethylcyclopentane	91018	0.272675	0.204597
cis-1-methyl-3-ethylcyclopentane	91046	0.003477	0.020184
cis-2-butene	43217	0.022688	0.251229
cis-2-heptene	91028		0.011069
cis-2-hexene	98035		0.022989
cis-2-octene	43266		0.003656
cis-2-pentene	43227	0.301938	0.254449
cis-3-hexene	98003		0.008575
cyclohexane	43248	0.481225	0.763316
cyclohexene	43273		0.007849
cyclopentane	43242	0.361888	0.398764
cyclopentene	43292	0.065403	0.061916
ethane	43202	0.071730	0.057749
ethanol	43302	32.318667	18.743300
ethene	43203	0.044696	0.040084
ethylbenzene	45203	0.793185	0.654170
ethylcyclohexane	43288	0.038481	0.024370
ethylcyclopentane	98057		0.119559
ethyne	43206	0.049748	0.021098
m-& p-xylene	45205	5.512488	5.279506
methane	43201	3.945573	3.845547
methanol	43301	4.080843	1.601009
methylcyclohexane	43261	0.764922	0.691277
methylcyclopentane	43262	1.666373	1.628655
methylpropane	43214	0.113028	1.747851
methyl-tert-butyl-ether	43378		0.005183
naphthalene	98046	0.002312	0.046124
n-butane	43212	0.911832	7.662908
n-decane	43238	0.146296	0.274068
n-dodecane	43255		0.020430
n-heptane	43232	0.837381	0.783633
n-hexane	43231	1.462534	1.593401
n-nonane	43235	0.182404	0.285675
n-octane	43233	0.346615	0.412575

Species Name	*SAROAD*	*Weight Percentage, %*	
		OG2305 Gasoline-Powered Vehicle Hot Soak (Summer-Grade E6)	*OG2306 Gasoline-Powered Vehicle Hot Soak (Winter-Grade E6)*
n-pentane	43220	2.647331	3.443458
n-pentylbenzene	45255		0.012924
n-propylbenzene	45209	0.266215	0.173936
n-undecane (hendecane)	43241	0.015246	0.029209
o-xylene	45204	1.791203	1.878219
propane	43204	0.155016	0.563065
propene	43205	0.059153	0.118116
styrene	45220	0.033139	0.008658
toluene	45202	9.993516	8.330913
trans-1,2-dimethylcyclopentane	91021	0.095965	0.179555
trans-1,3-dimethylcyclohexane	98059	0.043664	0.051889
trans-1,3-dimethylcyclopentane	91019	0.290969	0.271053
trans-1,3-pentadiene	90100		0.006353
trans-1,4-dimethylcyclohexane	98181	0.074953	0.044748
trans-1-methyl-3-ethylcyclopentane	91044	0.009909	0.030047
trans-2-butene	43216	0.023024	0.277465
trans-2-heptene	91026	0.003230	0.012013
trans-2-hexene	98034	0.090866	0.078069
trans-2-octene	43263	0.012641	0.031314
trans-2-pentene	43226	0.731901	0.667628
trans-3-heptene	98006	0.011034	0.023074
trans-3-hexene	98136	0.015115	0.037948
trans-4-octene	43250	0.005222	0.011378
Total		*100.000000*	*100.000000*