Attachment III

State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model

Adopted: _____

Note: **This is a wholly new document proposed for adoption by the Air Resources Board. Modifications to the originally-proposed text are shown in <u>underline</u> to indicate additions and ~~strikeout~~ to indicate deletions.**

This version shows only those pages that contain substantive modifications to the originally-proposed text - pages 2, 7, 17, 18, 19,

50 and 51.

Table 1
Properties and Specifications for Phase 3 Reformulated Gasoline

Fuel Property	Units	Flat Limit	Averaging Limit	Cap Limit
Reid vapor pressure (RVP)	psi, max.	6.90[1]/7.00	none	7.20
Sulfur (SUL)	ppmw, max.	20	15	60/30[23]
Benzene (BENZ)	vol.%, max.	0.80/1.00[2]	0.70	1.10
Aromatic HC (AROM)	vol.%, max.	25.0/35.0[2]	22.0	35.0
Olefin (OLEF)	vol.%, max.	6.0	4.0	10.0
Oxygen (OXY)	wt. %	1.8 (min) 2.2 (max)	none	1.8(min)[34] 3.5(max)[45]
Temperature at 50 % distilled (T50)	deg. F,max.	213/220[2] 211	203 201	220 225
Temperature at 50% distilled (T90)	deg. F, max.	305/312[2]	295	330 335
Driveability Index (DI)[5]	no units	1225	not applicable	not applicable

[1] Applicable during the summer months identified in 13 CCR, sections 2262.4(b). If the applicant elects to comply with the regulatory option which provides for the use of the evaporative HC emissions model, the flat RVP limit is 6.90. That is, all predictions for evaporative emissions increases or decreases made using the evaporative HC emissions models are made relative to 6.90 psi. If the applicant elects to comply with the regulatory option which provides for the use of only the exhaust HC emissions model, the flat RVP limit and the candidate fuel RVP specification is 7.00. Also, under the federal Reformulated Gasoline Regulations, the U.S. EPA enforces a minimum RVP limit of 6.4 psi.

The exhaust models contain an RVP term, but this has been made constant by fixing the RVP for both the reference and candidate fuels at 7.00 psi in the calculation of the standardized RVP values used in the exhaust emission equations. This fixing of the RVP takes RVP out of the exhaust models as a fuel property which effects exhaust emissions. Thus, RVP effects only evaporative HC emissions.

[2] The higher value is the small refiner CaRFG flat limit for qualifying small refiners only, as specified in section 2272.

[23] The Phase 3 RFG sulfur content cap limits of 60 and 30 parts per million are phased in starting December 31, 2002, and December 31, 2004, respectively, in accordance with section 2261(b)(1)(A).

[34] Applicable only during specified winter months in the areas identified in 13 CCR, section 2262.5(a).

[45] If the gasoline contains more than 3.5 percent by weight oxygen but not more than 10 volume percent ethanol, the maximum oxygen content cap is 3.7 percent by weight.

[5] DI equals (1.5 x T10) + (3 x T50) + T90 + (20 x (wt.% oxygen)). The DI standard applies during only the Reid vapor pressure control periods identified in section 2262.4(b)(2).

5. **ASTM** means the American Society of Testing and Materials.

6. **Averaging Limit** means a limit for a fuel property that must be achieved in accordance with 13 CCR, section 2264.

7. **Benzene content (BENZ or Benz)** means the amount of benzene contained in the fuel expressed to the nearest hundredth of a percent by volume in accordance with 13 CCR, section 2263.

8. **Candidate fuel or candidate fuel specifications** means the fuel or set of specifications which are being evaluated for its emission performance using these procedures.

9. **Cap limit** means a limit that applies to all California gasoline throughout the gasoline distribution system, in accordance with 13 CCR, sections 2262.3 (a), 2262.4 (a), and 2262.5 (a) and (b).

~~10. **DI or Driveability Index** is defined as (1.5 x T10) + (3 x T50) + T90 + (20 x (weight percent oxygen))~~

11. **EMFAC/BURDEN 7G** means the EMFAC/BURDEN 7G motor vehicle emission inventory and emissions calculation system maintained by the ARB.

12. **Executive Officer** means the executive officer of the Air Resources Board, or his or her designee.

13. **Exhaust-only option** means the compliance option available to applicants which uses only the exhaust HC emissions models in the evaluation of the HC emissions equivalency of the candidate fuel specifications.

14. **Evap option** means the compliance option available to applicants which uses the evaporative HC emissions models and the CO adjustment factor in the evaluation of the HC emissions equivalency of the candidate fuel specifications.

15. **Flat limit** means a single limit for a fuel property that applies to all California gasoline sold or supplied from a California production facility or import facility.

16. **Intercept** means the average vehicle effect for a particular Tech class and a particular pollutant. The intercept represents the average emissions across vehicles in the Tech class, for a fuel with properties equal to the average values of all fuels in the data base for that Tech class.

Table 6
Candidate and Reference Specifications for Oxygen

Oxygen Content for Candidate Fuel Specified by Applicant		Number of Reference vs Candidate Comparisons Required	Values to be Used in Comparison in Equations	
minimum	**maximum**		**Candidate**	**Reference**
≥ 1.8, ≤ 2.2	≥ 1.8, ≤ 2.2	1	2.0	2.0
≥ 1.8, ≤ 2.2	> 2.2	2	minimum	1.8
			maximum	2.0
< 1.8	≥ 1.8, ≤ 2.2	2	minimum	2.0
			maximum	2.2
< 1.8	> 2.2	2	minimum	2.0
			maximum	2.0
< 1.8	< 1.8	2	minimum	2.0
			maximum	2.0
≥ 2.5, ≤ 2.9	≥ 2.5, ≤ 2.9	1	2.7	2.0
> 2.2, < 2.5	> 2.2	2	maximum	2.0
			minimum	2.0
≧ 2.5	> 2.9	2	minimum	2.0
			maximum	2.0

Table 7

Optional Worksheet for Candidate and Reference Fuel Specifications
Does the applicant which to use the evaporative HC emissions model and the CO adjustment factor in the evaluation of the equivalency of the candidate fuel specifications? YES ___ NO ___

If the above question is answered yes, the flat RVP limit is 6.90 psi and the RVP cap is 7.20 psi. If the above question is answered no, 7.00 psi is the flat RVP limit and the candidate fuel RVP specification.

Fuel Property	**Candidate Fuel[1]: Specifications**	**Compliance Option: Flat or Average**	**Reference Fuel: Phase 3 RFG Specifications** (Circle Option Chosen)	
			Flat	**Average**
RVP		Flat	6.90[5] / 7.00	None
Sulfur			20	15
Benzene			0.80/1.00[6]	0.70
Aromatic			25.0/35[6]	22.0
Olefin			6.0	4.0
Oxygen[2] (Total)	(min) (max)	Flat-Range	(min) (max)	None
Oxygen[3] (as MTBE)	(min) (max)	Not Applicable	Not Applicable	None
Oxygen[4] (as EtOH)	(min) (max)	Not Applicable	Not Applicable	None
T50			213/220[6] ~~211~~	203 ~~201~~
T90			305/312[6]	295

note: Footnotes are on the next page

Footnotes for Table 7

[1] The fuel property value must be within or equal to the cap limit.

[2] If the oxygen content range for the candidate fuel is ≥ 1.8 and ≤ 2.2, the candidate fuel and reference fuel oxygen value used in the predictive model equation is 2.0. For all other cases, see Table 6, Candidate and Reference Specifications for Oxygen.

[3] The oxygen content (as MTBE) is reported because the hot soak evaporative benzene emissions model includes an MTBE content term (See VIII.A.2).

[4] The oxygen content (as EtOH) is reported because the exhaust formaldehyde and the exhaust acetaldehyde models include EtOH content terms for the predictions for the candidate fuel specifications (See VI.A.1.c & d., VI.A.2.c & d., VI.A.3.c & d.). The EtOH content term is not included in the exhaust formaldehyde and acetaldehyde predictions for the reference fuel specifications because it is assumed that, for the reference fuel specifications, MTBE is the oxygenate used to meet the oxygen requirement.

[5] If the applicant elects to use the evaporative HC emissions models, the flat RVP limit is 6.90. That is, all predictions for evaporative emissions increases or decreases are made relative to 6.90 psi. If the applicant has elected not to use the evaporative HC emissions models, the flat RVP limit is 7.00. The exhaust models contain an RVP term, but this term has been made constant by fixing the RVP for both the reference and candidate fuels at 7.00 psi in the calculation of the standardized RVP values used in the exhaust emissions equations. This fixing of the RVP takes RVP out of the exhaust models as a fuel property which effects exhaust emissions.

[6] The higher value is the small refiner CaRFG flat limit for qualifying small refiners only, as specified in section 2272.

VIII. EVAPORATIVE BENZENE EMISSIONS CALCULATIONS

A. Evaporative Benzene Emissions by Process

The evaporative benzene models predict the evaporative benzene emissions (in units of milligrams per mile) as a function of RVP, gasoline benzene content, and gasoline MTBE content (for Hot Soak Benzene Emissions). There are three evaporative benzene models, one for each of the following three process of evaporative benzene emissions: 1) Diurnal/Resting Loss Emissions, 2) Hot Soak Emissions, and 3) Running Loss Emissions.

1. Diurnal/Resting Loss Emissions

The predicted Diurnal/Resting Loss Benzene Emissions ($EVBenz_{DIRES}$) is calculated as follows:

$$EVBenz_{DIRES} = \{\frac{572}{452} \times [Exp(-4.304062385 + (0.234434005 \times RVP))] \times [(0.0294917804 \times Benz) - (0.0017567009 \times Benz \times RVP)]\}$$

where

$EVBenz_{DIRES}$ is the predicted evaporative Diurnal/Resting Loss benzene emissions and is calculated for both the reference and candidate fuel specifications

Benz is the benzene content of the gasoline, in percent by volume

RVP is the RVP of the gasoline, in psi

2. Hot Soak Loss Emissions

The predicted Hot Soak Benzene emissions ($EVBenz_{HS}$) is calculated as follows:

$$EVBenz_{HS} = \{\frac{572}{452} \times [Exp(-8.498652909 + (1.142251184 \times RVP) - (0.048390975 \times RVP^2))] \times [(0.0463141591 \times Benz) - (0.0027179513 \times Benz \times RVP) - (0.0001435812 \times Benz \times MTBE)]\}$$

where

$EVBenz_{HS}$ is the predicted evaporative Hot Soak benzene emissions and is calculated for both the reference and candidate fuel specifications

Benz is the benzene content of the gasoline, in percent by volume

RVP is the RVP of the gasoline, in psi

MTBE is the MTBE content of the gasoline, in percent by volume

3. Running Loss Emissions

The predicted Running Loss Benzene emissions ($EVBenz_{RL}$) is calculated as follows:

$$EVBenz_{RL} = \{\frac{572}{\cancel{452}} \times [0.3925594957 - (0.1197399622 \times RVP) + (0.011349611 \times RVP^2)] \times [(0.0648391842 \times Benz) - (0.005622979 \times Benz \times RVP)]\}$$

where

$EVBenz_{RL}$ is the predicted evaporative Running Loss benzene emissions and is calculated for both the reference and candidate fuel specifications

Benz is the benzene content of the gasoline, in percent by volume

RVP is the RVP of the gasoline, in psi

If the applicant elects not to use the compliance option which provides for the use of the evaporative HC emissions models, the RVP of both the reference fuel and candidate fuel is assumed to be 7.00 for purposes of using the equations in this section to calculate evaporative benzene emissions.