

# **Assessing the Effect of Five Gasoline Properties on Exhaust Emissions from Light-Duty Vehicles certified to Tier-2 Standards**

## **Analysis of Data from EPA Phase 3**

**(EPAAct/V2/E-89)**

### **Appendix I.3f**

#### **Final Model Fitting**

#### **Non-methane Hydrocarbons (NMHC) (Bag 3)**

No. Observations:	837
No. Vehicles:	15
No. censored measurements:	119
No. missing measurements:	0
No. measurements removed:	0
Model Type:	Tobit regression

### **I.3f.1 Model Fitting based on the 11-term design model.**

Model fitting for the 11-term design model gives results identical to those for the 16-term extended model, as presented below.

### I.3f.2 Model Fitting based on the 16-term extended model.

Models fit for NMHC (Bag 3): (Grand Intercept not fit by Tobit models).

Model Term	Notation	Model					
		Full	FM6 <sup>1</sup>	FM8	FM9	FM10	FM11
etOH	$Z_e$	•	•	•	•	•	•
Arom	$Z_a$	•	•	•	•	•	×
RVP	$Z_r$	•	•	•	•	•	•
T50	$Z_5$	•	•	•	•	•	•
T90	$Z_9$	•	•	•	•	•	•
etOH × etOH	$ZZ_{ee}$	•	×				
T50 × T50	$ZZ_{55}$	•	×				
etOH × Arom	$ZZ_{ea}$	•	×				
etOH × RVP	$ZZ_{er}$	•	•	•	•	•	•
etOH × T50	$ZZ_{e5}$	•	•	×			
etOH × T90	$ZZ_{e9}$	•	×				
Arom × RVP	$ZZ_{ar}$	•	•	×			
Arom × T50	$ZZ_{a5}$	•	×				
Arom × T90	$ZZ_{a9}$	•	•	•	×		
T50 × T90	$ZZ_{59}$	•	×				
RVP × T90	$ZZ_{r9}$	•	•	•	•	×	

<sup>1</sup> Indicates “Full minus 6,” etc.

NMHC (Bag 3): Model fitting history, starting with the 17-term extended model.

Fit Parameters			Test with respect to Previous Model		
Model	$p-1^1$	$-2\ln L$	Dev.	$d$	$\Pr > \chi^2$
Full Model	16	2447.661			
FM6	10	2448.148	0.487	6	0.998
FM8	8	2449.275	1.127	2	0.569
FM8	7	2449.727	0.452	1	0.501
FM10	6	2450.108	0.381	1	0.537
FM11 <sup>2</sup>	5	2450.114	0.006	1	0.938

<sup>1</sup> Total number of terms excludes the intercept, as the Tobit Models do not fit intercepts.

<sup>2</sup> Best fit with respect to the 16-term extended model.

**NMHC (Bag 3): Coefficients and Tests of Effect for the Full and Reduced Models, with respect to the 16-term extended model.**

Effect	<i>Full Model</i>				
	Estimate	Std. Err.	d.f.	t -value	Pr>t
Intercept					
$Z_e$	-0.1038	0.0561	1	3.42	0.064
$Z_a$	0.0007	0.0352	1	0.00000	0.98
$Z_r$	-0.0565	0.0474	1	1.42	0.23
$Z_5$	0.0779	0.0626	1	1.55	0.21
$Z_9$	0.1517	0.0364	1	17.35	<0.0001
$ZZ_{ee}$	-0.0391	0.0652	1	0.36	0.55
$ZZ_{55}$	-0.0250	0.0533	1	0.22	0.64
$ZZ_{ea}$	-0.0228	0.0529	1	0.19	0.67
$ZZ_{er}$	0.0769	0.0359	1	4.58	0.032
$ZZ_{e5}$	-0.0505	0.0689	1	0.54	0.46
$ZZ_{e9}$	0.0056	0.0423	1	0.02	0.90
$ZZ_{ar}$	-0.0430	0.0573	1	0.56	0.45
$ZZ_{a5}$	-0.0231	0.0642	1	0.13	0.72
$ZZ_{a9}$	-0.0258	0.0359	1	0.52	0.47
$ZZ_{59}$	0.0099	0.0478	1	0.040	0.84
$ZZ_{r9}$	0.0329	0.0405	1	0.66	0.42

$\sigma^2_{veh}$	
$\sigma^2_{\varepsilon}$	0.9347

<i>Reduced Model (FM11)</i>				
Estimate	Std. Err.	d.f.	t -value	Pr>t
-5.9827				
-0.0581	0.0405	1	2.06	0.15
-0.0313	0.0355	1	0.78	0.38
0.1356	0.0427	1	10.09	0.0015
0.1546	0.0321	1	23.23	<0.0001
0.0773	0.0313	1	6.09	0.014

4.4045
0.9358