Haltermann Test & Reference Fuels

Proposed CARB-III Repeatability and Reproducibility Study

Study Basis

- Fuel samples produced in lab under controlled conditions
  - Manufacturing scale would present additional challenges
- 16 Samples of same fuel sent out to labs
- 4 different analytical labs in Houston area
- Blind analysis…no specifications or targets provided to the analytical lab. Hence, no bias.

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Findings

- Data and results in attached spread sheet
- Analytical data compiled on a typical blend
- Statistical analysis performed on the lab results
- Some parameters in the proposed CARB specs are narrower that the reported ASTM reproducibility for those methods. These are highlighted in pink.
- The proposed specs do not appear to pass the CARB predictive model.

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PRODUCT: CARB-III E10 Certification Gasoline
Repeatibility & Reproducibility study

Analysis Date: August 2010

TEST	METHOD	UNITS	SPECIFICATIONS			ASTM		Mean	Standard	Sample	95% Confidence Interval		
			MIN	TARGET	MAX	r	R		Deviation	Size	Single Measurement		
Distillation - IBP	ASTM D86	°F						109.2	4.1	16	100.6	-	117.9
5%		°F						130.6	3.2	16	123.9	-	137.4
10%		°F						136.6	2.1	16	132.0	-	141.1
20%		°F						144.2	1.9	16	140.0	-	148.3
30%		°F						151.4	3.5	16	143.9	-	159.0
40%		°F						176.9	8.3	16	159.1	-	194.6
50%		°F	205		215	1.3	3.4	213.3	3.5	16	205.9	-	220.7
60%		°F						229.9	4.6	16	220.2	-	239.6
70%		°F						246.4	3.5	16	239.0	-	253.8
80%		°F						272.8	4.8	16	262.5	-	283.1
90%		°F	310		320	2.9	7.3	314.9	3.7	16	307.1	-	322.8
95%		°F						330.2	3.2	16	323.3	-	337.0
Distillation - EP		°F			390			356.3	3.9	16	347.9	-	364.6
Recovery		vol %						98.0	0.6	16	96.6	-	99.3
Residue		vol %			2.0			1.0	0.1	16	0.8	-	1.1
Loss		vol %						1.1	0.6	16	-0.2	-	2.3
Reid Vapor Pressure	ASTM D5191	psi	6.9		7.2	0.18	0.31	7.10	0.05	16	7.0	-	7.2
Ethanol content	ASTM D4815	vol %	9.8		10.0	0.2	0.8	8.8	0.4	8	7.94	-	9.75
MTBE content	ASTM D4815	vol %			0.05					0			
Sulfur	ASTM D5453	ppm	8		11			8.0	1.0	16	5.78	-	10.19
Composition, aromatics	ASTM D5580	vol %	20.0		22.0	0.44	1.40	22.2	1.5	8	18.77	-	25.63
Composition, olefins	ASTM D6550	vol %	4.0		6.0	0.30	0.79	5.3	0.1	4	5.07	-	5.43
Benzene	ASTM D5580	vol %	0.6		0.8	0.02	0.09	0.6	0.1	8	0.48	-	0.79
Sensitivity	D2699/2700		7.5					10.2	0.4	16	9.36	-	10.99

D4815 detection limit 0.2%