

CaRFG3 Commingling Study – Fuel Sampling Protocol

I. Introduction

In adopting the regulations for California Phase 3 reformulated gasoline (CaRFG3) by way of Resolution 99-39, the Board directed staff to further evaluate the expected real-world emissions impact of commingling CaRFG3 containing ethanol with CaRFG3 not containing ethanol in motor vehicle fuel tanks. Because as little as two volume percent ethanol in gasoline will raise its Reid vapor pressure (RVP) by about one pound per square inch (psi), commingling may result in increased evaporative motor vehicle emissions. The extent of commingling and its impact on evaporative emissions depends on several factors, including whether the federal reformulated gasoline year-round minimum oxygen requirement will continue to apply in California, refiner choices regarding the mix of oxygenated and non-oxygenated gasoline in a given area, and customer choices regarding brand and grade loyalty.

II. Field Study Overview

One aspect to be incorporated into the evaluation is a field study of the actual impacts of commingling fuels in vehicle fuel tanks. It is anticipated that this field study will be conducted at retail gasoline facilities in Northern California that are currently marketing non-methyl tertiary-butyl ether (MTBE) gasoline. Vehicle fuel tank samples will be obtained from customer's vehicles identified as likely to have commingled fuel in their tank after refueling. The obtained fuel samples (including representative underground tank samples) will be analyzed for the fuel properties needed to evaluate the actual impact of commingling on vehicle evaporative emissions.

Fieldwork for this study will be conducted in two phases. The first phase, to be conducted in June, is to evaluate the efficacy of the draft fuel sampling protocol. Samples will be taken from each of the service station's underground tanks upon arrival and departure at each test site. Vehicle fuel tank samples will be obtained prior to refueling from all customers willing to participate. While the sampling and refueling operations are taking place, the customer will be interviewed to obtain information necessary for further evaluation. This information will be recorded on field data sheets and will include sample identification, year/make/model of vehicle, initial fuel gauge level, amount and type of product dispensed, and final fuel gauge level. A second fuel sample will be obtained from their tank after refueling. Experience gained in this first phase will determine if and how the sampling protocol can be improved and finalized.

The second phase of fieldwork, to be conducted in August, will be the implementation of the finalized sampling protocol. The general approach will be to screen all customers as they arrive in order to identify vehicles expected to have commingled fuel in their tank after refueling. Those vehicles expected to have commingled fuel will have their vehicle fuel tanks sampled both before and after refueling. While the sampling and refueling operations are taking place, the

customer will be interviewed and the field data sheets will be completed. There will be three different fuel samples that must be correctly identified and properly associated with each vehicle tested.

Samples from the vehicle tanks and the station's underground tanks will be obtained using American Society of Testing and Materials (ASTM) D 5842-95, "Standard Practice for Sampling and Handling of Fuels for Volatility Measurement". Vehicle tanks are not mentioned in the ASTM sampling method. However, we will be essentially following the tank tap portion of the sampling method using apparatus that the ARB has successfully used for some time to obtain diesel samples from vehicle tanks to check for presence of red dye (see Section III.E for photos of apparatus). Special care will be taken to ensure that minimal evaporation takes place during the sampling process so that accurate RVP results will be obtained.

To minimize the amount of handling and the duration of sample storage, samples will be analyzed in ARB's mobile laboratory that will be located in the general vicinity. This should enable the completion of most sample analyses within 48 hours. All samples will be analyzed for RVP using ARB's "Test Method for the Determination of the Reid Vapor Pressure Equivalent Using an Automated Vapor Pressure Test Instrument" (see CCR Title 13 §2297). All samples will be analyzed for the amount and type of oxygenate, and the oxygen content, by ASTM D 4815-94, "Standard Test Method for Determination of MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol and C1 to C4 Alcohols in Gasoline by Gas Chromatography".

III. Sampling Protocol

A. Required Equipment

- 4-ounce clear glass sample bottles with lined plastic lids.
- 1-liter aluminum sample bottles with foil lined plastic lids.
- Teflon ¼ inch O.D. tubing.
- Hand-operated vacuum pump.
- Sample labels/Field data sheets.
- Nozzle extension.
- Sectioned boxes for 4-ounce bottle storage.
- Ice chests for sample bottle conditioning and sample storage.
- Cleanup and equipment maintenance supplies.
- Product rinse container.

B. Sampling Procedures

1) Vehicle Tank Sampling

A modified version of ASTM D 5842-95 will be used to obtain the vehicle fuel tank samples. While this method does not specifically address sampling from a vehicle fuel tank, the tank tap sampling procedure is being adapted to accommodate our specific needs. The sampling equipment is the same equipment that has been successfully used in ARB's ongoing program to sample vehicle fuel tanks to test for red dyed diesel fuel.

Prior to drawing each individual sample, the 4-ounce bottle will be chilled in an ice bath. The bottle will then be connected to the hand-operated vacuum pump and a new piece of Teflon tubing will be inserted through the pump compression fitting to the bottom of the sample bottle. Since the pump works on a vacuum principle, a negative pressure will be produced within the bottle. As a result, no product will touch the pump itself but instead will be drawn through the tube and bottom-fill the bottle. If any product is accidentally drawn into the pump by overfilling or tipping the bottle, the pump will be disassembled, wiped down with a clean, dry shop towel, and air-dried prior to its next use. To obtain the sample, the tube will be inserted into the vehicle's fuel fill pipe until it reaches product. The bottle will be rinsed with product and drained prior to obtaining the final sample. When the bottle is 70 to 85% full, it will be disconnected from the pump, capped, labeled, and stored in a cool location out of direct sunlight. The sample tube will be identified as spent and not be available for reuse.

2) Service Station Nozzle Sampling

ASTM D 5842-95 will be used to obtain samples from the service station's underground tanks. Although this method allows the use of 4-ounce sample bottles, 1-liter sample bottles will be used. The 1-liter sample bottles will be chilled in ice water prior to obtaining a sample. The bottle will be rinsed with product and drained before being bottom-filled with a nozzle extension attached to the service station nozzle. After the bottle is filled between 70 to 85% full, the bottle will be capped, labeled, and stored in a cool location out of direct sunlight.

C. Sample Handling Procedures

It is essential that proper sample identification and field data sheet referencing is completed for each vehicle sample set. Preprinted self-adhesive sample identification labels will be attached to each sample bottle and corresponding field data sheet. Label ink and adhesive will be resistant to water and gasoline to assure identification integrity. Vapor pressures are extremely sensitive to evaporation losses and to slight changes in

composition. Necessary precautions will be observed when handling samples to ensure the samples are representative of the product and satisfactory for RVP analysis.

D. Analytical Methods

Fuel samples obtained will be analyzed by the following methods:

Fuel Quality	Analysis Method
RVP (psi)	CCR Title 13 §2297*
Oxygen Content (wt.%)	ASTM D 4815-94
MTBE (vol.%)	ASTM D 4815-94
Ethanol (vol.%)	ASTM D 4815-94

*Paragraph (d)(1.0) which specifies a Title 13 sampling method will be replaced with ASTM D 5842 sampling method which allows for the use of either 32 oz or 4 oz bottles.

E. Tank Sampling Apparatus

