50 CAR EFFICIENCY EVALUATION OF
THE OPW CONTROL SYSTEM
ON THE GILBARCO VAPORVAC VAPOR RECOVERY SYSTEM
AT COSTCO CAL EXPO

TEST DATE: SEPTEMBER 4, 2002

PREPARED FOR:

OPW FUELING COMPONENTS
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1.0 INTRODUCTION

On September 4, 2002 personnel of VOC Testing, Inc. performed a 50 car efficiency test of the OPW membrane emission control system with the Gilbarco VaporVac vapor recovery system installed at the Costco service station at 1600 Expo Parkway, Sacramento, California. The testing of the 50 cars and three extra cars was performed in accordance with California Air Resources Board Method TP-201.2, "Vapor Recovery Test Procedure, Efficiency and Emission Factor for Phase II Systems, as amended July 25, 2001.

Participants and Observers

Lou Dinkler-- CARB
Delbert Powell -- VOC Testing, Inc.
Mike Stapleton -- VOC Testing, Inc.
John Gray – OPW

2.0 PROGRAM SCOPE

The scope of the test program conducted by VOC Testing, Inc. included the following evaluations:

The purpose of the testing performed on September 4, 2002 was to determine the efficiency and mass emission rate of the overall vapor recovery system installed at the service station. This included emissions from automobile fueling, from vent pipe emissions, and the emissions from the OPW membrane system, which controlled underground tank pressure. The automobiles were selected at random; they were tested as they came into the service station. The fueling was performed by an employee of VOC Testing to eliminate the possibility of different operators introducing some difference in performance.

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3.0 SUMMARY OF RESULTS

Table 3-1 summarizes the results of the efficiency evaluation of the OPW membrane vapor control system and the Gilbarco VaporVac Stage 2 vapor recovery system installed at theCostco service station at Cal Expo in Sacramento, California on September 4, 2002.

TABLE 3-1
SUMMARY OF RESULTS CARB TP-201.2

Number of cars used in efficiency determination	52
System Efficiency	97.8%
Average Vapor to Liquid Ratio	1.11
Mass Emission Rate of Overall System	0.135 lbs/1,000 gallons

4.0 TEST AND ANALYSIS PROCEDURES

The purpose of the test program was the efficiency evaluation of the assist vapor recovery system installed at the service station in accordance with the test procedures of the California Air Resources Board.

4.1 Automobile Refueling Efficiency Test

The testing of each vehicle consisted of the following:

Vehicle fuel temperature measurement--

A flexible type K thermocouple 48 inches long was inserted into the vehicle fill pipe until a stable temperature reading was obtained. The thermocouple was then removed and checked for liquid gasoline. This process was repeated until the thermocouple was found to be wet.

Vehicle fuel system leak check --

The vehicle fill pipe interface was sealed with a stopper containing a 1/4 inch tube attached to a calibrated rotameter, 0-1" of water magnehelic gauge, and a cylinder of nitrogen. The nitrogen flow was adjusted to achieve a stable pressure reading of 0.5 inches of water. The flow rate required to achieve the pressure reading was read from the rotameter. A reading of 5.1 on the rotameter scale used is equivalent to 0.01 acfm of nitrogen. If the flow rate was more than 0.01 cubic feet per minute the vehicle failed the leak check and the fueling data from that vehicle was not used for the test.

Vapor Leakage from the nozzle/fillneck interface during fueling-

During the fueling of the test vehicle the emission of hydrocarbons at the fillneck was quantified with an EPA sleeve with a sweep air flow rate of 5.1 acfm. Hydrocarbons in the air returning through the sleeve were quantified with a flame ionization detector total hydrocarbon analyzer calibrated at the beginning of the day and every three hours thereafter with certified calibration gases of propane in nitrogen of 1.045%, 2.13%, and 4.5%. The volume of air collected from the sleeve was measured with a model 3M175 roots meter. The temperature of the sleeve air was measured with a Type K thermocouple, and the pressure was measured with a manometer.

In addition to the EPA sleeve and explosimeter calibrated at a level of 0.1 LEL (4,000 ppm by volume as propane)was used to check for hydrocarbon leakage from the sleeve. The explosimeter was kept one inch from the interface and moved around it during the fueling. If and explosimeter reading of more than 0.1 LEL was found during the fueling the vehicle data was not used in the efficiency calculations.

Measurement of vapor returned to the underground tank-

The volume of vapor returned to the underground tank was measured with a Dresser Model 3M125 roots meter installed in the vapor return line of the dispenser where it attached to the underground piping. The volume reading of the meter was read at the beginning and end of the vehicle fueling, and was observed during the fill to assure that no backward movement occurred. The pressure of the roots meter was monitored during the fueling with a 0-5 inch of water magnehelic gauge. The temperature of the returned vapors was measured with a Type K

thermocouple installed at the exit of the roots meter and was recorded during each fueling. The volume of gasoline dispensed was recorded from the gasoline dispenser for each fueling. The concentration of hydrocarbons in the returned vapor was monitored with a Horiba PIR2000 nondispersive infrared detector total hydrocarbon analyzer. The analyzer was calibrated at the beginning and end of the test day , and at three hour intervals with certified calibration gas standards of propane in nitrogen of 10.2%, 25%, and 50% by volume. The temperature of the dispensed fuel was measured with a Type K thermocouple installed on the dispensed fuel line.

4.2 Underground Tank Vent Emissions

During the test the emissions from the underground tank vent were monitored continuously. The quantification of vent pipe emissions was done by placing a perforated sleeve over the tank vent pressure/vacuum valve, and drawing a constant flow of 1.4 cubic feet per minute of ambient air through the sleeve to sweep any hydrocarbons and collect them. A slip stream from the sweep air was analyzed continuously with a flame ionization detector total hydrocarbon analyzer spanned at 0-500 ppm as propane. The analyzer was calibrated with certified calibration gas standards of 100 ppm, 200 ppm, and 415 ppm propane in nitrogen. The pressure varied from -0.1 inches of water to -0.50 inches of water during the test. The system pressure remained below 2.5 inches of water throughout the test. The vent pipe was equipped with a p/v valve which minimized vent pipe emissions.

4.3 Control Device Emissions

The OPW membrane vapor recovery system at the station senses and controls the underground tank pressure. The underground tank pressure is sensed with a pressure transducer, which turns on the vapor processor when the pressure rises to -0.2 inches of water. The processor extracts hydrocarbon laden air from the underground tank ullage space, passes it through a membrane, and vents a low concentration of hydrocarbons to the atmosphere. By emitting relatively low hydrocarbon concentration air, the processor lowers the underground tank ullage pressure, keeping the pressure slightly negative. The volume of emissions from the processor were measured with a 2" 3M125 Roots meter mounted on the exhaust stack. A sample of the exhaust gas was continuously monitored with a Horiba PIR2000 nondispersive infrared analyzer spanned at 0-15% propane. The analyzer was calibrated with certified gas standards of propane in nitrogen of 10%, 4.5%, and 2.132%. The exhaust gas temperature was measured with a type K thermocouple.

4.4 Data Analysis

During the efficiency test the mass of hydrocarbons recovered and returned to the underground tank, the mass of hydrocarbons emitted to the air at the fillneck, and the mass of hydrocarbons emitted to the air at the vent pipe and control device were quantified. The efficiency of hydrocarbon recovery for each vehicle fueling was calculated based on this data. The test data was recorded continuously on strip chart recorders. The hydrocarbon concentrations a each test point were also taken 3 times per second, and average over 30 second intervals with a Metrosonics data acquisition system. The calculations and mathematical formulae used in this analysis are shown in Appendix B.