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COMPLIANCE TEST REPORT
DETERMINATION OF THE CAPTURE EFFICIENCY, DESTRUCTION EFFICIENCY AND REMOVAL EFFICIENCY OF THE WET ROTOCLONE AND CATALYTIC OXIDIZER
FG2983 COATOXDON
POST CONSUMER BRANDS
BATTLE CREEK, MICHIGAN
APRIL 2019

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AIR QUALITY DIVISION

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1.0 EXECUTIVE SUMMARY

Post Consumer Brands operates a food production facility in Battle Creek, Michigan. The source is a flavoring process on one of the production lines in Building 29. The process is designated FG2983CoatOxdOn in the Michigan Department of Environmental Quality ROP NO: MI-ROP-B1548-2014d.

KBD Technic was retained by Post Consumer Brands to determine (1) the VOC capture efficiency (CE), (2) the removal efficiency (RE) of the wet rotoclone, (3) the VOC destruction efficiency (DE) of the catalytic oxidizer. The tests were conducted April 17, 2019.

The results of the tests are summarized in Table 1.1.

Table 1.1 Summary of test results

SOURCE	TEST TYPE	TEST RESULT
Flavoring process	Capture efficiency	74.1%
Wet rotoclone	Removal efficiency	0%
Catalytic oxidizer	Destruction efficiency	86.1%

2.0 INTRODUCTION

Post Consumer Brands operates a food production facility in Battle Creek, Michigan. The source is a flavoring process on one of the production lines in Building 29. The process is designated FG2983CoatOxdOn in the Michigan Department of Environmental Quality ROP NO: MI-ROP-B1548-2014d. KBD Technic was retained by Post Consumer Brands to determine (1) the VOC capture efficiency (CE), (2) the removal efficiency (RE) of the wet rotoclone, (3) the VOC destruction efficiency (DE) of the catalytic oxidizer. The tests were conducted April 17, 2019.

The Michigan Department of Environmental Quality was notified in writing of the test program with the submission of the Test Protocol. Tom Gasloli from the Michigan Department of Environmental Quality witnessed the process operation and testing procedures. Cathy Sanford was the Project Coordinator for Post Consumer Brands. Craig Jones, Mike Schappacher, Warren Wells and Arron Gray of KBD Technic conducted the tests.

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 Capture Efficiency

Refer to Figure 3.1 for a simplified process flow diagram and the location of the test sites for the capture efficiency tests.

The capture efficiency was determined by measuring the captured VOC emissions. The amount of flavoring was monitored and the VOC content of 73.6% was used to determine the VOC applied. An ethanol in air calibration gas was used to determine a propane to ethanol response factor to convert the emission rates from a propane basis to an ethanol basis. Three 60-minute test runs were made.

The CE was calculated using the following equation:

$$CE = \frac{G}{A}$$

Where:
CE = Capture efficiency, %
G=Sum of the captured VOC emissions or VOC emission entering the catalytic oxidizer, lb/hr
A=Applied VOC available for capture, lb/hr

3.2 VOC Removal efficiency and VOC destruction efficiency

The VOC removal efficiency (RE) of the wet rotoclone was determined by continuously monitoring the VOC concentration at the inlet and outlet for three 60-minute periods. The concentration was converted to a mass emission rate based on the stack gas flow rate. These tests were conducted simultaneously with the capture efficiency tests.

The VOC destruction efficiency (DE) of the catalytic oxidizer was determined by continuously monitoring the VOC concentration at the inlet and outlet of the catalytic oxidizer for three 60-minute periods. The concentration at each measurement site was converted to a mass emission rate based on the stack gas flow rate.

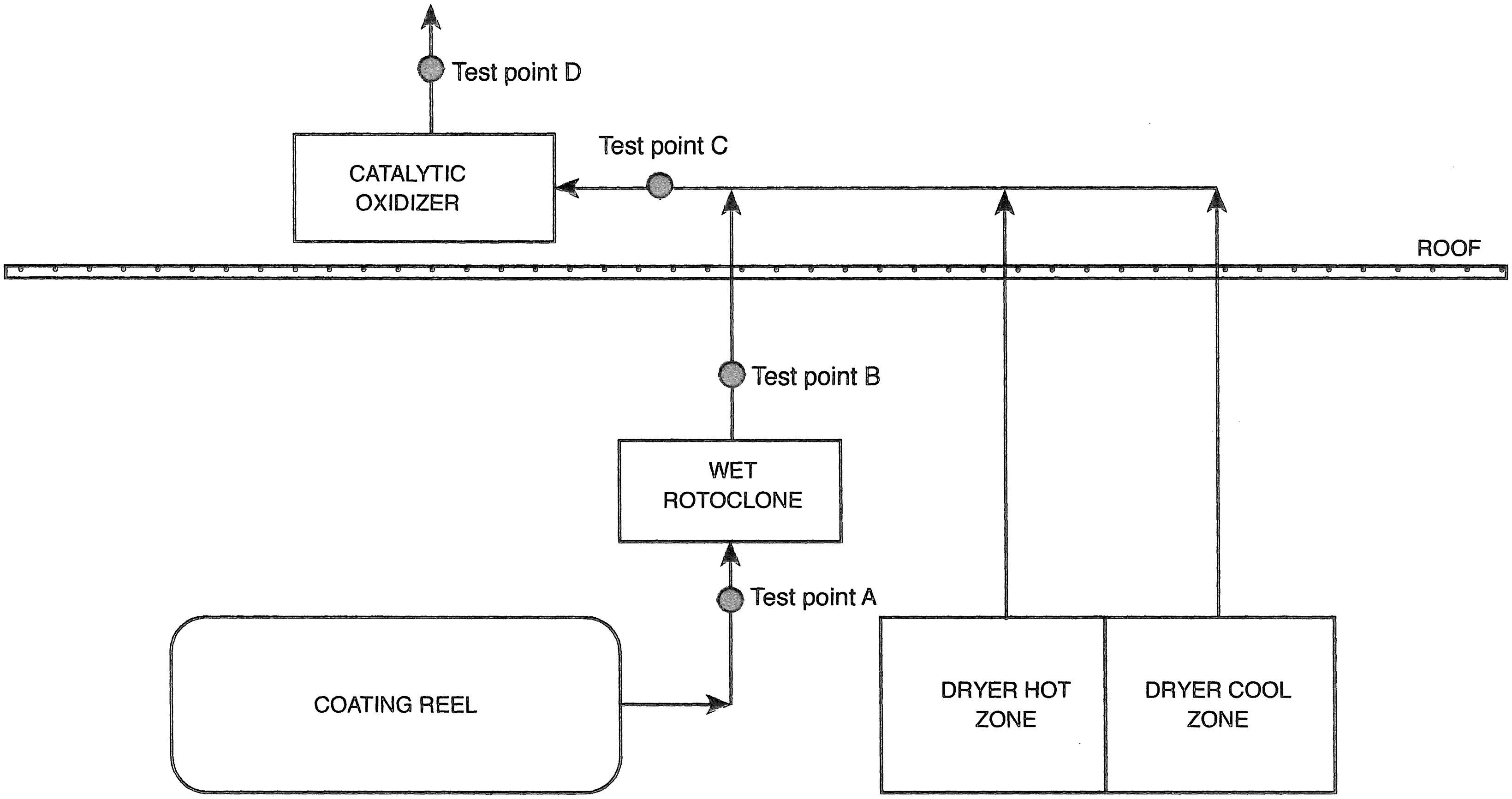
The RE was calculated as follows:

$$RE = \frac{ER_{inlet} - ER_{outlet}}{ER_{inlet}}$$

Where:
RE = VOC removal efficiency, %
ER_{inlet} = emission rate of VOC determined at the inlet of the wet rotoclone, lb/hr.
ER_{outlet} = emission rate of VOC determined at the outlet of the wet rotoclone, lb/hr.

The DE was calculated as follows:

$$DE = \frac{ER_{inlet} - ER_{outlet}}{ER_{inlet}}$$



● Test sites for VOC and volumetric flow rate

$$\text{Capture efficiency} = \frac{A + (C\text{-}B)}{\text{Application rate} \times \%\text{VOC}}$$

Figure 3.1 Process flow diagram

Where:
DE = VOC destruction efficiency, %
ER_{inlet} = emission rate of VOC determined at the inlet of the catalytic oxidizer, lb/hr.
ER_{outlet} = emission rate of VOC determined at the outlet of the catalytic oxidizer, lb/hr.

The following procedures were used for this survey:

° ***Measurement Sites***
The location of air volume measurement sites and the number of traverse points to be sampled was determined as specified in USEPA Reference Method 1, *"Sample and Velocity Traverses for Stationary Sources"* where possible. The test ports used for previous tests were utilized.

° ***Velocity, Flow Rate, and Temperature***
The stack gas velocity and temperature was determined by USEPA Reference Method 2, *"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type "S" Pitot Tube)".* The velocity pressure was measured with Type 'S' pitot tubes and oil filled or electronic manometers. Electronic manometers were calibrated as per Section 6.2.1 of Method 2. The gas temperature was measured with Type 'K' thermocouples. One velocity traverse was made at each location during each hour of testing.

° ***Dry Molecular Weight***
The dry molecular weight was determined using USEPA Reference Method 3, *"Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight".* Several grab samples of the stack gas were analyzed with Fyrite combustion gas analyzers for oxygen and carbon dioxide. For non-combustion sources, an oxygen concentration of 21% by volume was assumed.

° ***Stack Gas Moisture-Wet rotoclone***
Stack gas moisture content was determined using USEPA Reference Method 4, *"Determination of Moisture Content in Stack Gases".* Moisture content was determined using wet bulb/dry bulb temperature measurements. The wet and dry bulb temperatures were measured with calibrated Type "K" thermocouples. The stack gas moisture was calculated from vapor pressure tables.

° ***Stack Gas Moisture-Catalytic oxidizer inlet and outlet***
Stack gas moisture content was determined using the principles of USEPA Reference Method 4, *"Determination of Moisture Content in Stack Gases".* The moisture content was used only to determine the dry molecular weight for the air volume calculations. The moisture content at the elevated temperature sites was determined using an impinger train that was weighed before and after each test to the nearest 0.5 g with a calibrated electronic balance. The samples were collected at a single point in the center of the duct. Reference Method 4 calls for insertion of a heated probe into the duct. An un-heated stainless steel probe and flexible connector was used to extract the sample gas from a single point in the center of the stack. Inserting an electrically heat traced probe into a duct containing solvent vapors poses risks of fire or explosion and it is against our policy to expose our clients and ourselves to this type of risk. A one-hour moisture run was made during each test. A drawing of the sample train is included in Figure 3.2.

° ***VOC Emissions***
The concentration of volatile organic compounds were determined using USEPA Reference Method 25A, *"Determination of Total Gaseous Organic Concentration Using a*

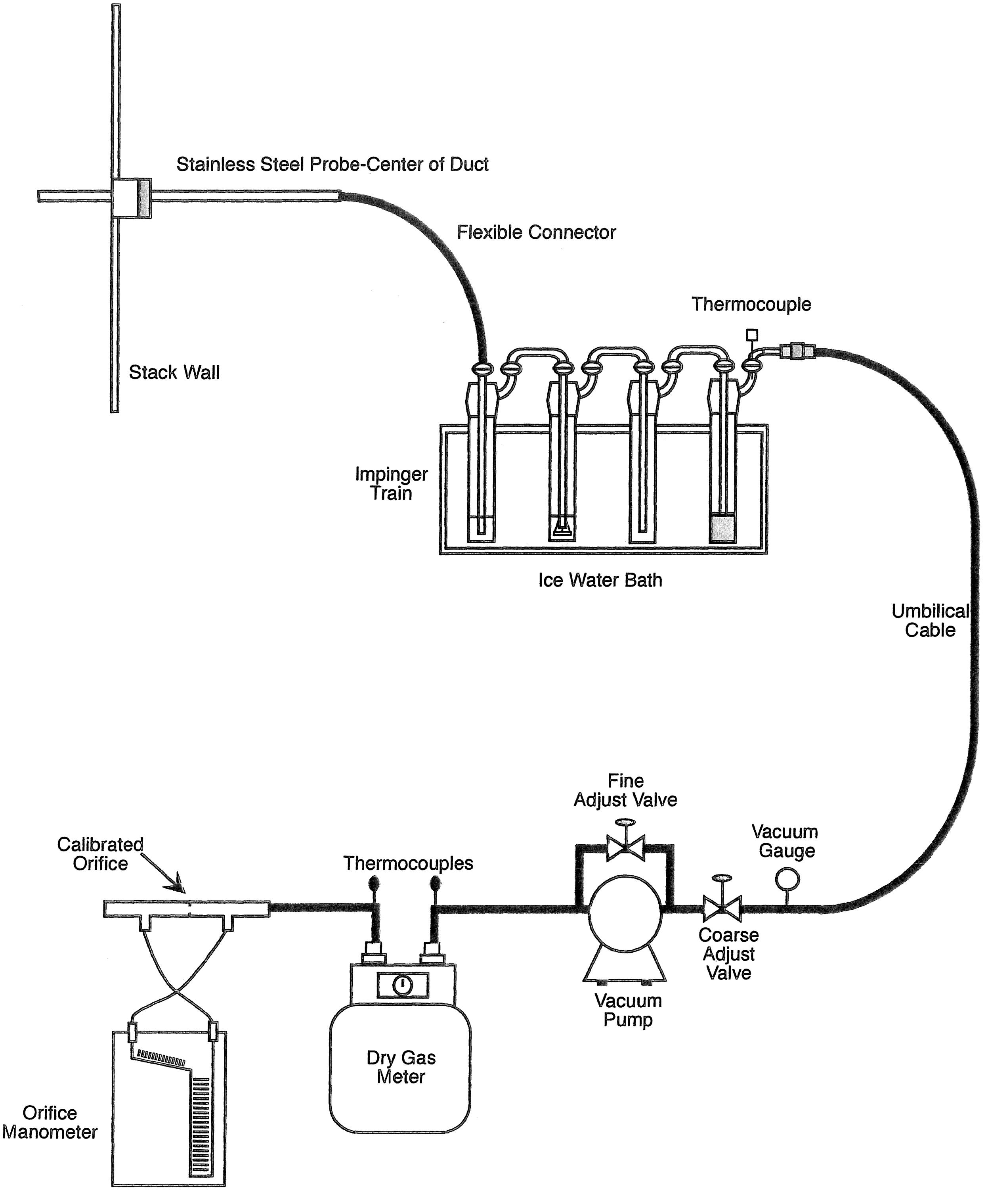


Figure 3.2 USEPA Reference Method 4 sampling train

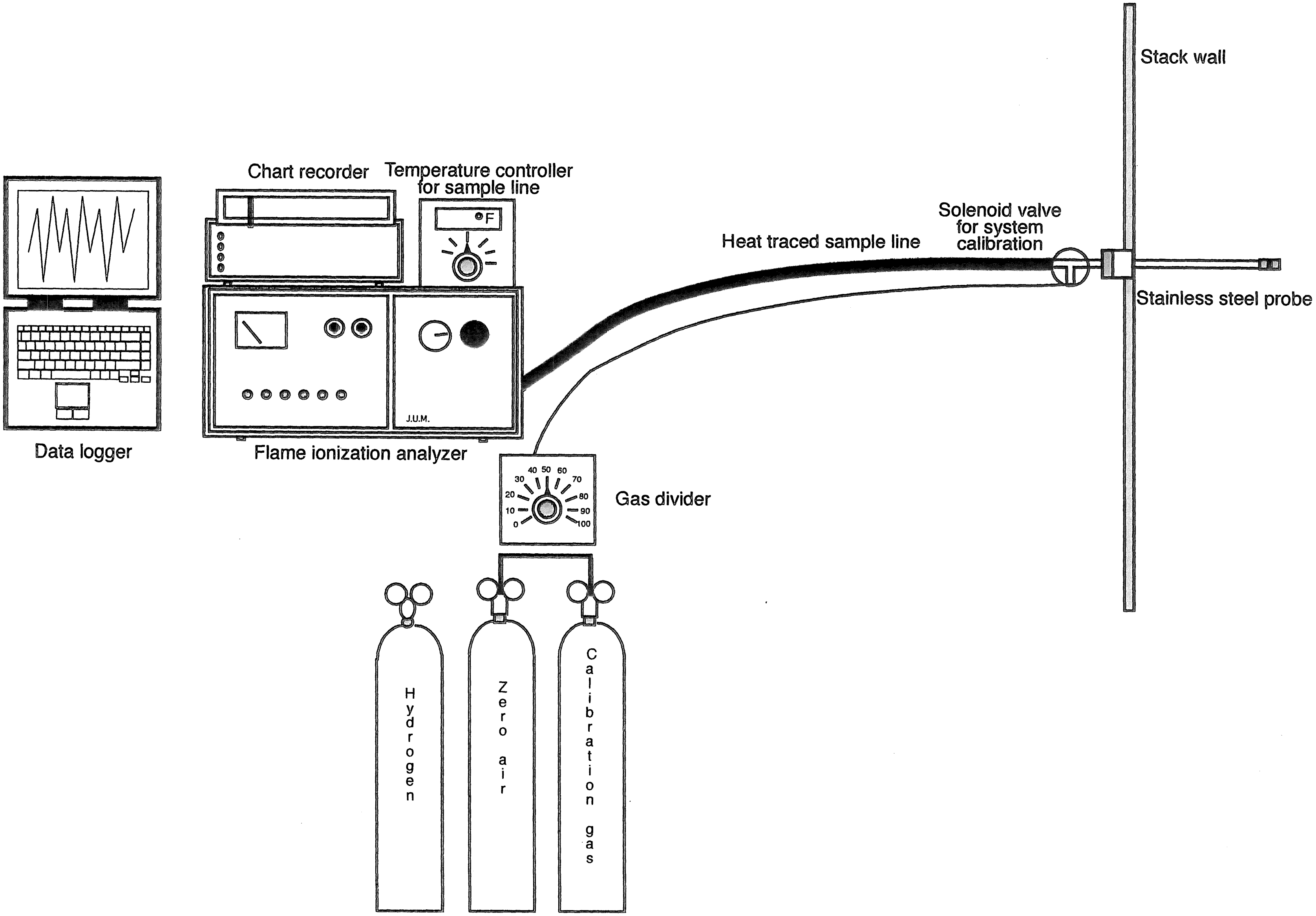


Figure 3.3 USEPA Reference Method 25A measurement system

Flame Ionization Analyzer". Continuous samples of the stack gas were extracted and analyzed with flame ionization analyzers (FIA). The sample gas was delivered to the analyzers through sampling systems that consist of heat traced, Teflon sample lines and stainless steel probes. The temperature of the sample lines was set at ≥110°C (230°F). The FIA output signals were recorded continuously on a strip chart recorder and instantaneously logged on a computer equipped with a data acquisition device. A drawing of the measurement system is included in Figure 3.3.

The FIA's were calibrated as specified in the Reference Method with ultra zero air (< 0.1 ppm THC), low-level, mid-level, and high-level mixtures of propane in air. The calibration standards were certified by USEPA Protocol 1 *"Traceability Protocol for Establishing True Concentrations of Gases Used for Calibration and Audits of Continuous Source Emission Monitors"*. Prior to the first test and each subsequent test, the linearity of the sampling system was established by introducing the high level span gas and zero gas through the sampling system to the analyzer and making the necessary adjustments. The mid-level and the low-level calibration gases were then introduced to each sampling system to check for calibration error. The measurement system response time was determined at this time. After each test, the sampling system and analyzer response to zero air and the mid-level span gas was checked to determine drift. All calibration and drift checks met Method requirements.

An ethanol in air calibration gas was used to determine a propane to ethanol response factor to convert the emission rates from a propane basis to an ethanol basis for the capture efficiency analysis.

° ***Methane***

The concentration of methane was determined at the outlet of the catalytic oxidizer using the principles of USEPA Reference Method 25A, *"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"*. Continuous samples of the stack gas were extracted and analyzed with a JUM Model 109A, or equivalent, flame ionization analyzer (FIA). The FIA is equipped with a heated catalyst that converts non-methane hydrocarbons to CO_2 and allows methane to pass through to the detector. The detector was calibrated with Protocol 1 standards of methane in air to determine linearity and analyzer drift.

° ***Gas dilution systems***

All of or a portion of the calibration standards were prepared using a gas dilution system. Gas standards from cylinders certified by USEPA Protocol 1 *"Traceability Protocol for Establishing True Concentrations of Gases Used for Calibration and Audits of Continuous Source Emission Monitors"* were diluted with zero air. The gas dilution systems were verified in the field using USEPA Method 205, *"Verification of Gas Dilution Systems for Field Instrument Use"*.

° ***Quality Assurance***

The Quality Assurance procedures used in this survey include equipment calibration by USEPA and manufacturer's guidelines, use of standard published procedures for sample collection and analysis, and attention to the QA procedures included in the Reference Methods. The quality assurance procedures and results for the equipment used in this survey are included in Appendix A.