AUGUST 31, 2005 PERFORMANCE TEST REPORT ON THE VAPOR COMBUSTION UNIT

PERFORMANCE TEST REPORT

JOHN ZINK THERMAL OXIDIZER INSTALLED AT
THE TESORO PETROLEUM DISTRIBUTION TERMINAL
IN BOISE, IDAHO

TEST DATES: AUGUST 31, 2005

Prepared for:

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1.0 Introduction

On August 31, 2005 personnel of VOC Testing, Inc. conducted a performance test of the John Zink thermal oxidizer emission control system installed at the Tesoro Refining and Marketing Company petroleum distribution terminal in Boise, Idaho. The testing entailed the simultaneous sampling of the inlet and outlet hydrocarbon concentrations, inlet volume, temperature, and pressure, and outlet carbon monoxide and carbon dioxide of the vapor control system during tank truck loading. The purpose of the testing was to determine the hydrocarbon mass emission rate of the thermal oxidizer.

The system was tested over a 6 hour period with more than 80,000 gallons loaded. The test was performed with the thermal oxidizer receiving vapors directly from tank trucks being loaded.

This report presents the results of the performance test, and describes the equipment and procedures used.

2.0 Test Results

The results of the performance test conducted on August 31, 2005 at the Tesoro petroleum distribution terminal in Boise, Idaho are summarized in Table 1.

The raw data and calculations supporting these results can be found in Appendix A and B.

Table 1

Efficiency an Mass Emission Rate Determination

Test Time	7:25 a.m. - 1:25 p.m.
Volume of Gasoline Loaded	182,515 gallons (690,819 l.)
Thermal Oxidizer Inlet Volume	36,314 SCF (1,028.4 Nm^3)
Thermal Oxidizer Exhaust Volume	2,266,574 SCF (64,190.7 Nm^3)
Average Inlet Concentration (THC)	11.1 % as C_1
Average Outlet Concentration (THC)	102.1 ppmv as C_1
Outlet Mass Emission (THC)	25.92 lbs. (11.76 kg)
Inlet Mass (THC)	531.8 lbs. (241.2 kg)
Hydrocarbon Removal Efficiency	95.1 %
Mass Emission Rate	0.142 lb/1000 gal. (17 mg/l)

3.0 Process Description

The John Zink thermal oxidizer installed at the Tesoro pretroleum distribution terminal in Boise, Idaho removes hydrocarbons from the air/vapor mixture displaced during gasoline truck loading by thermal oxidation at high temperatures. The thermal oxidizer receives vapors directly from tank trucks being loaded. The starting sequence begins when a truck hooks up its groung connection. This causes the combustion air blower and pilot light to come on in preparation for the flow of vapor. When the pressure at the motor operated valve in the inlet piping reaches 6 inches of water the valve opens, allowing vapor flow to the burner. When loading ceases, and the pressure at the valve drops to 0.5 inches of water, the valve closes.

The John Zink thermal oxidizer tested is a vertical cylindrical combustion chamber with refractory insulation and steel innerlining. The starting sequence begins with a pre-purge in which the air blower purges the combustion chamber for several minutes to remove any residual hydrocarbons. The pilot light then comes on, the motor operated vapor valve opens when the pressure at the valve reaches 6 inches of water, and vapors are fed to the burner through a detonation arrestor.

4.0 Testing Procedures

Inlet Volume and Hydrocarbon Monitoring

An six inch Rockwell T-30 turbine meter was inserted into the piping between the vapor holders and thermal oxidizing chamber to measure the volume of the vapor going into the combustion chamber. The temperature of the inlet vapor mixture was measured with a type K thermocouple placed onto the surface of the meter. A continuous sample of the inlet vapor was drawn with a 30' foot teflon sample line to the analyzer. The inlet gas volume was monitored in accordance with EPA Method 2a, "Direct Measurement of Gas Volume Through Pipes and Small Ducts."

The inlet gas sample was analyzed continuously with a Horiba PIR2000 hydrocarbon analyzer equipped with a nondispersive infrared detector. The analyzer was calibrated with certified standard gases of propane in nitrogen of 10, 23 and 45.4%. The inlet gas analysis of hydrocarbon concentration was performed in accordance with EPA Method 25B "Determination of Total Gaseous Organic Concentration Using a Nondispersive Infrared Analyzer". This method and other methods sited are included in Appendix C.

Outlet Sample Continuous Monitoring for Hydrocarbons, Carbon Monoxide, and Carbon Dioxide

The exhaust gas of the thermal oxidizer was continuously monitored for carbon monoxide, carbon dioxide, and total hydrocarbons. The sample was taken through a stainless steel probe spanning the stack outlet with sample holes at 4" intervals. The sample was drawn through 30 feet 1/4'' teflon tubing to a condenser system to remove moisture from the sample. The condenser system consisted of three modified Greenburg-Smith impingers in series in an ice water bath. The sample leaving the drying system was pulled through 3 feet of 1/4'' teflon tubing by a teflon coated diaphram pump to a manifold from which a slipstream was drawn for each of the three continuous analyzers.

Carbon monoxide and carbon dioxide concentration were analyzed using Horiba PIR 2000 non-dispersive infrared analyzers. The analyzers were calibrated at the beginning and end of the test with certified standards of CO and CO2 in nitrogen. The CO concentrations used were 52, 225, and 451 ppm. The CO2 standard concentrations used were 2.0, 4.0 and 13.7%. The carbon monoxide and carbon dioxide concentrations were recorded on a strip chart and five minute averages were recorded.

The outlet hydrocarbon gas sample was analyzed continuously with a Scott Model 116 total hydrocarbon analyzer equipped with a flame ionization detector. The analyzer was calibrated with certified standard gases of propane in nitrogen of 51, 182, 401 ppm. The hydrocarbon analysis was performed in accordance with EPA Method 25a.

Backpressure and Leak Detection

The vapor recovery system backpressure was checked at each loading position during the test with a Camlock adapter fitted with a 0-25 inch water magnehelic gauge which was placed on the vapor return hose during filling of the tank throughout the fill and the maximum, minimum and five minute interval backpressures were recorded for at least one fill for each flame arrestor.

During the test the vapor recovery system piping, flanges and valves were leak tested with a RKI Eagle explosimeter which was calibrated with 1.0% methane in air. Any leaks found were noted and any >99% L.E.L leaks were repaired before the test began.

At the beginning of the test all loading was halted for approximately 5 minutes in order to take the totalizer readings from the product dispensers. This procedure was also followed at the end of the test.