Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP42 Section: 7.1

Background Chapter 4

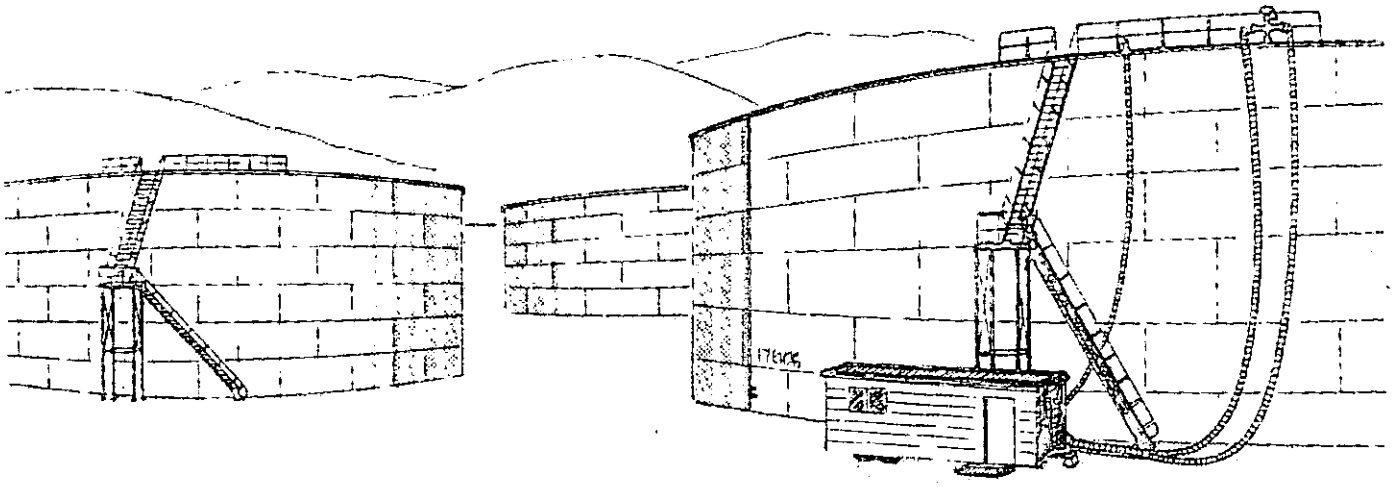
Reference: 4

Title: Hydrocarbon Emissions from Fixed-Roof Petroleum Tanks

Engineering Science, Inc., prepared for the Western Oil and Gas Association,

July 1977.

HYDROCARBON EMISSIONS FROM FIXED-ROOF PETROLEUM TANKS



PREPARED FOR

WESTERN OIL AND GAS ASSOCIATION

PREPARED BY

ENGINEERING-SCIENCE, INC.

HYDROCARBON EMISSIONS FROM FIXED-ROOF PETROLEUM TANKS

PREPARED FOR

WESTERN OIL AND GAS ASSOCIATION
609 South Grand Avenue
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JULY, 1977

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FOREWORD

Evaporation losses during storage and handling of crude oil and its products have been of concern to the petroleum industry for many years. As early as 1952, the American Petroleum Institute sponsored a "Symposium of Evaporative Loss" at one of its annual meetings. Initial reductions in evaporation losses by the industry helped maintain better product quality and improved safety within the industry. That concern for evaporation losses has continued and is now shared by environmental regulatory agencies as well. A number of efforts are underway to quantify hydrocarbon emissions so that major sources can be identified and controlled. Furthermore, much work is being done today to study the relationship of hydrocarbon emissions to photochemical smog problems.

The only basis available for estimating emissions from fixed-roof storage tanks has been a document describing potential volumetric product loss published by the American Petroleum Institute in June 1962, entitled, "API Bulletin on Evaporation Loss from Fixed-Roof Tanks" and identified as API 2518.

The API equations for fixed-roof tanks were based on work done over 20 years ago with a major emphasis on the economic benefits of reducing product volume loss. The work was based primarily on large gasoline storage tanks and no empirical data were developed for working losses; correlations for these were based entirely on theoretical considerations. Furthermore, it is doubtful that the correlations were meant to be applied to small production lease tanks or crudes with significant amounts of methane or ethane.

The Western Oil and Gas Association undertook this study to determine, through field measurements, the general applicability of the API correlations for predicting hydrocarbon evaporation losses. In the event that measured emissions differed significantly from predicted emissions, methods for predicting emissions were to be re-evaluated. Thus, as air quality concerns arise in the future, it is hoped that this report can serve as a new reference point for estimating fixed-roof tank emissions and in determining the need for further empirical data.

ACKNOWLEDGMENTS

The Western Oil and Gas Association (WOGA) contracted with Engineering-Science, Inc. (ES) for this evaluation of hydrocarbon emissions from fixed-roof storage tanks in late November 1976. Chairmen of WOGA Committees who sponsored and supported this project were:

Mr. William B. Harrell, Chairman, WOGA Environmental Conservation Committee (ECC), Mobil Oil Corporation, Torrance, California.

Mr. Morton C. Roman, Chairman, WOGA Project Coordinating Subcommittee, Atlantic Richfield Company, Los Angeles, California.

In addition, Dr. Carlton B. Scott, Union Oil Company of California, Los Angeles, California, assisted in developing the project as the former Chairman of ECC. While the ECC has overall responsibility for WOGA's environmental programs, specific projects are carried out under the direction of appointed task groups of engineers and scientists, each possessing qualifications in some phase of the subject under consideration. WOGA, likewise, directed and monitored this project through a 16-member task force made up as follows:

Name	Organization
Robert D. Harrer, Chairman	Chevron U.S.A. Inc. San Francisco, California
William N. Harman, Vice-Chairman	Chevron U.S.A. Inc. La Habra, California
T. J. Abshier	Mobil Oil Corporation Los Angeles, California
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William L. Shumate	Union Oil Company of California Los Angeles, California
Richard H. Thomas	Texaco, Inc. Los Angeles, California
Rich Voils	Mobil Oil Corporation Los Angeles, California
Glenn R. Wong	Exxon Company U.S.A. Los Angeles, California

The successful completion of this project was partially ensured by the unbiased efforts and open dialogue of several engineers and scientists from the air pollution control agencies. Open meetings were held monthly to discuss progress, and all ideas voiced by these participants were fully considered within the limits of established time and budget constraints. The following organizations were represented at different times and by different individuals throughout the course of this investigation.

Environmental Protection Agency
Region IX, San Francisco, California

Environmental Protection Agency
Research Triangle Park, North Carolina

California Air Resources Board
Sacramento, California

Santa Barbara County Air Pollution Control District
Santa Barbara, California

Santa Barbara County Petroleum Department
Santa Maria, California

South Coast Air Quality Management District
El Monte, California

Ventura County Air Pollution Control District
Ventura, California

The American Petroleum Institute provided input to the projects through its Committee on Evaporative Loss Measurements.

The California Independent Producers Association provided suggestions and ideas on the project through their representative:

John O. Robertson, Jr.
American Pacific International
Los Angeles, California

Engineering-Science, Inc. received support for testing arrangements and special technical problems from WOGA through additional WOGA consultants. Mr. Max Smith was especially helpful to the field project through his day-to-day arrangements with the owners and operators of the tested storage tanks. Mr. Jack H. Galey assisted ES with special technical problems. As a representative of WOGA, Dr. E. R. (Sam) Fett of Union Oil Company of California, Union Research Center, provided guidance on the laboratory analyses.

The Project Manager for this investigation was Mr. A. L. Wilson. The Project Coordinator was Mr. Donald R. Holtz and the Technical Director was Mr. M. Dean High, Vice President, Engineering-Science, Inc. To all who contributed to the study and preparation of this report, Engineering-Science, Inc. extends its sincere appreciation.

TABLE OF CONTENTS

		Page
Foreword		i
Acknowledgments		ii
CHAPTER I	EXECUTIVE SUMMARY	I-1
CHAPTER II	CONCLUSIONS AND RECOMMENDATIONS	II-1
CHAPTER III	INTRODUCTION	III-1
	Background	III-1
	Objectives	III-1
	Scope	III-2
	Approach	III-3
CHAPTER IV	METHODOLOGY	IV-1
	Principle	IV-1
	Flow Measurement	IV-1
	Hydrocarbon Measurement	IV-6
	Temperature	IV-6
	Calibration	IV-6
	Safety Considerations	IV-12
	Field Procedures	IV-12
	Laboratory Procedures	IV-15
CHAPTER V	HYDROCARBON EMISSION MEASUREMENTS	V-1
	General	V-1
	Standing Storage Tanks Subject to Breathing Losses	V-3
	Working Tanks Subject to Combined Working, Breathing, and Flashing Losses	V-6
CHAPTER VI	COMPARISON OF MEASURED EMISSIONS WITH API CALCULATED EMISSIONS AND MEASURED PARAMETERS	VI-1
	Breathing Losses	VI-2
	Working Losses	VI-17
	Special Tanks Subject to Pressure Drop Flashing	VI-30
APPENDIX		

LIST OF TABLES

No.	Title	Page
V-1	Hydrocarbon Emission Measurements of Breathing Losses from Standing Storage Tanks	V-5
V-2	Hydrocarbon Emission Measurements From Working Tanks	V-9
VI-1	Measured Versus API Calculated Emissions for Standing Storage Fixed-Roof Tanks	VI-6
VI-2	Calculated True Vapor Pressure and Paint Factor for Standing Storage Tanks	VI-8
VI-3	Measured Hydrocarbon Emissions Compared With API 2518 Calculated Emissions for Tanks in Continuous Working Operation	VI-20
VI-4	Calculated True Vapor Pressure, Paint Factor and Turnover Factor for Working Tanks	VI-22
VI-5	Measured Hydrocarbon Emissions Compared With API 2518 Calculated Emissions for Special Tanks Receiving Crude Under Pressure From An Upstream Process	VI-31
VI-6	Calculated True Vapor Pressure, Paint Factor and Turnover Factor for Special Tanks	VI-32
VI-7	Calculated Versus Measured Reid Vapor Pressure	VI-34

LIST OF FIGURES

No.	Title	Page
I-1	Summary of Hydrocarbon Emission Tests on Fixed-Roof Tanks	I-2
IV-1	Photographs of Field Trailer and Associated Equipment	IV-2
IV-2	Photographs of Field Trailer and Instrumentation	IV-3
IV-3	Hydrocarbon Vapor and Air Volume Metering System	IV-4

LIST OF FIGURES (Cont.)

No.	Title	Page
IV-4	Schematic of Instrumentation for Hydrocarbon Emission Measurement	IV-7
IV-5	Century Model 138 Organic Vapor Analyzer Calibration Curves	IV-9
IV-6	Hydrocarbon Sample Degradation	IV-10
V-1	Example Operations of Fixed-Roof Tanks	V-4
V-2	Example of Breathing Profile for Standing Storage Tanks	V-7
VI-1	Extrapolation of RVP versus TVP Nomograph From API 2518	VI-3
VI-2	Relationship of Condensed Vapor Density and Molecular Weight for Typical Hydrocarbon Compounds	VI-5
VI-3	Measured Versus Calculated Breathing Loss Emissions for Standing Storage Tanks	VI-7
VI-4	Measured Versus Calculated Breathing Loss Emissions for Standing Storage Tanks - API and ES Data	VI-10
VI-5	Hydrocarbon Vapor Concentration Versus $\left(\frac{P}{14.7-P}\right)^{0.68}$ for Crude Oil Standing Storage Tanks	VI-11
VI-6	Emission Concentration Versus Crude Oil RVP, Standing Storage Tanks	VI-12
VI-7	Emission Concentration Versus Crude Oil True Vapor Pressure, Standing Storage Tanks	VI-14
VI-8	Measured Volume Flow Versus $D^{1.73}H^{.51}\Delta T^{.50}F_pC$	VI-15
VI-9	Daily Vapor Volume Expelled Versus Vapor Space Volume for Standing Storage Tanks	VI-16
VI-10	Measured Hydrocarbon Emissions Compared with API 2518 Calculated Emissions for Tanks in Continuous Working Operation	VI-23
VI-11	Total Hydrocarbon Concentration Versus Reid Vapor Pressure for Batch and Continuous Tanks	VI-24

LIST OF FIGURES (Cont.)

No.	Title	Page
VI-12	Total Hydrocarbon Concentration Versus True Vapor Pressure for Batch and Continuous Tanks	VI-25
VI-13	Total Hydrocarbon Concentrations Versus Reid Vapor Pressure x K_T for Continuous Tanks	VI-26
VI-14	Total Hydrocarbon Concentration Versus True Vapor Pressure x K_T for Continuous Tanks	VI-27
VI-15	Measured Vapor Volume Expelled Versus Volumetric Liquid Flow Into Tank for Continuous Tanks	VI-29

CHAPTER I

EXECUTIVE SUMMARY

CHAPTER I

EXECUTIVE SUMMARY

Since its publication in 1962, API Bulletin 2518 has been used to estimate hydrocarbon emissions from fixed-roof storage tanks. Little additional data have developed since that time, and because of wide application of the API equations by both industry groups and government agencies charged with air pollution control, it has become evident that the data base needs to be re-examined and expanded.

Potential problems exist in applying the API equations to facilities and types of operations not measured in the original correlation. Some of these questionable applications include tanks handling unstabilized crude containing methane and ethane, and production working tanks with large throughputs but with corresponding small liquid level changes.

The Western Oil and Gas Association initiated this investigation to develop additional and up-to-date measured data to add to the API data base. The objectives included developing data through field measurements of fixed-roof storage tanks, determining API method applicability by comparing measured to calculated emissions, deriving from the new data base correlations predicting emissions from fixed-roof tanks in crude oil and low vapor pressure distillate service, and characterizing the emission composition by stock type, gravity, temperature, etc.

LIMITED STUDY!

Fifty-six tests were conducted on 49 fixed-roof tanks. Twenty-three tests were conducted to measure breathing loss emission and 33 for working losses. Ten tests were voided for various reasons; 46 tests were completed. Figure I-1 illustrates the 46 tests and some of the parameters associated with fixed-roof losses. Field testing on the project started in January and was completed in May 1977.

To measure the hydrocarbon emissions, ES followed a procedure in API Bulletin 2512 which involved directly metering the total volume of vapor out of and into the storage tanks, and measuring the hydrocarbon concentration continuously with a flame ionization detector. Grab samples of the vapor were collected and analyzed on a gas chromatograph

SUMMARY OF HYDROCARBON EMISSION TESTS ON FIXED-ROOF TANKS

Tank Location 26 - Los Angeles County 3 - Orange County 9 - Santa Barbara County 8 - Ventura County	**Tank Capacity (Bbls)** 11 - Less than 2000 10 - 2000 thru 5,000 4 - 5,001 thru 50,000 16 - 50,001 thru 100,000 5 - Greater than 100,000	**Tank Color** 12 - White 8 - Gray 13 - Aluminum 13 - Other
Stock Type 37 - Crude 6 - Distillate 3 - Fuel oil 46	**Stock Reid Vapor Pressure** 11 - Less than 1 ~~16 - 1.0 to 3.0~~ ~~10 - 3.1 to 5.0~~ 7 - More than 5.0 7 - Not Measured No's don't check 3	**Stock Temperature** 28 - Less than 100°F 18 - Greater than 100°F
Tanks Tested 21 - Breathing 25 - Working 5 - Batch 13 - Continuous 7 - Special	**Total Hydrocarbon Emissions Standing Storage Tanks** 13 - Less than 10 lbs/day 3 - 11 thru 100 lbs/day 3 - 101 thru 200 lbs/day 2 - 201 thru 575 lbs/day 21	**Total Hydrocarbon Emissions Working Tanks** 7 - Less than 10 lbs/day 6 - 11 thru 100 lbs/day 8 - 101 thru 1000 lbs/day 4 - Greater than 1000 lbs/day 25

FIGURE I-1

liquid samples, taken at each tank, were analyzed for physical and chemical characteristics. Positive displacement gas meters, and turbine meters, were housed in trailers and connected by 6-inch flexible hoses to the tanks. The flame ionization detector, the vapor sample collection system, and the temperature measurement system also were contained in the trailers.

Results of the testing program showed that breathing losses average about 58 percent of the quantities estimated by the API equation.

Losses from working tanks are dependent upon the mode of operation. The working tanks in this study were classified into three groups according to their mode of operation: batch, continuous, and special/boiling. Measured results on the five batch tanks were not definitive; however, some general trends were noticed.

The continuous operation tanks included Lease Automatic Custody Transfer (LACT) tanks and wash tanks. Hydrocarbon emission rates from working tanks varied considerably but on 13 tested tanks, total emissions were only about 55 percent of the quantities calculated by the breathing and working loss equations of API 2518.

Seven special tanks which recieved boiling crude were analyzed separately. Emissions from five of these tanks were controlled by vapor recovery systems. Permission was obtained from local control officials to disconnect the systems for testing. Results showed large emissions from most of the tanks due to flashing of the light ends. API Bulletin 2518 indicated that boiling crudes were not intended to be covered by the API equations so no correlations were attempted.

CHAPTER II

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER II

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

(1) No new hydrocarbon emission prediction equations were recommended for fixed-roof storage tanks, although several general trends were observed in portions of the data.

(2) Measured hydrocarbon evaporation losses from static storage tanks containing crude oil, fuel oil, and low vapor distillates were less than losses calculated by the API equations. For the tanks in this study, the average losses were 58 percent of those calculated from API 2518. Tanks of 2,000 barrel capacity or less showed negligible evaporation losses while in standing storage.

(3) Measured hydrocarbon evaporation losses from static storage tanks containing fuel oil and low vapor pressure distillates were negligible. This is a result of the relatively low concentration of hydrocarbons (less than 1.3 pounds of hydrocarbons per 1000 standard cubic feet) in vapors expelled from the tank.

(4) Losses from working tanks were found to be dependent upon the actual operating pattern of the specific tank. Thus, broad application of the API Bulletin 2518 equations for losses from working crude oil tanks is not a valid procedure.

(5) Measured hydrocarbon evaporation losses from continuous tanks containing crude oil and low vapor pressure distillates were less than losses calculated from API Bulletin 2518 equations, which were based on the volume of liquid pumped into the tank. For tanks in this study, average emissions were 55 percent of those predicted by API 2518. Losses from continuous tanks were highly variable. It appeared that losses were influenced by both the manner in which the liquid level changed and the liquid throughput.

(6) The API equations were obviously not valid for tanks receiving unstabilized crude under a slight pressure; flashing of light ends in the tank was observed. The API Bulletins suggested that the equations might not be applicable for use on tanks where flashing of the light ends occurred.

(7) The molecular weights of collected hydrocarbon vapors ranged from about 22 to 125 lb/lb-mole. The majority of the hydrocarbon vapors from crude oil had molecular weights between 50 and 55. The vapors from fuel oil and low vapor pressure distillates such as diesel tended to have higher molecular weights than crude oil, generally averaging 70 to 100.

(8) The basic API method of measuring hydrocarbon losses from fixed-roof storage tanks using positive displacement meters was demonstrated to be workable. On tanks emitting hot vapors, coolers must be used in the lines to remove condensible hydrocarbons and water vapors before the hydrocarbons reach the meters.

(9) For those unstabilized crude oils containing significant amounts of methane or other light ends, the Reid vapor pressure may not be a good indicator of the stock's true vapor pressure. Apparently the laboratory test procedure is not truly suitable for analyzing unstabilized crude oils due to the unavoidable loss of the light ends during transfer of the sample to the Reid apparatus.

RECOMMENDATIONS

(1) For calculating breathing losses from crude oil, distillates and other low vapor pressure petroleum products contained in fixed-roof storage tanks, the API breathing loss equation should be reviewed and modified, if necessary, due to the large variability of results between measured and predicted losses.

(2) The API working loss equation for fixed-roof storage tanks should be modified or tailored to take into account specific tank operations.

(3) For continuous operating tanks where simultaneous filling and emptying operations occur, the API working loss equation should be adjusted to reflect the actual change in fluid levels either in addition to, or in lieu of, the amount of liquid throughput.

(4) For those tanks receiving unstabilized crude under slight pressure, the API equations should definitely not be used.

(5) For unstabilized crude oils, the Reid vapor pressure should not be used as the sole indicator of true vapor pressure.

CHAPTER III

INTRODUCTION

CHAPTER III

INTRODUCTION

BACKGROUND

In June 1962, the American Petroleum Institute, published API Bulletin 2518 entitled "Evaporation Loss from Fixed-Roof Tanks." The major emphasis of this Bulletin centered on evaporation losses from gasoline storage and working tanks. Observations on crude oil breathing losses were reported on only 15 tanks. Fourteen of the 15 were 115 feet in diameter. Thirteen of the 15 were painted white. A correlation was developed for crude losses from these 15 data points by multiplying the expression developed for gasoline losses by a constant (K_c).

API Bulletin 2518 reports that, for crude oil working losses, data were very limited and scattered. Therefore, no empirical correlation was possible. Theoretical considerations suggested that crude oil working losses could also be obtained by multiplying the theoretical expression developed for gasoline working losses by a constant.

While the 1962 data base was somethat limited and intended for predicting liquid volume loss, no other research group, public or private, had presented any substantial data on which to estimate vapor emissions. Other potential problems existed in applying the API equations to tanks which were different from those utilized in the original correlation to unstabilized crude oils or crude oils containing methane or ethane, and to working tanks with large throughputs but small liquid level changes.

OBJECTIVES

The Western Oil and Gas Association undertook this investigation in late November 1976, to develop up-to-date measured emission data on the amounts and types of hydrocarbon emissions from fixed-roof storage tanks to add to the existing data base presented by API. The study had two primary objectives:

- Determine the hydrocarbon emissions from selected fixed-roof tanks by making field measurements.
- Determine the applicability of the API equations by comparing observed emissions to the calculated losses.

In addition, if consistent trends were observed in the data base, another objective was:

- Characterize the composition of the emissions as a function of crude type or product, specific gravity, storage temperature, etc.

In the event that a significant discrepancy was observed between the emissions calcualted from the API equation and the emissions measured in the field, and if consistent trends were also observed, a final objective was:

- Derive correlations predicting hydrocarbon emissions from fixed-roof tanks within limitations of the new data base.

SCOPE

To update the data base on emissions from fixed-roof tanks, the WOGA task force made available 49 tanks for testing. A total of 56 tests were scheduled on the 49 tanks. Twenty-three separate tests were scheduled for breathing losses. Thirty-three tests were schedules for working losses. Of the 56 scheduled tests, ten had to be voided for various reasons; 46 were completed. Some of the tanks were tested in a standing as well as a working mode or were re-tested. Twenty-one breathing loss tests of tanks in static storage were completed; 25 working loss tests were completed. Of the working loss measurements, 5 batch and 13 continuous tanks were completed. The remaining working loss measurements were conducted on 7 special oil field service tanks that received unstabilized crude under slight pressure. Among the working tanks two

particular types are wash tanks[1] and lease automatic custody transfer (LACT) tanks.[2]

All tanks were located in Santa Barbara, Ventura, Los Angeles, and Orange Counties, California. Thirty-seven of the tanks contained crude oil and nine of the tanks contained low vapor pressure distillate products or fuel oil. The tanks were tested between January and May 1977. All tanks had vertical cylindrical shells and fixed roofs. All tanks were operated at approximately atmospheric pressure (±0.86 inch water column). All tested tanks were equipped with pressure/vacuum valves and were not freely vented to the atmosphere. Permission was received from the appropriate governmental agencies to disconnect tanks from vapor recovery systems for testing.

This study represented a cross-section of tanks in Southern California containing mostly California crudes and distillates. It did not necessarily represent the total population of tanks found in the United States nor did it represent a statistical sampling of the various types of tanks in the industry. Lastly, the study did not take into account all the possible variations of tank or process operating procedures.

APPROACH

A sampling schedule was developed whereby four tanks were tested each week using two field trailers. The trailers were disconnected from the tanks and moved to a new site each Monday and Thursday. Two or three full days of testing were available on each tank. Tanks were prepared for testing by disconnecting vapor recovery systems (where they were used), sealing the tanks to be vapor tight and arranging for testing with the field superintendent or other official. Two 6-inch diameter flexible plastic hoses were connected from the tank to gas meters in the

---

(1) The term "wash tank" refers to a tank in which the primary separation of produced oil and water occurs. These are production tanks and are considered as process tankage rather than storage tankage.

(2) The term "lease automatic custody transfer" (LACT) tank refers to a particular type of continuously working tank in the production area. Control of the crude is automatically transferred from the producer to the transporter (e.g., pipeline operation) as it leaves this tank.

trailer which measured the vapor expelled or air drawn into the tank over the test period. Vapor temperatures were recorded and organic vapor analyzers continuously recorded the total hydrocarbon content of the discharged vapors. Grab samples of the emitted vapors were collected in Tedlar bags and returned to the laboratory for analyses by gas chromatograph. Liquid samples of the crude oil and distillate stocks were collected at the time of testing and later analyzed for key parameters relating to potential emissions.

CHAPTER IV

METHODOLOGY

CHAPTER IV

METHODOLOGY

PRINCIPLE

Testing procedures employed in this investigation were designed to measure controlled working and breathing hydrocarbon losses from crude oil and other low vapor pressure petroleum products in fixed-roof storage tanks. The technical approach for the testing effort was patterned after API Bulletin 2512, "Tentative Methods of Measuring Evaporative Loss from Petroleum Tanks and Transportation Equipment," Part II, Sections E and F.

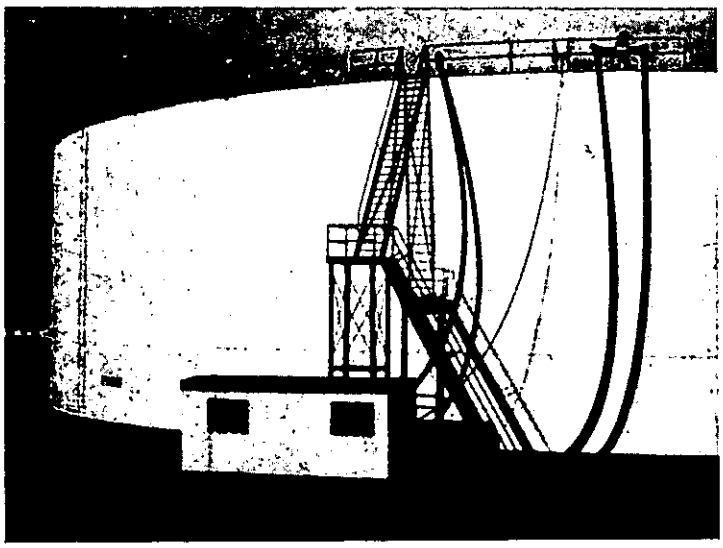
The mass rate of hydrocarbon emissions was determined by directly metering the volume of vapor from the storage tank and by measuring the hydrocarbon concentration of the vapors using a continuous flame ionization detector. Grab samples of vapor also were collected for subsequent analysis on a gas chromatograph. Samples of the liquid content of the tanks were collected for determination of physical and chemical characteristics. Parameters monitored during the field testing program paralleled those needed in the API 2518 equations. Two office-size mobile trailers were used to house and to transport the permanently installed test equipment and the associated hoses and connecting devices. A trailer was placed as close to the tank as possible and connected to the tank with six-inch flexible hose. Photographs of the field trailers are shown in Figures IV-1 and IV-2.

FLOW MEASUREMENT

Vapors expelled from the tank as well as air drawn into the tank were metered by two separate measurement systems installed in each trailer. Each air or vapor system was comprised of a large and a small positive displacement diaphragm meter and a turbine meter connected in parallel (Figure IV-3). Those three meters were required to cover the potential range of flow rates. The meter used primarily in the field testing was the positive displacement diaphragm meter Model Number 10000, manufactured by Rockwell International. The turbine meter,

PHOTOGRAPHS OF FIELD TRAILER AND ASSOCIATED EQUIPMENT

A

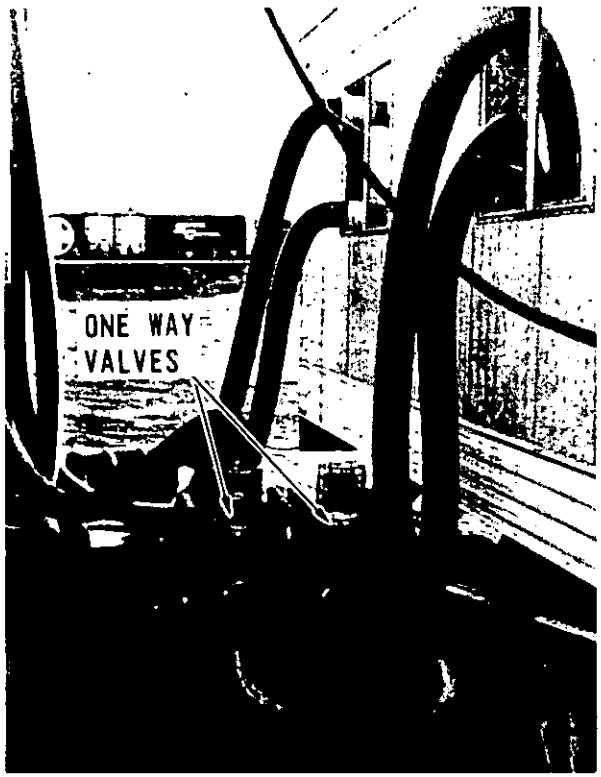


A. FIELD TRAILER

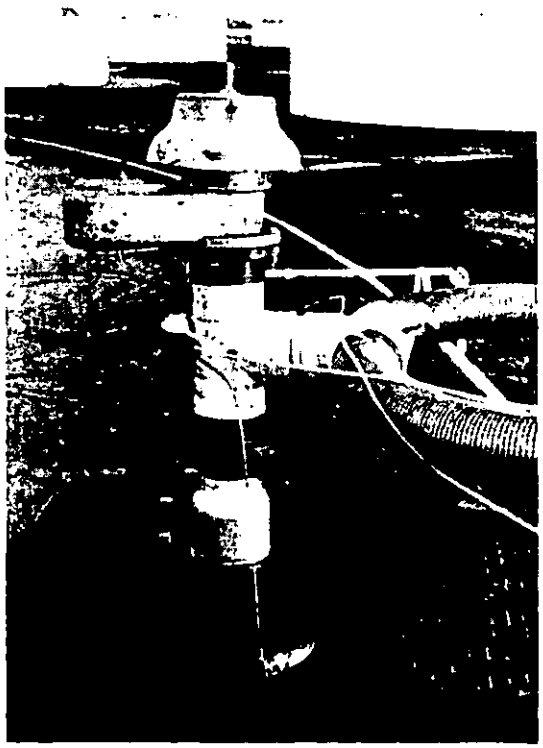
B. ONE-WAY VALVES

C. TANK MANIFOLD

B

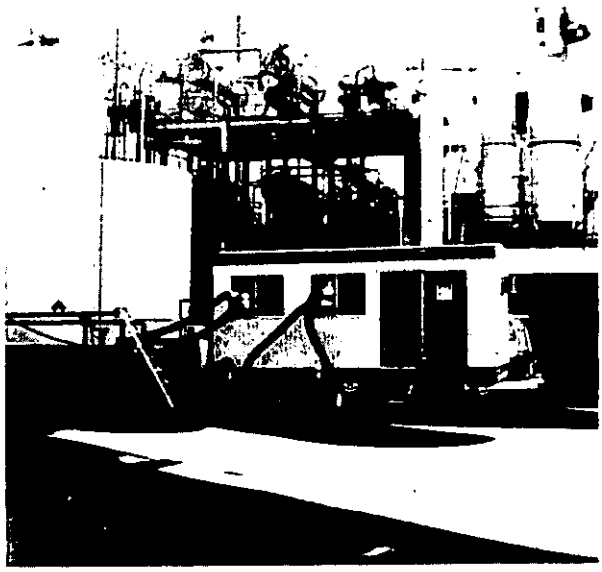


C



PHOTOGRAPHS OF FIELD TRAILER AND INSTRUMENTATION

A

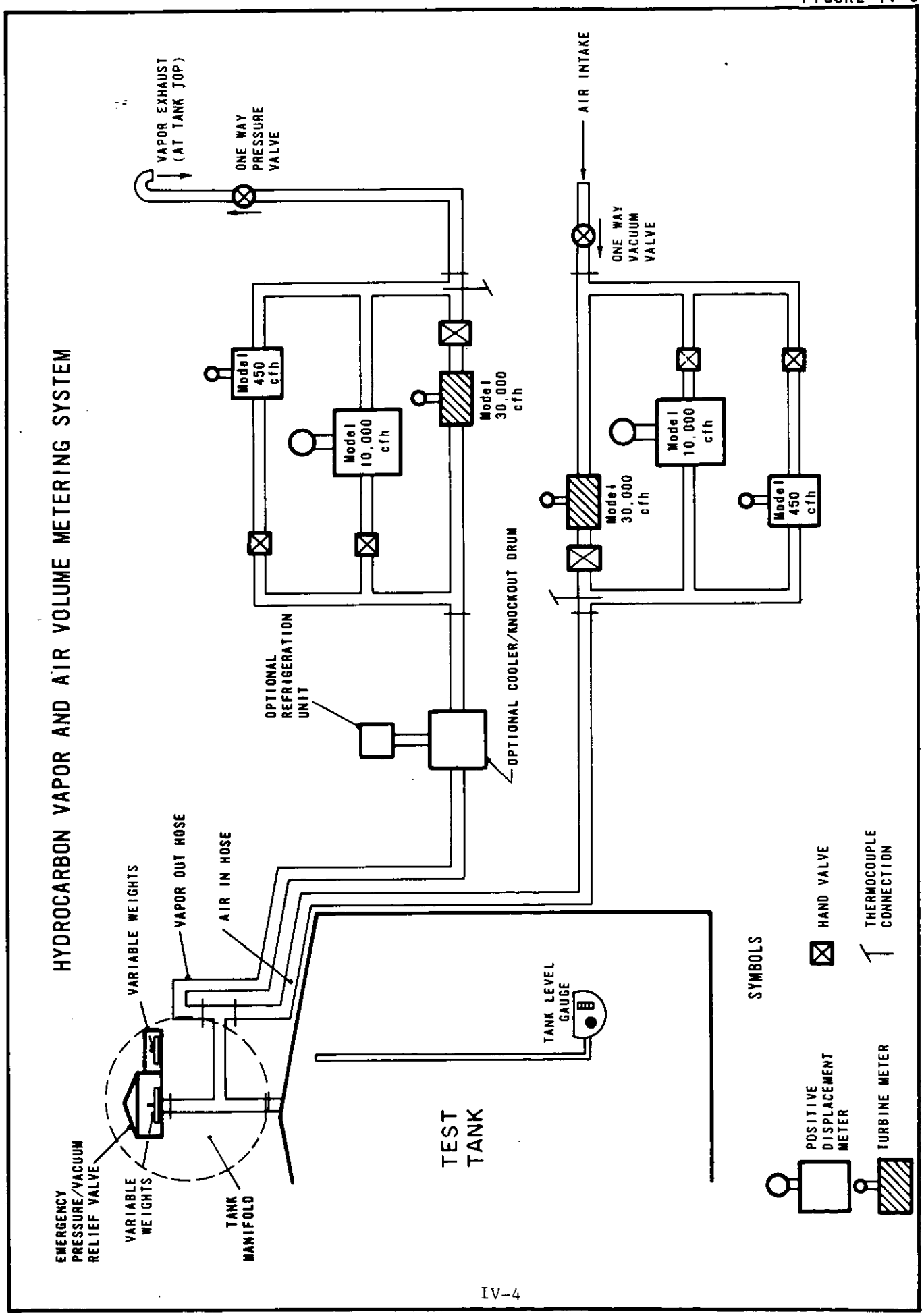


A. FIELD TRAILER

B. INSTRUMENTATION

B

FIGURE IV-3


HYDROCARBON VAPOR AND AIR VOLUME METERING SYSTEM
VAPOR EXHAUST (AT TANK TOP)
ONE WAY PRESSURE VALVE
AIR INTAKE
ONE WAY VACUUM VALVE
Model 450 cfh
Model 10,000 cfh
Model 30,000 cfh
Model 30,000 cfh
Model 10,000 cfh
Model 450 cfh
OPTIONAL REFRIGERATION UNIT
OPTIONAL COOLER/KNOCKOUT DRUM
VARIABLE WEIGHTS
VAPOR OUT HOSE
AIR IN HOSE
TANK LEVEL GAUGE
TEST TANK
EMERGENCY PRESSURE/VACUUM RELIEF VALVE
VARIABLE WEIGHTS
TANK MANIFOLD
SYMBOLS
HAND VALVE
THERMOCOUPLE CONNECTION
POSITIVE DISPLACEMENT METER
TURBINE METER

Model Number 30000, also manufactured by Rockwell International, was used exclusively during peak flow periods when the differential pressure drop across the positive displacement meters approached the tank relief valve settings. A small positive displacement meter (Rockwell Model 450) was used for extremely small flows. Meters were equipped with integrating flow recorders and were brought on and off stream manually. For large flows, the large positive displacement meter and turbine meter were sometimes run simultaneously. A one-way valve was installed on the downstream side of the meters on the vapor side in order to prevent the meters from turning backwards when the tank was under negative pressure. Similarly a one-way valve was placed upstream of the meters on the air side of the metering system to prevent the air side meter from turning backwards under a positive tank pressure. These one-way valves were also weighted to simulate the action of a 0.86-inch water column pressure/vacuum relief valve since the API equations are based on tanks with relief valves. Tell-tales were installed on the tank pressure relief valve to indicate if and when vapor escaped to the atmosphere during a test.

Six-inch diameter flexible vinyl hoses were used to carry the tank's vapors or intake air to the meter system and one-way valves. Due to safety considerations, only PVC (40 IPS) piping was used inside the trailers. Vapor condensation in the flow meters and lines was no problem during tests of unheated tanks. Tests on heated tanks, however, required heat exchangers immediately upstream of the vapor flow meters to remove condensible hydrocarbons. This heat exchanger used a water-ethylene glycol mixture chilled to about 45°F to cool the vapors. Since condensate can collect in the low spots of the vinyl hoses, those hoses were normally arranged so that any condensate would drain into the heat exchangers. All of the hydrocarbon condensate collected in the heat exchangers was weighed for later inclusion in the hydrocarbon loss calculations. On a few tanks, the vapors leaving the heat exchangers were also warmed-up about 10°F before entering the meters, by a heated section of pipe to further minimize condensation in the meters. This approach was later discontinued because of safety considerations.

HYDROCARBON MEASUREMENT

A sample stream of the tank vapors was continuously drawn through a 1/4-inch i.d. heated line to the test trailers for analysis. A portion of the sample stream was bled to a Century Organic Vapor Analyzer (OVA) Model 138 to obtain hydrocarbon concentration. Since the OVA can measure a maximum concentration of only 10,000 ppm (1%), it was necessary to dilute the bleed stream with hydrocarbon-free air. The ratio of diluent air to the bleed stream was normally 100:1.

The vapor grab samples for gas chromatograph analyses were obtained in two different manners. The samples for tanks with hot vapors were taken by hand from a tap on the heated sample line. This was done to avoid condensing any of the hot vapor before it reached the sample bag. Initially, the grab samples for unheated tanks were collected automatically with a sequential sampling system. This system used another bleed stream from the heated sample line to fill the Tedlar bags. In the last third of the program, however, grab samples for unheated tanks were taken manually. A schemetic of the hydrocarbon analysis system is presented in Figure IV-4.

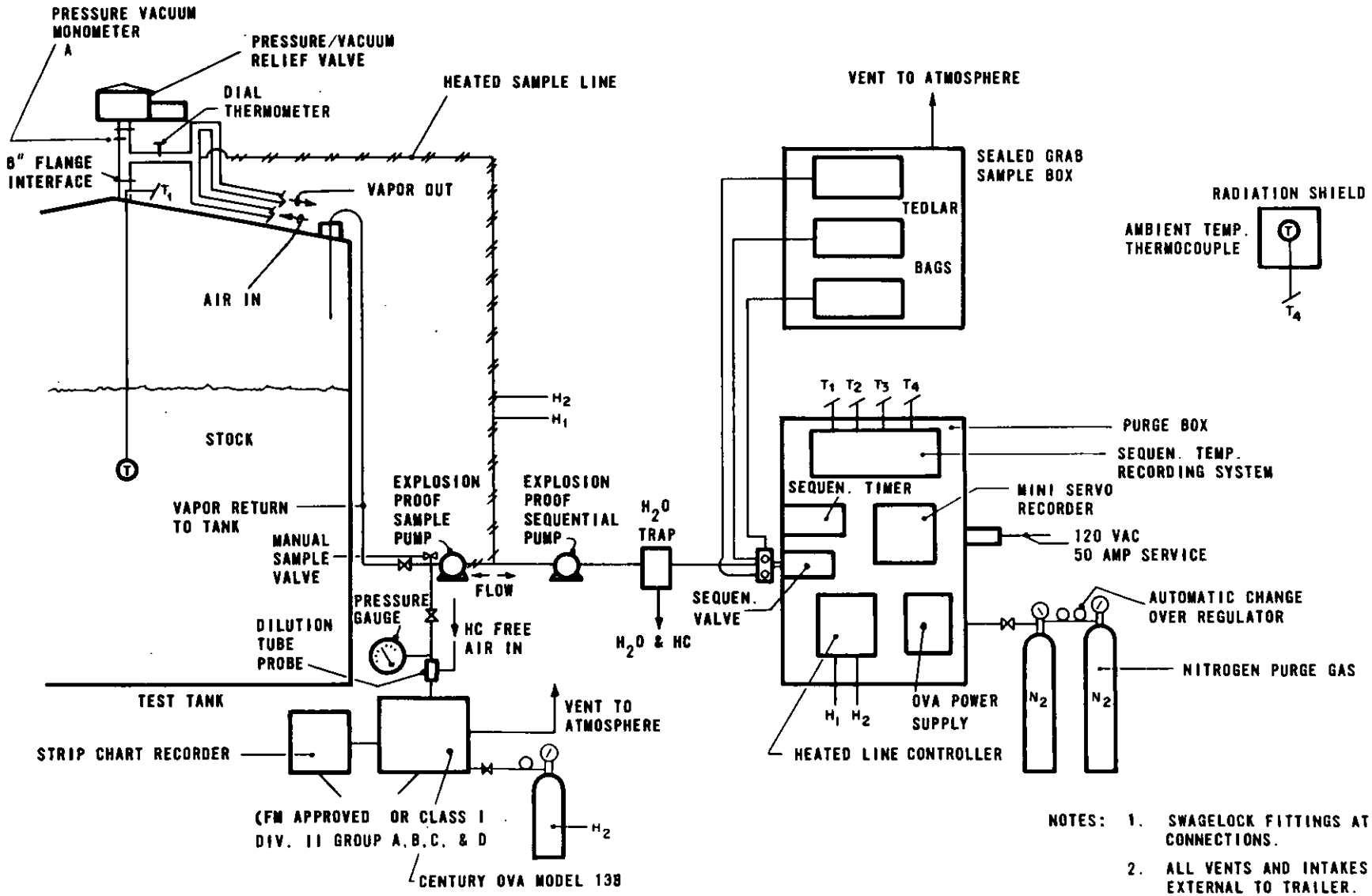
TEMPERATURE

A Thornwaite Model 304 4-channel sequential temperature monitoring system was used for the study. The sequential temperature sensing system employed copper-constantan thermocouples to measure vapor and air temperatures at the meters, and ambient air temperature and liquid stock temperature in the tank. The system worked well during the first half of the testing program. Later, however, due to the need for frequent maintenance on the system, it was replaced completely with dial and mercury thermometers.

CALIBRATION

The gas meters were calibrated or proved prior to and during the study by the Southern California Gas Company. Displacement meters were proved according to the methods prescribed by the American National Standards Institute (ANSI) Bulletins B109.1 and B109.2

SCHEMATIC OF INSTRUMENTATION FOR HYDROCARBON EMISSION MEASUREMENT



NOTES:
1. SWAGELOCK FITTINGS AT ALL CONNECTIONS.
2. ALL VENTS AND INTAKES ARE EXTERNAL TO TRAILER.

FIGURE IV-4

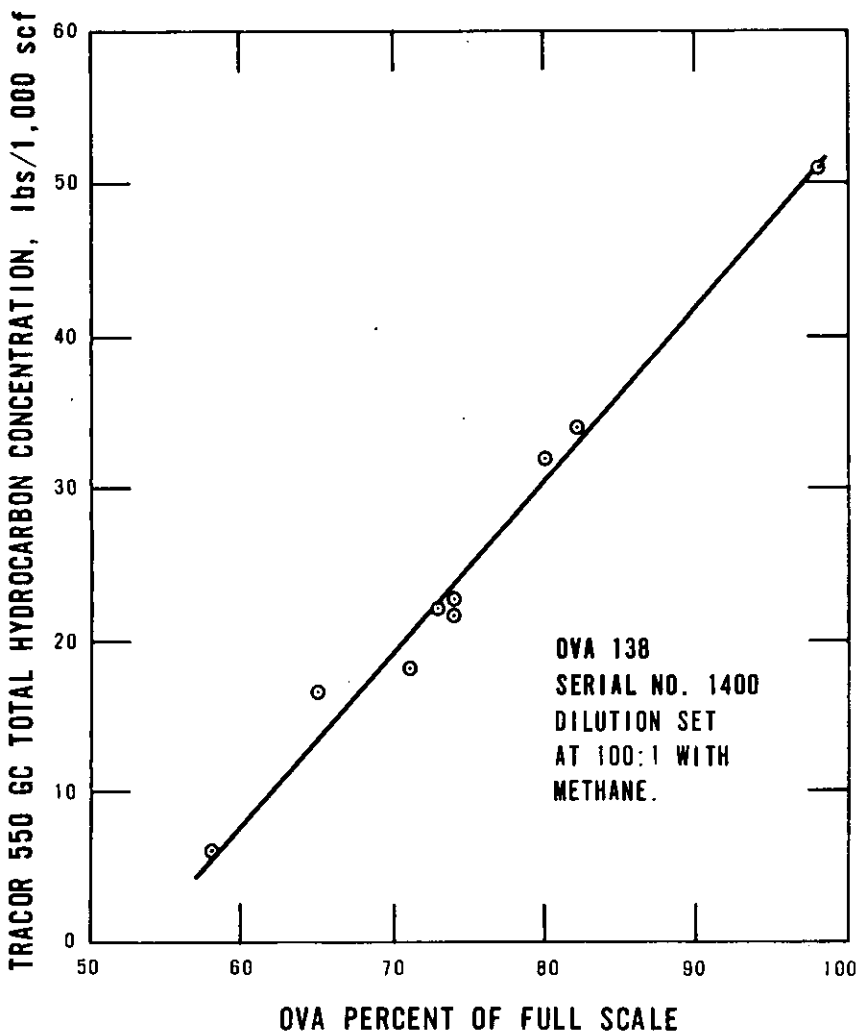
(proposed). Turbine meters were comparison-proved against a test meter traceable to the National Bureau of Standards. The meters were accurate to within 1 percent with one exception: that meter understated flow rate by 5 percent and was not used after the discrepancy was discovered in the testing program.

The Century Organic Vapor Analyzer was spanned daily using 100 percent methane. The methane calibration standard was stored in Tedlar bags and new standards were routinely prepared. To relate OVA readings to the gas chromatograph results, several comparisons were made on different selected tank vapors (Figure IV-5). Results showed excellent correlation of the OVA flame ionization detector response and the gas chromatograph analysis of the weight concentrations.

A few samples were stored for up to 30 days prior to analysis with the gas chromatograph because of equipment delivery delays. In order to check for potential degradation of the samples during storage, laboratory tests were performed on selected tank vapor samples during the field program.

Degradation tests were conducted on actual samples collected in Tedlar bags. The results of the degradation test are depicted by Figure IV-6. A total of 13 replicate samples were collected during Test No. 9 at the Chevron 821 tank. Each bag was identically pre-evacuated, filled with sample, and stored. The bags were analyzed on the chromatograph on 0, 1, 7, 10, and 26 days after collection. On each day on which samples were analyzed, several samples were run in order to gauge the reproducibility of the collection and analytical techniques. It was concluded that the degradation or loss of hydrocarbons in the bags cannot be distinguished from the variation due to the sampling/analytical methods. The samples collected at Chevron 821 had total hydrocarbon concentrations on the order of 25 lbs/1000 scf. Another series of 9 replicate samples were collected at Texaco 25267 during Test No. 47 (a tank containing heated crude oil). Measured concentrations for these samples were on the order of 5 lbs/1000 scf as the tank was under a negative pressure and air was mixing with the hydrocarbon vapors. These samples exhibited about 40 percent loss in total hydrocarbon

CENTURY MODEL 138 ORGANIC VAPOR ANALYZER CALIBRATION CURVES



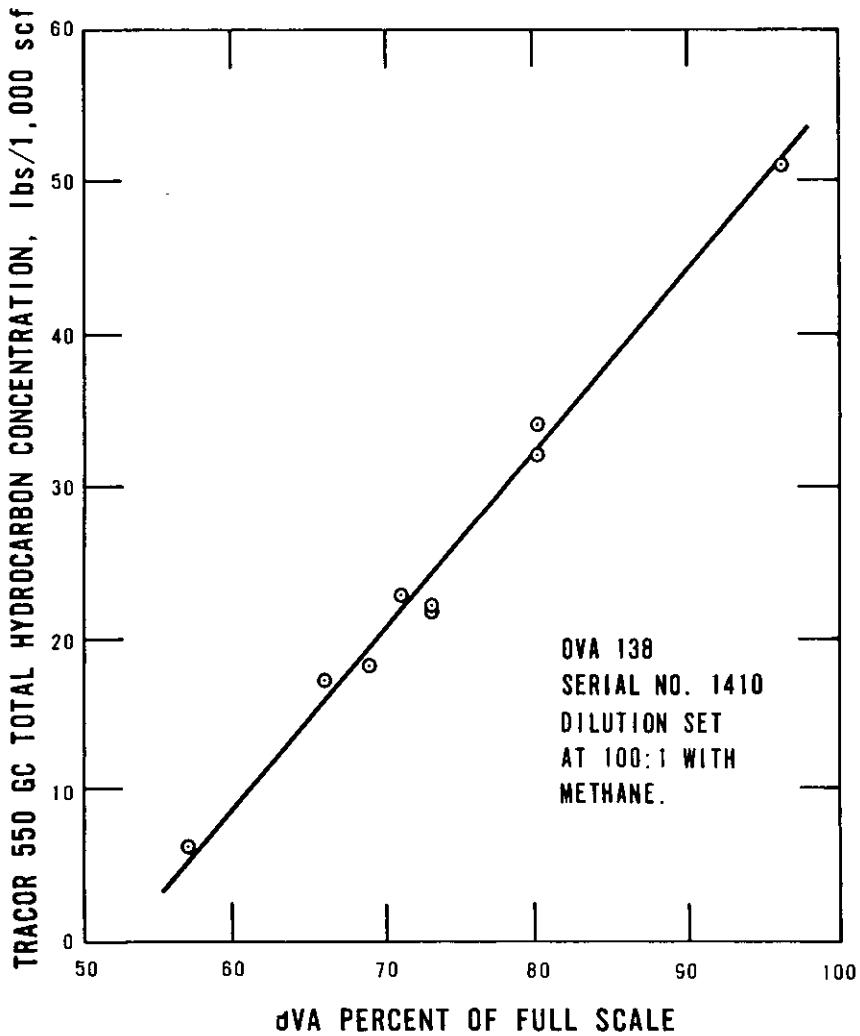
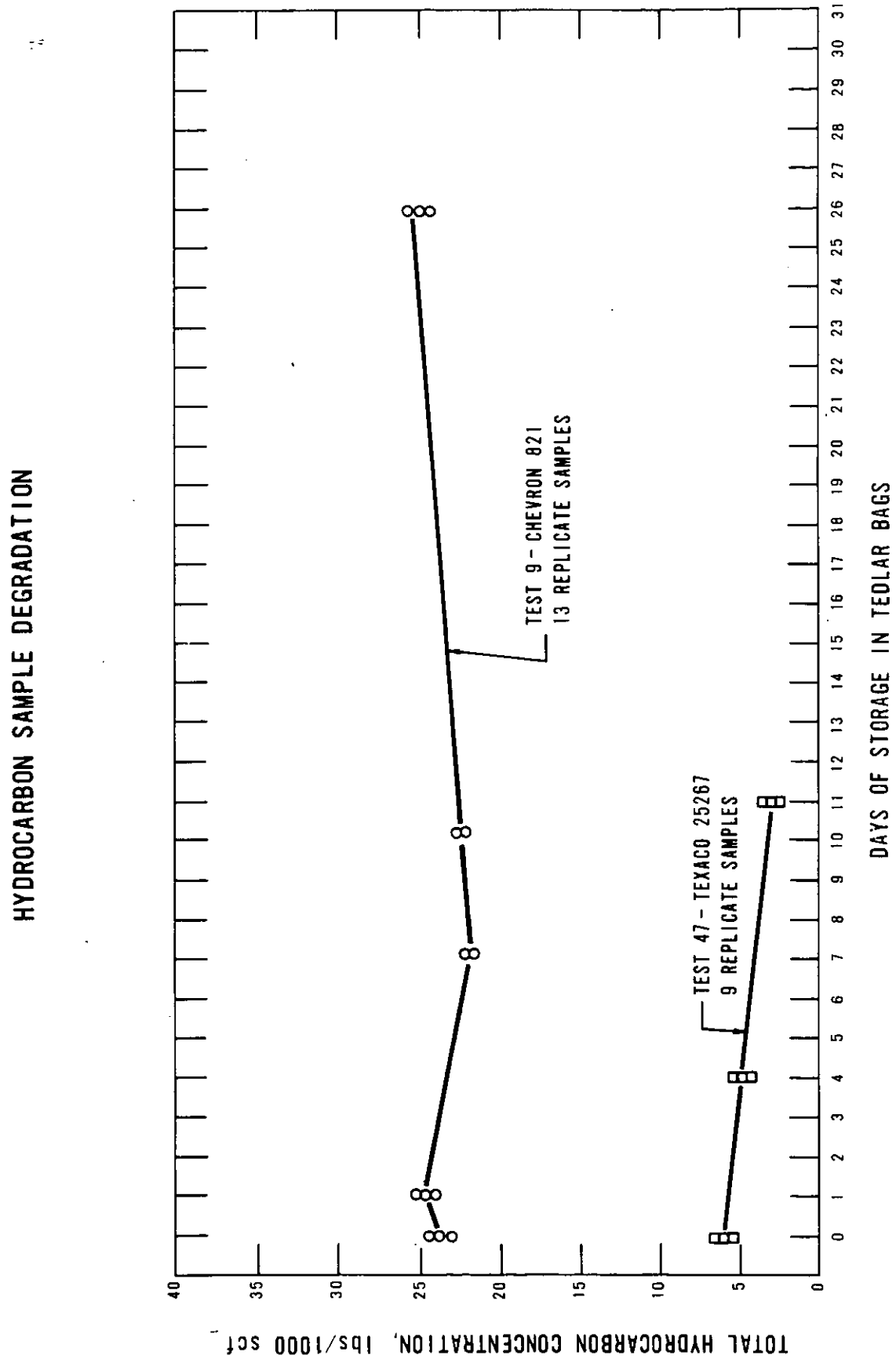


FIGURE IV-5

FIGURE IV-6


HYDROCARBON SAMPLE DEGRADATION
TEST 9 - CHEVRON 821
13 REPLICATE SAMPLES
TEST 47 - TEXACO 25267
9 REPLICATE SAMPLES
DAYS OF STORAGE IN TEDLAR BAGS
TOTAL HYDROCARBON CONCENTRATION, lbs/1000 sct
0
5
10
15
20
25
30
35
40
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

over an 11-day period. Part of the variation over the testing period, however, was due to the experimental method. The lowest measured concentration on day 0 for example, was approximately equal to the highest concentration on day 11. In general, there was no clear indication as to whether the lighter or heavier hydrocarbons in these Tedlar bags were being lost due to storage.

Schuetzle, et al.[1] reported in the literature that hydrocarbon loss in Tedlar bags was dependent on the quality, quantity, and temperature of the organic vapors. In the Schuetzle study, total hydrocarbon loss from bags containing 500 ppm hydrocarbon was less than 10 percent over a several day period. However, Schuetzle did find that highly polar compounds were more susceptible to adsorption on the Tedlar bags than were non-polar compounds. The organic vapors from crude oil, on the other hand, are primarily saturated, straight chain hydrocarbons which are non-polar. Bag samples collected from the various storage tanks had measured total hydrocarbon concentrations which were greater by a factor of 10 than those reported in the referenced study.

Since total hydrocarbon measurements for samples collected at the Chevron 821 tank were more representative of the concentrations encountered throughout the study, it was felt that the mechanism by which hydrocarbon samples undergo degradation was also representative (i.e., permeation of light ends out of the bag and condensation of heavier ends on the bag walls) of the majority of samples collected. Therefore, measured total hydrocarbon concentrations were not upgraded to reflect degradation even though a few samples were stored for up to 30 days.

In addition, in the cases where sample storage time was long enough for possible degradation to occur, the OVA-138 data for that test was compared with the gas chromatograph analysis. It was found that the OVA-138 concentration data was generally consistent with the gas chromatograph analysis for the higher concentrations. Thus, the OVA-138 data

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(1) Schuetzle, O., Prater, T., Ruddell, A., "Sampling and Analysis of Emissions from Stationary Sources I. Odor and Total Hydrocarbons," Journal of the Air Pollution Control Association, Vol. 25, No. 9, 1975, pp. 925-932.

supports the conclusion that noticeable degradation did not occur in those particular cases where sample storage time was greater than desired.

SAFETY CONSIDERATIONS

Due to the explosive and hazardous nature of the hydrocarbon vapors which were metered and sampled during the investigation, each mobile field laboratory was equipped with a Bacharach portable organic vapor analyzer Model Number J-W 23-7350 and a hydrogen sulfide monitor. Scott air packs with self-contained breathing apparatus and safety harnesses also were available in the trailers.

All instrumentation selected for use in the mobile trailers was required to meet Class I, Division II, Group A, B, C, and D safety criteria. Recorders, sequential sampling switches, power supplies, heated line controllers, and any other instruments which did not meet the safety code were enclosed in a fiberglass case which was kept under a slight positive pressure with nitrogen purge gas. The cases were purged in order to prevent the potential build-up of explosive gases.

FIELD PROCEDURES

Tank Preparation

Before each test, the tanks were normally prepared by the tank owners. This preparation included the blinding of pressure relief valves and vapor recovery lines and the sealing of leaks. However, no pressure tests were conducted on the tanks prior to testing. Tanks that were on vapor recovery were disconnected several days before the tests began to allow equilibrium conditions to occur. The metering system was connected to the tank with a flanged adapter. Depending on the individual tank, the adapter was fitted to either the gauge hatch opening or to the tank's pressure/vacuum relief valve opening. Hose connections were made leak-tight by using a silicone sealant. A visual inspection was made of the tank for any vapor shadows which would be indicative of hydrocarbon leaks. Leak checks were performed when the system was under a positive pressure. In some instances, a

liquid soap solution was used. Leaks were sealed with rubber gaskets, putty or clay. Whenever no vapor flows could be detected, efforts were doubled to ensure that all possible leaks in the system had been eliminated. Weights were added to the pressure/vacuum valve on the tank roof according to the specifications of the individual tank owners based on the stress design of the tanks.

Electrical connections were made according to the safety requirements of the respective tank owners. In cases where explosion-proof or other special connections were required, hook-ups were made by operating personnel.

Flow

Before each test, dial readings on the flow meters were recorded and recorder charts were indexed. Periodically during the test, additional dial readings were recorded and the chart clock was updated. Tank gaugings were taken at the beginning of the test and at selected time intervals during the test. Tank pressures were monitored by a manometer located in the trailer. Manometer readings were manually recorded and these readings served as a guide to the selection of the appropriate gas meters by the operator and as a warning indicator when tank pressure (or vacuum) approached the relief valve settings on the tank roof.

Temperature

During the early stages of the testing program, the sequential temperature sensing system provided 10 readings per hour. During the later phase, meter temperatures were manually recorded on the average of six times per day. The number of times that the stock temperature could be measured varied with the individual tanks. Most tanks were equipped with sample taps so that stock temperatures could be obtained routinely along with meter and ambient temperatures. Stock temperatures for wash tanks, however, could be measured only at the start and finish of a test, as access to the gauge hatch was required, and the hatch was being used to hold test equipment.

A min-max thermometer was used to measure daily ambient air temperature change; values were recorded each morning. A mechanical pyranograph, Model Number R-401-E, manufactured by Weather Measure Corporation, was used during the day to measure solar insolation. Ambient temperature and solar insolation were augmented by data from local weather stations.

Hydrocarbon Vapor

Hydrocarbon concentrations in the discharged tank vapor were monitored continuously by organic vapor analyzers through heated sample lines. Hydrocarbon vapor samples for subsequent analysis by gas chromatograph were initially scheduled to be collected in Tedlar bags every three hours by the sequential sampling apparatus. However, it was soon evident that standing storage tanks would draw in air at night and therefore the samples collected at night would contain only hydrocarbon concentrations in the ambient air. In addition, the concentration profile observed during the breathing out cycle was relatively flat. Therefore the sequential sampling apparatus was abandoned in favor of manual sampling. In general then, only about three grab samples were collected daily for each test tank.

Liquid Stock Samples

Liquid sample collection points were selected based on the tank operation. Initially, liquid stock samples were collected in glass bottles. However, because of concern for weathering loss of the light ends, most of the liquid stock samples were later collected in numbered stainless steel bombs which had been previously evacuated. The sample bomb was connected to the sample tap in a vertical position to fill from the bottom in order to prevent trapping any light ends which might flash off. A volume of oil equal to five times the volume of the bomb was allowed to pass through before the flow was stopped and the bomb sealed. (In a few instances, a special rig for filling the sample bomb was used to collect stock samples where the only access point to the crude oil was the gauge hatch.)

LABORATORY PROCEDURES

Grab samples of hydrocarbon vapors were collected regularly from each tank for analysis by gas chromatograph. Likewise, a liquid oil sample was collected from each tank for subsequent analyses of its chemical and physical properties. The laboratory procedures are briefly described in the following.

Hydrocarbon Vapor

Vapor samples collected from the tanks were analyzed for C_1 through C_{13+} hydrocarbons using a Tracor 550 gas chromatograph with flame ionization detector. The column packing material was silicone oil (20% OV-101) on J-M 22 Firebrick 70/80 mesh. The column was 6 ft by 2 mm ID. Ultra pure nitrogen carrier gas swept the column at 30 cc/min. Injection loop valve and associated lines were kept at 90°C. The column temperature was programmed to increase at 15°C/min from 30°C to 250°C. The flow rate of hydrogen to the flame ionization detector was set at 45 cc/min; air flow to the detector was 1.4 cfm.

Collection samples were stored carefully in sealed cases at room temperature. Early in the study, difficulty with delivery and set-up of the gas chromatograph led to a backlog of hydrocarbon samples. The maximum storage time between collection and analysis was about 30 days. Once the backlog was eliminated, typical storage time was one week on the unheated tank vapors. During the last month or so of the field work, samples were delivered daily from the field to the laboratory and storage time seldom exceeded two days.

Before analysis, those hydrocarbon samples which had been collected from hot tanks were heated to between 180-200°F for five minutes or until no condensate was visible in the Tedlar bag. The sample was introduced into the gas chromatograph sample loop, allowed to reach thermal equilibrium, then swept into the column.

The Tracor 550 gas chromatograph was calibrated daily with a one percent propane standard (Gravimetric standard PS 131) nitrogen gas mixture at the temperature of the samples to be tested. Multipoint calibrations were also performed throughout the study.

Liquid Stock

Crude oil samples collected at the various tanks were quantitatively analyzed for methane through heptane plus hydrocarbons using fractional distillation techniques. Reid vapor pressures were measured per the procedure prescribed in ASTM D-323 and API gravities were measured for both the heptane plus fractions and for the crude oil samples according to ASTM D-287. For the distillate and fuel oil samples, reflux distillations and flash point measurements were conducted according to ASTM D-86 and D-323 respectively. For further detail the reader should consult the referenced methods for the details of the API gravity, flash point, and reflux distillation procedures. A discussion of the fractional distillation procedure is presented below.

Crude oil samples were subjected to hydrocarbon analysis through the use of low temperature fractional distillation. This method is virtually the only available method suitable for accurate quantitative separation of crude and/or refined petroleum products into their individual hydrocarbon components from methane through hexane. The accuracy and precision attainable vary from 0.1 percent to 0.5 percent, depending on percentage of component and sample, difference of boiling point, time of distillation and many other factors.

The apparatus used for the analysis was a Podbielniak Series 8600 Hyd-Robot automatic recording low temperature fractional distillation apparatus with a column packed with Heli-Grid packing (4.7 millimeters diameter by 36 inches long). This type of column has been found to provide excellent analytical results especially for those samples where the concentrations of the light and intermediate hydrocarbons are relatively low. A permanent record of each distillation is made via a strip chart recorder. The boiling point of the material leaving the fractionating column is recorded on the abscissa, while the standard gaseous volume of same material is monitored on the ordinate.

The distillation commences with the sample charge, which consists of condensing approximately 20-25cc of liquid material into the distillation kettle, using liquid nitrogen. The liquid nitrogen flash is removed from the kettle, the sample is warmed slowly and the lightest

component is vaporized into the column for fractionating. A controlled reflux is established within the column by circulating heated air around the lower part of the column and chilled air around the upper column area. Once a reflux has been established, the material is ready for removal from the column. The vapor phase initially passes a thermocouple located in the top of the column which senses the temperature of the material and electronically relays this information to the strip chart recorder. The vapor then passes through a capillary manifold system, across a rate control valve, and into a volumetrically calibrated receiver bottle situated in a constant temperature bath of 100°F. For samples with small amounts of hexane and lighter, the entire distillation is performed at a pressure of 100 millimeters of mercury. As gas enters the receiver bottles, the pressure valve within the bottle is sensed by a pressure compensating manometer. As one leg of the manometer rises, a metallic probe within that leg closes an electric circuit, which in turn drives the strip chart recorder. Hence, the length of chart driven is proportional to the volume of gas entering the receiver bottle. After the final component (normal hexane) has been removed from the column, the distillation is terminated by closing a stopcock. The gas in the receiver bottles is mixed thoroughly by the use of a device called a Toepler pump. A sample of the gas is then collected in a small glass container and is subsequently subjected to chromatographic analysis. The heptane plus residue remaining in the kettle is then weighed and its physical properties are measured through the use of a pycnometer (density) and cryoscopic apparatus (molecular weight). The molecular percent analysis is then obtained by determining the standard gaseous volume of each component and relating this to the total standard gaseous volume of the starting sample.

CHAPTER V

HYDROCARBON EMISSION MEASUREMENTS

CHAPTER V

HYDROCARBON EMISSION MEASUREMENTS

GENERAL

Fixed-roof tanks are widely used for storage of volatile liquids. They may also be used as continuously operated process tanks. The sides are cylindrical and the roofs are normally coned. The roof usually has a minimum slope of 0.75 inch per 12 inches. A fixed-roof tank will safely accommodate only a very low internal pressure or vacuum depending on the design, size and general maintenance. Many fixed-roof tanks are equipped with pressure and vacuum relief valves that are set at 0.86 in H_2O. Smaller tanks will normally accommodate more pressure or vacuum than larger tanks.

The pressure/vacuum relief valves will prevent the vapors from escaping for small temperature changes or very small changes in stock level, but they will relieve the excess of pressure or vacuum caused by significant liquid level or temperature changes.

In order to better understand the significance of the measured emissions of fixed-roof tanks, a thorough appreciation of the fixed-roof tank's operating conditions is required. Fixed-roof tanks are used for many purposes and are operated in several different modes that affect emission cycles.

A very common use of a fixed-roof tank is for storage of petroleum liquids. After the liquid has been fed into the tank and the liquid level is static, the only emissions that occur are those defined as breathing loss. Breathing loss emissions are those mainly associated with the thermal expansion and contraction of the vapor resulting from the daily ambient temperature cycle. Other atmospheric conditions such as wind speed, rain, cloud cover, solar insolation, and barometric pressure also may affect the temperature and pressure of the vapor space.

It is also common for fixed-roof tanks to be in a working mode. In this mode there is movement of liquid either into or out of the tank or both. The rates of liquid movement can be quite constant or vary

erratically. Liquid usually enters at the bottom of the tanks through spreaders. The liquid can remain in the tank for a very short period of time (minutes) or may be stored up to several months. Short storage times of only several hours are mainly associated with tanks that serve a process function such as separating water from crude oil. Storage times of only a few hours are also associated with fixed-roof tanks that operate as surge or routine shipping vessels.

The cycle or mode of liquid withdrawal from the tank is also an important variable. The withdrawal rate can be less than or greater than the feed rate for certain periods of the working cycle. Some fixed-roof tanks operate at a constant liquid level by withdrawing the oil through an overflow pipe near the top of the tank. Emissions associated with a change in the liquid level of a tank, which may include both the displacement of vapor by rising liquid surface and the loss of vapor following a rapid withdrawal, is defined as working loss.

Losses associated with other phenomena such as the liquid boiling due to high temperatures or by the flashing of light components from unstabilized crude are not considered in the normal definition of working loss. Throughout this report, working loss will be defined as that loss associated with the filling and/or emptying of the fixed-roof tank. It should be noted that total measured emissions from any particular working tank operation is a combination of both the breathing and working loss as all tanks are subject to atmospheric changes.

Working fixed-roof tanks can be categorized as follows based on how the liquid is fed and withdrawn:

(1) Batch operations that allow the liquid to be fed into the tank or withdrawn from the tank but not at the same time. The emissions are those associated with filling or emptying and breathing.

(2) Continuous operations that allow the liquid to be pumped in and out at various rates and cycles. The emissions are those associated with filling, emptying, and breathing. One special case is when the withdrawal rate exactly equals the feed rate which results in no liquid level change.

(3) Special operations that allow the liquid to enter the tank under pressure or elevated temperatures and result in the liquid boiling. The emissions are associated with the flashing off of the lighter components, filling, emptying, and breathing.

Figure V-1 shows typical configurations of the types of operation of fixed-roof tanks discussed above. Test data are listed in the Appendix.

STANDING STORAGE TANKS SUBJECT TO BREATHING LOSSES

Twenty-three standing storage tests were conducted. Two tests were voided (GATX 80006 and Chevron 499), one due to inadequate power supply to operate the instruments and the other due to lack of a representative liquid sample. The results of the 21 remaining tests are shown in Table V-1.

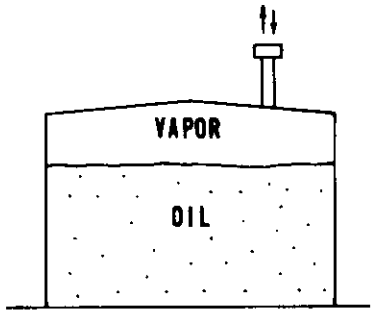
All emission tests reported are for a 24-hour midnight to midnight period. When several days of tests were performed, the 24-hour results were averaged. On moving days, testing was performed for only a fraction of a day but for the sake of compatibility, results were discarded even though they were valid.

Of the 21 tanks, 16 tests were on tanks containing crude oil while the other five contained distillates or fuel oil. Distillates are defined as liquid hydrocarbons obtained through refinery distillation processes. Some examples include diesel, jet fuel, and gas oil.

Fourteen of the 21 tested tanks resulted in emissions of 0 to 12 pounds of total hydrocarbons per day. The remaining 7 tanks had higher emissions ranging from 44 to 575 pounds per day.

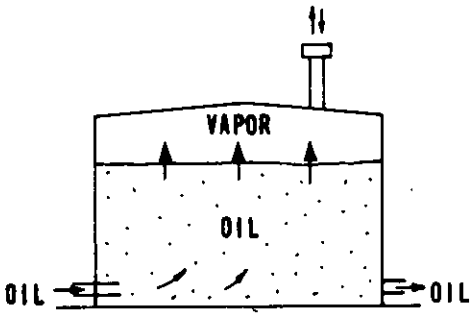
Significant factors affecting breathing loss emission rates were not readily evident during these tests. Four tanks in the tests were heated and insulated: Atlantic Richfield Soladino, Atlantic Richfield R-49, Chevron 25302, and Chevron 281. Five of the tanks tested, including two of the insulated tanks, were very small crude oil tanks, 2,000 barrels or less. Flows of vapors from all of these tanks were negligible.

EXAMPLE OPERATIONS OF FIXED-ROOF TANKS



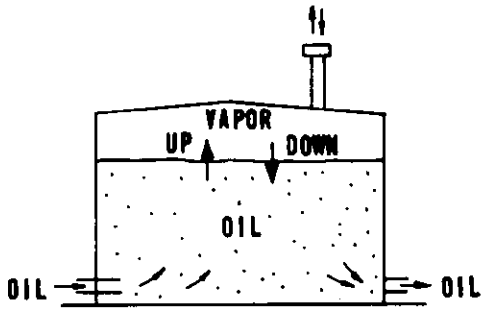
STANDING STORAGE

SUBJECT TO BREATHING LOSS.



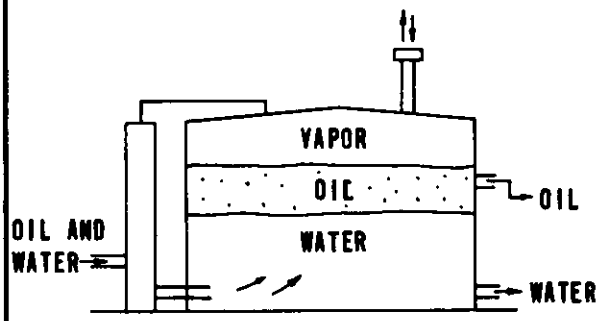
BATCH OPERATIONS

SUBJECT TO CYCLIC FILLING, EMPTYING, AND BREATHING LOSSES.



CONTINUOUS OPERATIONS

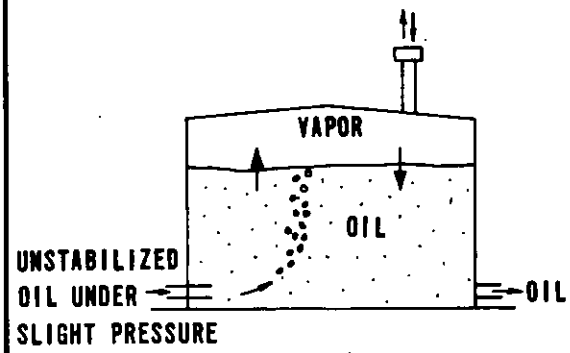
SUBJECT TO FILLING, EMPTYING AND BREATHING LOSSES.



CONTINUOUS OPERATIONS (WASH TANKS)

SUBJECT TO BREATHING LOSS.

NOTE: IF TANK FEED CONTAINS UNSTABILIZED CRUDE UNDER SLIGHT PRESSURE, THE TANK WILL BE SUBJECT TO FLASHING LOSSES ALSO.



SPECIAL OPERATIONS

SUBJECT TO FLASHING, FILLING, EMPTYING AND BREATHING LOSSES.

TABLE V-1

HYDROCARBON EMISSION MEASUREMENTS OF BREATHING LOSSES FROM STANDING STORAGE TANKS

	TANK PARAMETERS									STOCK PARAMETERS						BREATHING LOSS PARAMETERS					
Test No.	Company	Tank No.	Capacity (bbls)	Diam. (ft)	Height (ft)	Outage (ft)	Color Wall	Insulation	Type	Temp. (°F)	RVP (psia)	Gravity °API	Liquid Flow (bbls/day) In	Liquid Flow (bbls/day) Out	Days of Test	Avg. Temp. Change (°F)	Vapor Discharge scf(1) /day	Avg. Molecular Weight (lb/lb Mole)	Hydrocarbon Concentration (lbs/1000 scf) Methane	Hydrocarbon Concentration (lbs/1000 scf) Total	Hydrocarbon Emissions (lbs/day) Methane	Hydrocarbon Emissions (lbs/day) Total
1	Atlantic Richfield	C1003	1,000	21.6	16.0	6.2	Alum	No	Crude	100	1.8	22.2	0	0	3	23	0	67	-	-	-	-
2	Atlantic Richfield	Soladino	2,000	30.0	16.0	9.3	Gray	Yes	Crude	150	0.8	12.5	0	0	2	32	36	40	1.4	8.2	<1	<1
3	Atlantic Richfield	R49	101,000	135.0	40.0	4.0	Alum	Yes	Fuel Oil	150	-	-	0	0	2	33	0	52	-	-	-	-
4	Beren	1336	1,000	21.1	16.0	12.4	Alum	No	Crude	55	1.3	35.4	0	0	2	23	0	68	-	-	-	-
5	Chevron	281	33,944	95.5	28.7	3.3	Alum	Yes	Fuel Oil	180	-	-	0	0	1	15	1,030	126	0.0	1.3	<1	1
6	Chevron	490	75,238	120.0	38.3	8.5	Peach	No	Diesel	90	-	-	0	0	1	14	0	96	-	-	-	-
7	Chevron	817	79,200	120.0	40.0	39.6	Gray	No	Crude	56	[redacted](3)	24.4	0	0	3	22	20,100	69	0.1	6.6	2	133
8	Chevron	817(4)	79,200	120.0	40.0	37.3	Gray	No	Crude	65	[redacted]	23.7	0	0	3	16	17,820	67	0.1	5.4	1	96
9	Chevron	821(4)	63,200	117.0	36.0	23.2	Gray	No	Crude	73	[redacted]	23.4	0	0	3	19	5,450	55	0.2	21.8	1	119
10	Chevron	9407	54,120	114.5	30.4	3.6	Peach	No	Jet Component	60	-	-	0	0	3	21	0	121	-	-	-	-
11	Chevron	25302	1,985	29.7	16.1	2.0	Alum	Yes	Crude	158	(2)	11.0	0	0	2	40	20	26	1.4	2.2	<1	<1
12	Edgington	107	100,000	120.0	48.0	7.6	White	No	Crude	72	(3)	18.5	0	0	1	6	430	50	0.6	10.7	<1	5
13	Edgington	107(4)	100,000	120.0	48.0	35.8	White	No	Crude	88	≈0.5	18.6	0	0	2	14	18,310	64	0.1	7.5	2	138
14	GATX	80002	76,800	117.2	41.8	40.1	White	No	Fuel Oil	65	-	-	0	0	1	19	7,680	86	0.0	0.2	<1	2
15	[redacted]	80012	76,800	117.2	41.8	2.9	White	No	Crude	65	[redacted]	40.0	0	0	1	40	1,800	52	1.5	24.4	3	44
16	[redacted]	178013	170,880	175.8	41.5	2.3	White	No	Crude	56	[redacted]	43.1	0	0	3	38	5,110	62	0.3	44.0	2	225
17	[redacted]	178013(4)	170,880	175.8	41.5	6.9	White	No	Crude	65	[redacted]	34.9	0	0	2	20	16,560	53	0.4	34.8	7	575
18	GATX	178015	170,880	175.8	41.5	1.8	White	No	Crude	67	0.4	24.1	0	0	3	23	0	22	-	-	-	-
19	[redacted]	178018	170,880	175.8	41.5	2.5	White	No	Crude	63	[redacted]	40.5	0	0	2	42	230	52	1.3	27.8	<1	6
20	[redacted]	~~RD 4225~~	~~170~~	~~10.1~~	~~12.0~~	~~4.0~~	~~Green~~	~~No~~	~~Crude~~	~~74~~	[redacted]	~~29.9~~	~~0~~	~~0~~	~~2~~	~~18~~	~~0~~	~~60~~	~~-~~	~~-~~	~~-~~	~~-~~
21	Texaco	80034	79,840	117.2	40.8	21.7	Black	No	Diesel	66	-	-	0	0	2	36	26,440	71	0.1	0.4	2	12

(1) Standard conditions: 77°F, wet. (2) RVP not measured at 100°F. RVP reported as 0.1 at 70°F. RVP ~0.2 based on crude oil GC analysis.
(3) Liquid sample may not be representative of tank stock during test. (4) Repeat test.

[redacted] 8 tanks above 1.5 psia or 10.5 kPA

ENGINEERING-SCIENCE ES

Four unheated, uninsulated tanks contained distillate. The discharged vapor flow ranged from zero, for Chevron 490 with small outage, to a very large flow on Texaco 80034 with 21.7 feet of outage. The Texaco tank with the high flow rates was painted black on the tank walls and the tank roof. The other three tanks were painted peach or white color. For all distillate tanks, the discharged vapors were significantly lower in total hydrocarbon (THC) concentration than for the crude tanks. The total hydrocarbon concentration of discharged vapors for crude ranged from 2-44 lbs/1000 scf. The vapors discharged from distillate or fuel oil tanks contained only 0.2 to 1.3 lbs/1000 scf total hydrocarbon concentration. As for methane content, both the crude and distillate tests indicated low concentrations ranging from 0 to 1.5 lbs/1000 scf.

The remaining 10 large uninsulated tanks which contained crude oils showed three to have very low emissions, between 0 and 10 lbs/day. Seven tanks showed emission rates beteen 37 and 575 lbs/day. Significant factors affecting emission rates were not readily evident. None of the standing storage tests showed any significant amount of methane.

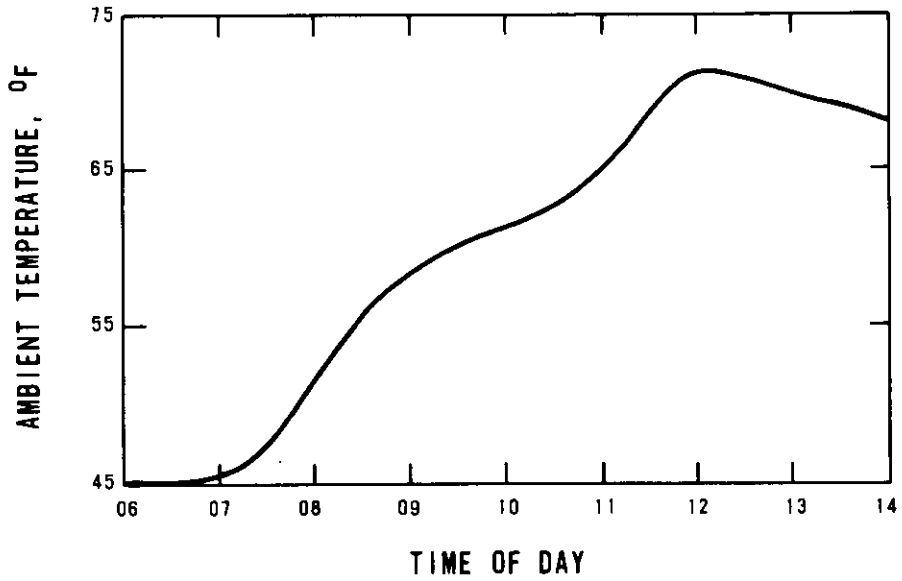
From the flow measurement charts, it was interesting to note that the breathing losses occurred most frequently between the hours of 0800 and 1200. Very little breathing occurred in the afternoon period and by mid-afternoon the tanks were under vacuum. An example of breathing loss patterns on a standing storage tank is shown in Figure V-2.

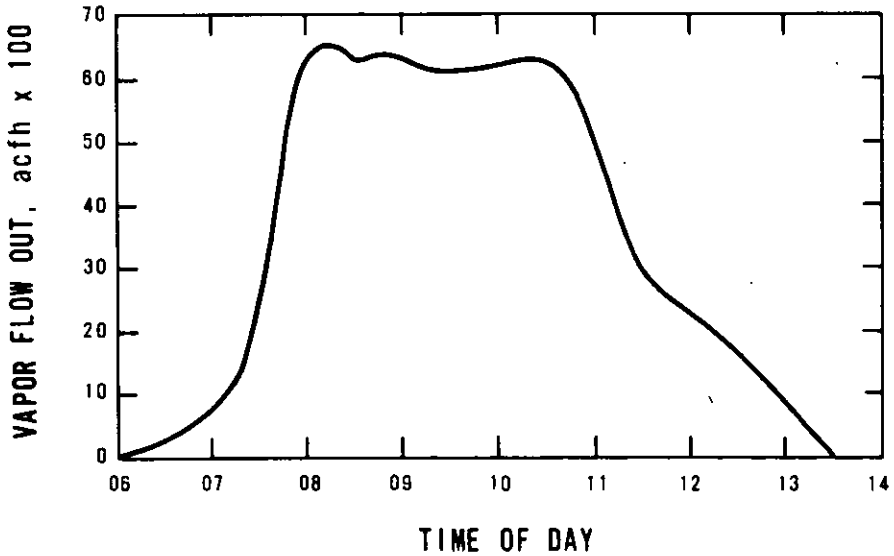
The molecular weights of the discharged vapors from a particular tank were fairly uniform. The molecular weight for all 15 crude oil tanks tested ranged from 22 to 69, with median being 55. The crude vapors contained some quantities of the light ends of hydrocarbons whereas the distillates did not (see Appendix). The molecular weight of the discharged vapor from distillate tanks ranged from 52 to 126.

WORKING TANKS SUBJECT TO COMBINED WORKING, BREATHING, AND FLASHING LOSSES

The tested working tanks included five batch tanks, 13 continuous tanks and seven special (flash/boiling) tanks. Of the 33 tanks which were scheduled for tests, eight tests were voided due to various

EXAMPLE OF BREATHING PROFILE FOR STANDING STORAGE TANKS (TEXACO 80034, MARCH 5, 1977)





SUNRISE 0617
SUNSET 1752

equipment or operational difficulties after several days of unsuccessful operation.

Several tanks identified as LACT tanks and wash tanks were tested in the study. These are essentially continuous tanks; however, some of these tanks receive unstabilized crude under slight pressure and were treated as special (flash/boiling) tanks. The LACT tanks serve a specific function in the oil field. Control of the crude is automatically transferred from the producer to the transporter (or pipeline) as it leaves this tank. The liquid level in these tanks varies between two set points. As liquid enters, the liquid level slowly rises to the upper set point. The high-volume LACT withdrawal pump is actuated and the liquid level falls to the lower set point. The withdrawal pump is turned off, and the procedure starts again.

Wash tanks are the second particular type of continuous service tank tested. They separate oil and water of the incoming crude. Oil normally exits the tank in an overflow pipe; therefore, the tanks have a constant liquid level. Frequently crude comes directly from the various wellheads to the wash tank. The crude mixture contains oil, water, sand, and gases such as nitrogen, and carbon dioxide. The mixture arrives at the wash tank sometimes under pressure (i.e., 30 to 50 psi) and often at elevated temperatures (i.e., 150 to 200°F). A vertical cylinder called a "boot" is sometimes attached to the side of wash tanks. The "boot" relieves any pressure from the crude oil so that flashing of the trapped gases can occur upstream of the wash tank. These gases are piped to the vapor space of the wash tank. From the boot, the oil/water mixture flows into the bottom of the wash tank. The oil floats to the top and overflows into other wash or LACT tanks and the water is drained from the bottom of the tank and discarded into a sump.

Each of the three categories of tanks: batch, continuous, and special (flashing/boiling) are presented separately to clarify the working loss emission problems. Important test data for each tank are summarized in Table V-2. Complete listings of the test data are given in the Appendix.

TABLE V-2

HYDROCARBON EMISSION MEASUREMENTS FROM WORKING TANKS

TANK PARAMETERS									STOCK PARAMETERS						WORKING AND BREATHING LOSS PARAMETERS							
Test No.	Company	Tank No.	Capacity (bbls)	Diam. (ft)	Height (ft)	Average[2] Outage (ft)	Color Wall	Insulation	Type	Temp. (°F)	RVP (psia)	Gravity °API	Liquid Flow (bbls/day) In	Liquid Flow (bbls/day) Out	Days of Test	Avg. Temp. Change (°F)	Vapor Discharge (scf[1]/day)	Molecular wt. (avg) lb/lb mole	Hydrocarbon Concentration (lb/1000 scf) Methane	Hydrocarbon Concentration (lb/1000 scf) Total	Hydrocarbon Emissions (lbs/day) Methane	Hydrocarbon Emissions (lbs/day) Total
Batch Tanks (Breathing and Filling Losses)																						
22	Chevron	490	75,238	120	38	16	Peach	No	Diesel	94	-	-	14,630	0	1	27	(7)	95.7	<0.1	1.2	-	-
23	Conoco	5389	2,500	34	16	4	Beige	Yes	Crude	195	0.1	17.7	59	0	1	34	(7)	58.6	1.1	14.0	-	-
24	Getty	55709	55,000	120	32	17	White	No	Crude	79	5.0	30.0	14,630	0	2	35	(7)	58.7	0.2	32.0	-	-
25	Getty	80712	80,000	120	40	23	Beige	No	Crude	72	5.7	30.0	13,500	0	3	13	(7)	46.3	3.1	36.0	-	-
26	Union	6761	1,000	22	16	13	Al(Spec)	No	Crude	63	4.6	29.2	80	0	2	35	(7)	56.4	-	-	-	-
Continuous Tanks (Breathing and Filling/Emptying Losses)																						
27	Aminoil[L]	25697	2,000	29	16	6-12	Lt.Gray	No	Crude	145	2.3	21.1	(4)	10,000	3	12	8,878	61.0	0.6	28.7	5	255
28	Atlantic Richfield	R26	96,690	120	48	3	White	No	Jet Fuel	64	-	-	49	97	3	24	0	78.5	0	0	0	0
29	Champlin[W]	2030D	2,000	30	16	2-2	Dk.Gray	No	Crude	105	(4)	20.0	(4)	2,200	2	20	0	47.0	0	0	0	0
30	Chevron	821	63,200	117	36	19	Gray	No	Crude	65	4.5[6]	25.8	6,300	6,465	3	24	3,510	57.3	0.2	19.0	1	67
31	Edgington	12005	12,000	43	45	10	White	No	Gas Oil	125	-	-	2,832	1,715	2	26	7,150	-	Trace	Trace	0	0
32	Getty[L]	1SB3	1,000	22	16	9-11	Tan	No	Crude	87	3.0	26.1	(4)	320	1	16	220	44.0	1.4	15.8	<1	3
33	Getty[L]	5729	5,000	47	16	10-13	Beige	No	Crude	110	5.5	30.1	(4)	6,400	3	13	14,855	52.0	3.6	91.0	52	1,289
34	Getty[W]	5793	5,000	39	24	1-1	Lt.Gray	Yes	Crude	106	5.9	30.0	(4)	6,400	2	17	160	52.0	4.4	106.3	<1	17
35	Mobil[L]	20x1160	2,000	30	16	9-15	Al(Diff)	No	Crude	90	3.5	30.0	(4)	1,650	3	23	259	30.5	2.3	32.1	<1	8
36	Shell	550S4	55,000[3]	100	40	27	White	No	Crude	132	0.8	17.0	1,244	634	1	21	8,405	62.8	0.2	23.0	2	195
37	Union[L]	8826	250	15.	8	3-6	Al(Diff)	No	Crude	65	4.4	28.2	(4)	106	1	30	595	52.0	0.7	35.0	<1	21
38	Union	10001	9,500	48	30	16	Al(Diff)	No	Crude	85	0.8	21.0	2,640	2,000	1	18	7,780	65.0	0.1	13.7	1	106
39	Union	37402	38,354	95	30	24	Tan	No	Crude	60	2.3	23.9	4,200	3,450	2	16	11,440	79.7	0.3	15.2	3	174

(1) Standard Condition: 77°F, wet.
(2) Average Outage is expressed as a range for LACT and wash tanks.
(3) Repeat Test.
(4) Not Measured.
(5) Partial day of testing L: LACT tank; W: Wash tank.
(6) Liquid sample may not be representative of tank stock during test.
(7) Measured flow rates inaccurate.

ENGINEERING-SCIENCE ES

TABLE V-2

HYDROCARBON EMISSION MEASUREMENTS FROM WORKING TANKS
(Continued)

TANK PARAMETERS									STOCK PARAMETERS							WORKING AND BREATHING LOSS PARAMETERS							
Test No.	Company	Tank No.	Capacity (bbls)	Diam. (ft)	Height (ft)	Average Outage (ft)	Color Wall	Insulation	Type	Temp. (°F)	RVP (psia)	Gravity °API	Pressure of Upstream Process (psig)	Liquid Flow (bbls/day) In	Liquid Flow (bbls/day) Out	Days of Test	Avg. Temp. Change (°F)	Vapor Discharge (scf[1]/day)	Molecular wt. (Avg.) lb/lb mole	Hydrocarbon Concentration (lb/1000 scf) Methane	Hydrocarbon Concentration (lb/1000 scf) Total	Hydrocarbon Emissions (lbs/day) Methane	Hydrocarbon Emissions (lbs/day) Total
Special Tanks (Breathing, Filling/Emptying, and Flashing Losses)																							
40	Conoco[W]	Kemp	1,500	21.5	24.0	3.0-3.0	Beige	Yes	Crude	185	1.6	15.8	25	(2)	59	2	31	237	35	8.4	30.0	2	7
41	Exxon[L]	410	3,000	30.0	24.1	18-19	Lt.Green	Yes	Crude	160	1.5	16.7	35	(2)	9,636	(5)	(4)	36,129	33	12.6	47.4	457	1,712
42	Getty[W]	9682	3,000	30.0	24.0	3.0-3.0	Yellow	No	Crude	185	0.4	12.0	30-35	(2)	2,400	3	25	6,444	47	7.9	46.9	51	302
43	Mobil[W]	30x55	3,000	29.7	24.0	2.5-2.5	Al(Diff)	No	Crude	110	4.3	31.6	22	(2)	360	2	26	62	40	8.9	59.7	<1	4
44	Texaco[L]	2583	1,000	21.5	16.1	9-12	Al(Diff)	No	Crude	120	3.2	22.3	50	(2)	464	1	25	8,128	44	8.2	65.3	68	542
45	Texaco[L]	25024	1,000	21.5	16.0	11.6-12.1	Al(Diff)	Yes	Crude	124	1.3	11.9	60	(2)	400	3	37	14,200	47	8.5	69.2	122	983
46	Texaco[L]	25267	1,000	21.5	16.0	9.5-9.8	Al(Diff)	Yes	Crude	194	0.7	9.9	50	(2)	439	2	21	2,490	89	1.2	80.0	3	199

(4) Not measured. (5) Partial day of testing. L: LACT tank; W: Wash tank.

ENGINEERING-SCIENCE ES

Batch Tanks

Seven batch tanks were originally scheduled for investigation. Two tests were voided (Chevron 499 and Mobil 900X2). The Chevron tank was voided because no oil sample was obtained at the time of testing. The Mobil tank test was voided because the vapor recovery system had not been disconnected from the tank for a sufficiently long period prior to the test. There was a possibility that vapors other than those generated from the tank stock could have been in the tank.

Flow rates from three of these tanks were extremely high, reaching over 75,000 scf/day for the Chevron and two Getty tanks. High flows were due to the rapid filling rates of oil into the tanks which reached approximately 15,000 bbls/day. The emergency pressure relief valve settings on the tanks were only slightly higher than the metering system pressure drop. For all but the Union 6761 and Conoco 5389 tanks the tell-tales indicated that the emergency pressure relief valve had opened. Therefore, unmeasured vapors had escaped. The measured volume flow is not correct for those tanks. An estimate of the volume flow can be made from the liquid pumped into the tank.

The Union 6761 and Conoco 5389 tanks were small bolted tanks with low liquid filling rates. During both tests, the metered volumetric exhaust flow was much smaller than would be caused from the liquid filling rates. This indicated leaks in the metering system or the tank. The system was checked for leaks but none could be found. It was concluded that the leaks were very small and were occurring at the tank, possibly around the hatch and/or bolts. Again, rather than void these tests, the volume flow can be estimated from the liquid flow rates.

Continuous Tanks

Thirteen tanks classifed as continuous were tested, including five atmospheric pressure feed LACT tanks and two atmospheric pressure feed wash tanks. In addition, four tests were voided: the Chevron 25699 tank because the extremely hot and voluminous vapors caused failure of the vinyl sampling hoses, the Union Weldon wash tank due to unsealable leaks in the tank, the Mobil 800X127 tank because of malfunction of the test meters and the Edgington 30004 tank because of unsealable leaks in the tank.

Two of the continuous tanks contained distillates and showed very low hydrocarbon concentration in the vapors and, therefore, low mass emissions. Of the remaining five continuous tanks handling crude that were neither LACT or wash tanks, one discharged only 6 lbs hydrocarbons per day while the other four discharged between 100 to 200 lbs hydrocarbons per day. For most of these tanks containing distillates and fuel oil, the liquid level changed only slightly, thus generating small vapor discharges.

The five LACT tanks that were classified as continuous (those without gas flashing into the tanks) showed varying emission rates, 3, 13, 21, 255, and 1289 lbs hydrocarbons per day. Four of the five tested LACT tanks were normally operated with vapor recovery systems. In preparation for field testing, the tanks were taken off vapor recovery 2 or 3 days prior to initiation of tests.

The two atmospheric pressure feed wash tanks generated only small amounts of vapor as would be expected since the liquid level does not change. The Champlin 2030D tank had zero vapor discharge while the Getty 5793 emitted only 17 lbs hydrocarbons per day.

Special (Flashing/Boiling) Tanks

Eight tanks were tested that received crude under slight pressure from which flashing occurred. All eight tanks were production tanks. One of these tank tests (Union 10117) was voided early in the program because the cooler had not yet been added to the flow measurement system, and vapor condensation was interfering with the gas meter operation. Also the vapor space in this tank could not be separated from the vapor space of adjoining tanks.

Four of the special tanks were LACT tanks and three were wash tanks. Five of the seven tanks had vapor recovery systems which were disconnected for the test. Emissions from the seven tests ranged from 4 to 1712 lbs hydrocarbons per day. Two tests were less than 10, four were between 10 and 1000 and one test was about 1000 lbs hydrocarbons per day. Of the three wash tanks, two had emissions less than 10 lbs of hydrocarbons per day and the third was 302. The tank with the largest emission rate had the highest liquid flow rate. These special tanks receiving unstabilized

crude-emitted vapors with a relatively high methane content. For six of the seven tanks tested, the methane content of the hydrocarbon vapors ranged from 10 to 28 percent by weight.

CHAPTER VI

COMPARISON OF MEASURED EMISSIONS WITH API CALCULATED EMISSIONS AND MEASURED PARAMETERS

CHAPTER VI

COMPARISON OF MEASURED EMISSIONS WITH API CALCULATED EMISSIONS AND MEASURED PARAMETERS

One aspect of the original scope of work was to determine the applicability of the API equations by comparing observed emissions to the calculated losses. In addition, if consistent trends were observed in the data base, another objective was to characterize emissions as a function of crude type or product, specific gravity, storage temperature, etc. The purpose of this chapter is to show the comparisons with the API equations and the measured parameters.

The American Petroleum Institute (API) evaluated product losses from fixed-roof storage tanks and presented its findings in several published bulletins. Three bulletins of significance to this project were:

API Bulletin 2513, "Evaporation Loss in the Petroleum Industry - Causes and Control," 1959.

API Bulletin 2518, "Evaporation Loss From Fixed-Roof Tanks," 1962.

API Bulletin 2523, "Petrochemical Evaporation Loss From Storage Tanks," 1969.

The first bulletin in this series, API 2513 contains a discussion of theoretical considerations affecting evaporation losses from fixed-roof tanks. API 2518 presents empirical correlations for predicting evaporation losses for tanks containing gasoline and crude oil. Evaporative loss correlations for tanks containing petrochemicals are presented in API 2523. The scope of each bulletin is quite specific and clearly defines the applicability of each correlation.

BREATHING LOSSES

The correlation, as presented in API 2518 for the prediction of breathing losses in fixed-roof tanks, is based primarily on data obtained from gasoline storage tanks. The equation derived in API 2518 for predicting breathing losses from crude in fixed-roof tanks is as follows:

$$L_y = K_c \left(\frac{24}{1000}\right) \left(\frac{P}{14.7-P}\right)^{.68} D^{1.73} H^{.51} T^{.50} F_p C$$

where:

L_y = breathing loss (bbls/yr)

K_c = factor to adjust gasoline breathing loss equation to breathing loss of crude oil = 0.58

P = true vapor pressure at bulk liquid temperature (psia)

D = tank diameter (ft)

H = average outage including correction for roof volume (ft)

T = average daily ambient temperature change (^{o}F)

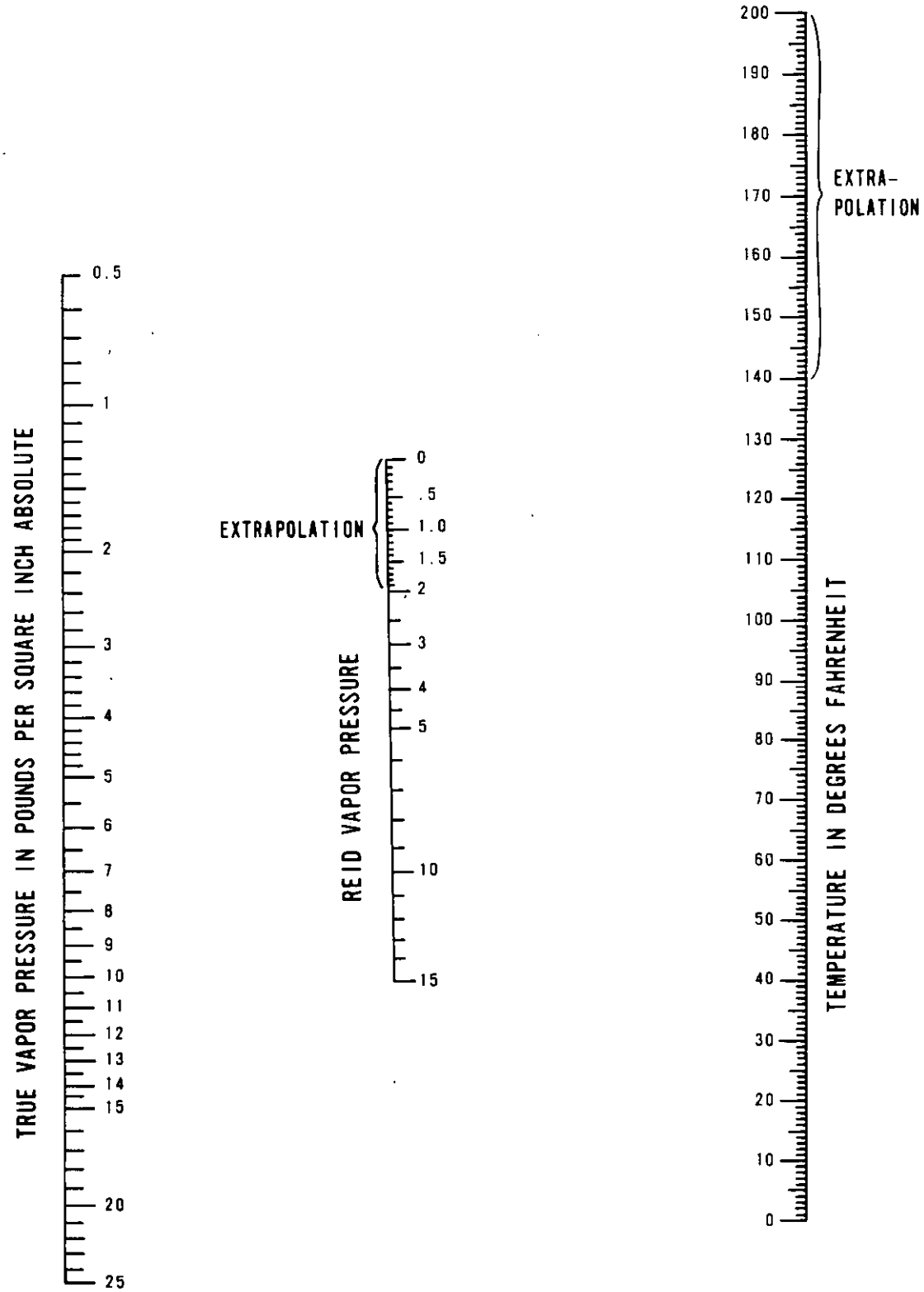
F_p = paint factor

C = adjustment factor for small diameter tanks.

The above equation was utilized to calculate emissions for comparison with measured hydrocarbon emissions from crude oil storage tanks. For comparison with measured emissions from tanks containing distillates, the factor K_c was set at 1.0, the same as the API correlation for breathing emissions from gasoline tanks, since API 2518 is not specific as to how to utilize the equation for hydrocarbon mixtures except gasoline and crude. Petrochemical losses are discussed in API 2523.

The true vapor pressure factor P was derived from the measured Reid vapor pressure (RVP) through use of a nomograph in API 2518. Some crude oils in the study ranged as low as 0.2 RVP, whereas the nomograph covered Reid vapor pressures only down to 2.0. Therefore, a line-fitting technique was developed to extend the range of the nomograph. (Figure VI-1). It was realized that caution must be used

EXTRAPOLATION OF RVP VERSUS TVP NOMOGRAPH FROM API 2518



when extrapolating beyond the original range of the nomograph. However, there was no alternative for this study.

For the distillate products, the true vapor pressure was determined from a plot of vapor pressure versus temperature which had been prepared from the liquid vapor reflux analysis.

The API equation calculates evaporation losses in barrels per year. Therefore, it was necessary to relate these liquid loss volumes to the mass emission rates measured in pounds per day. This was done using information presented in API 2513, page 40, on the liquid densities of certain hydrocarbon vapors. Figure VI-2 shows a graph of that information relating vapor molecular weight, M, to its condensed vapor density. Since Figure VI-2 is based on pure components and storage tank vapors are a mixture of compounds, the actual curve observed in practice may differ slightly from that shown. However, equations from API 2523, that are based on experimental data for gasoline vapors, closely agree with Figure VI-2 for molecular weights between 45 and 75 lb/lb-mole. That empirical equation is shown as the dotted line.

In this study, 21 tank tests were available for correlation with the API equation and significant parameters. Table VI-1 lists these measured emissions and those calculated with the API breathing loss equation. Measured versus calculated emissions for standing storage tanks are shown in Figure VI-3. Of the 21 tanks tested, only two had measured emissions larger than calculated by the API breathing equation. In general, the API equation overestimated emissions. For the breathing tanks in this investigation, the sum of the measured emissions was 58 percent of the sum of the predicted breathing losses.

As can be seen from Figure VI-3, many of the measured and calculated values were very low and tended to be more scattered than the higher values. This may be explained by possible "system noise" due to potentially larger errors associated with containing and metering extremely low flows.

Table VI-2 lists the calculated true vapor pressures and paint factors used in the API equation for standing storage tanks.

RELATIONSHIP OF CONDENSED VAPOR DENSITY AND MOLECULAR WEIGHT FOR TYPICAL HYDROCARBON COMPOUNDS

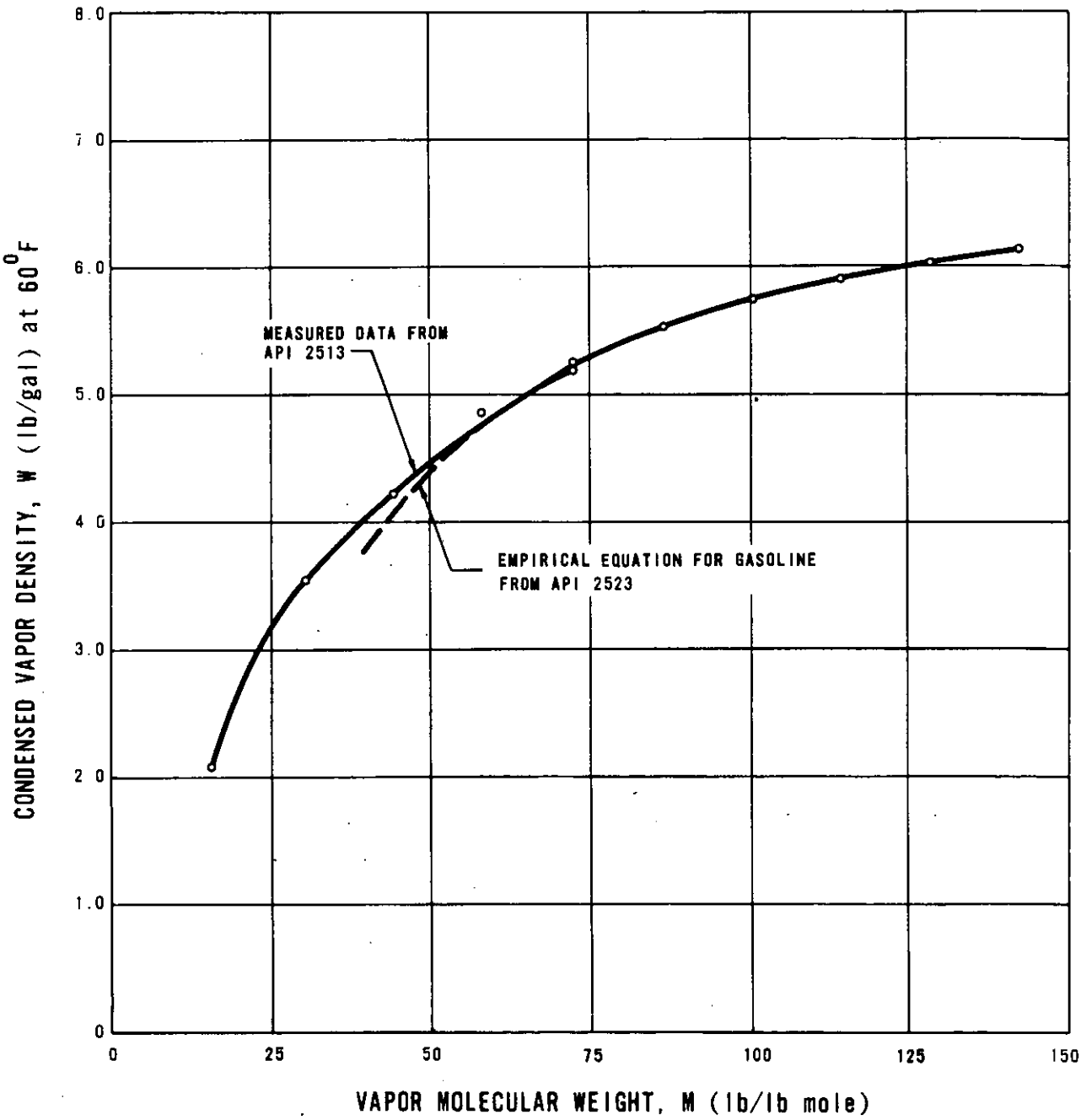


TABLE VI-1

MEASURED VERSUS API CALCULATED EMISSIONS
FOR STANDING STORAGE FIXED-ROOF TANKS

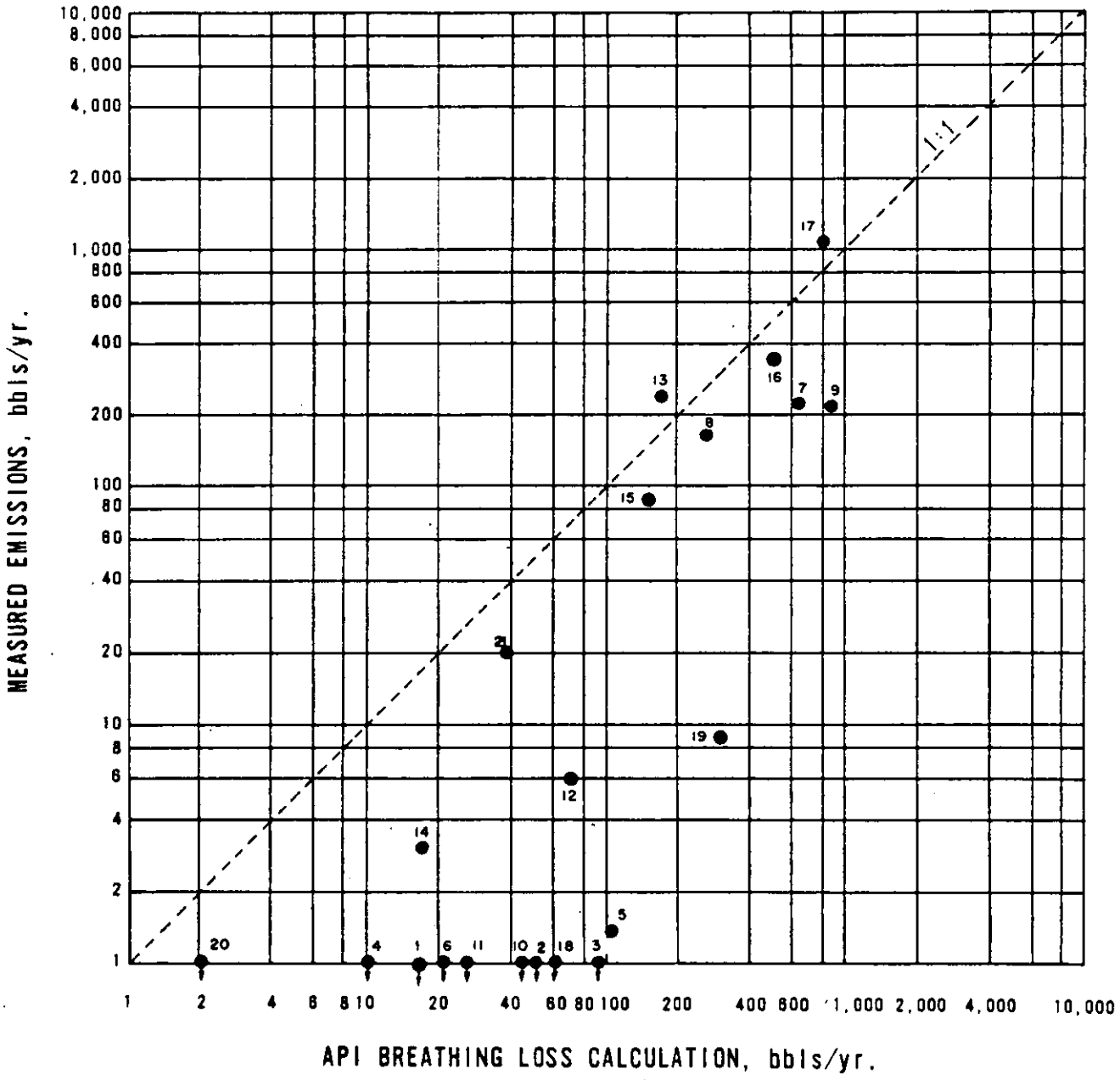
Test No.	Tank Name	Measured Loss (lbs/day)	Measured Loss (bbls/yr)	API Calculated Breathing Loss (bbls/yr)
1	Atlantic Richfield C1003	Negligible	Negligible	17
2	Atlantic Richfield Soladino	<1	<1	51
3	Atlantic Richfield R-49[1]	Negligible	Negligible	91
4	Beren 1336	Negligible	Negligible	10
5	Chevron 281[1]	1	1	101
6	Chevron 490	Negligible	Negligible	21
7	Chevron 817[1]	133	224	607
8	Chevron 817[2]	96	164	257
9	Chevron 821	119	222	856
10	Chevron 9407	Negligible	Negligible	44
11	Chevron 25302	<1	<1	26
12	Edgington 107[1]	5	6	74
13	Edgington 107[2]	138	240	167
14	GATX 80002	2	3	17
15	GATX 80012	44	84	138
16	GATX 178013	225	339	490
17	GATX 178013[2]	575	1,086	783
18	GATX 178015	Negligible	Negligible	61
19	GATX 178018	6	9	298
20	Getty KD 4225	Negligible	Negligible	2
21	Texaco 80034	12	20	38
	Total		2400	4149

[1] Liquid sample may not be representative of the stock during the test.

[2] Retest.

$$\frac{2400}{4149} = 0.58$$

MEASURED VERSUS CALCULATED BREATHING LOSS EMISSIONS FOR STANDING STORAGE TANKS



●(#) NUMBER REFERS TO TEST NUMBER

TABLE VI-2

CALCULATED TRUE VAPOR PRESSURE AND PAINT FACTOR FOR STANDING STORAGE TANKS

Test No.	True Vapor Pressure, P (psia)	Paint Factor, F_p
1	2.00	1.29
2	3.30	1.33
3 Arco-R-49 —	0.05 — FUEL OIL 150°F	1.58
4	0.30	1.39
5 Chevron 40281	0.35 ~~Diesel~~ 180°F F.O	1.58
6 Chevron 490	0.10 DIESEL ~~140~~ 90°F	1.00
7	1.50	1.58
8	0.60	1.58
9	3.80	1.46
10	0.05	1.58
11	3.00	1.58
12	1.20	1.00
13	0.80	1.00
14	0.01	1.58
15	1.60	1.00
17	3.40	1.38
18	0.50	1.00
19	1.50	1.18
20	2.80	1.46
21	0.02	1.58

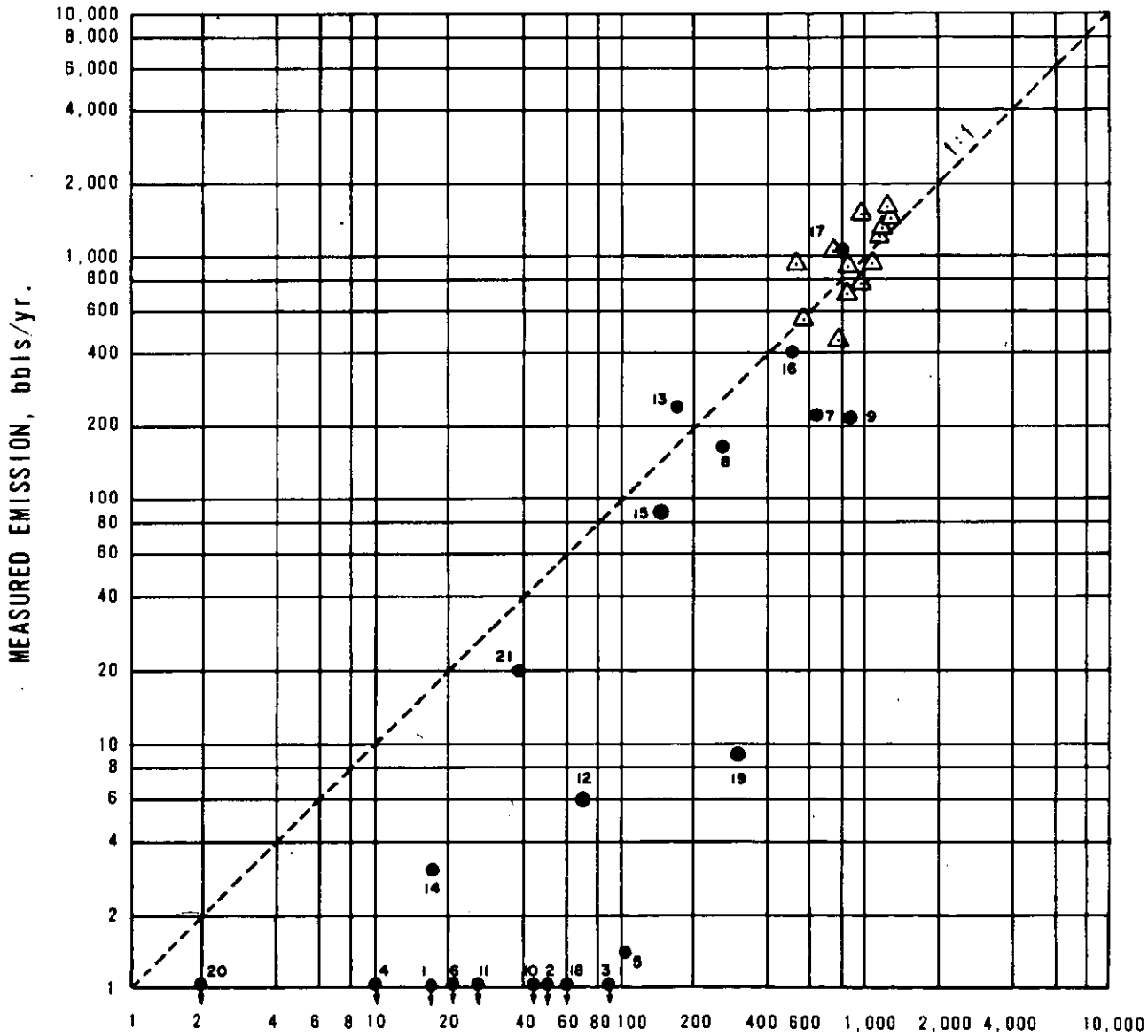
Breathing Losses Versus Measured Parameters

Figure VI-4 shows the ES measured versus API calculated emission rates plus the original API data set given in API Bulletin 2518. Emission rates in this investigation were generally below the emission rates in the original data set used to derive the crude oil breathing loss equation. Therefore, as for all empirical relationships, extension of the relationship beyond the original range of data should be done cautiously.

The API breathing loss equation can be divided into two main terms, one relating to the vapor flow rate and the other relating to the hydrocarbon concentration. One would expect the term $\left[\frac{P}{14.7-P}\right]^{.68}$ to be closely related to the total hydrocarbon concentration of the discharged vapor. Figure VI-5 shows a plot of $\left[\frac{P}{14.7-P}\right]^{.68}$ versus the total hydrocarbon concentration. No general trend is evident. One reason for the scatter could be that the vapor space was not saturated. However, concentrations during the field tests were fairly uniform, indicating essential equilibrium. Another reason for the scatter of data in Figure VI-5 could be the potential error in calculating true vapor pressure from the nomograph in API 2518. Lastly, the above expression may not be a proper parameter for estimating hydrocarbon concentrations.

In an effort to determine a parameter more closely related to the expelled vapor's hydrocarbon concentration, the Reid vapor pressure was plotted versus total hydrocarbon concentration (Figure VI-6). No vapor flow out of the tank was observed on three tanks so the data were not plotted in Figure VI-6. As mentioned in Chapter V, four Reid vapor pressures on crude oils were estimated from the liquid gas chromatograph analyses. These data, likewise, were not plotted in Figure VI-6. Finally, no data were plotted for the distillate oil storage tanks. Even though the number of remaining data points was limited to eight tanks, it appeared that the RVP may relate more closely to expelled vapor hydrocarbon concentration than does $\left[\frac{P}{14.7-P}\right]^{.68}$.

MEASURED VERSUS CALCULATED BREATHING LOSS EMISSIONS FOR STANDING STORAGE TANKS API AND ES DATA

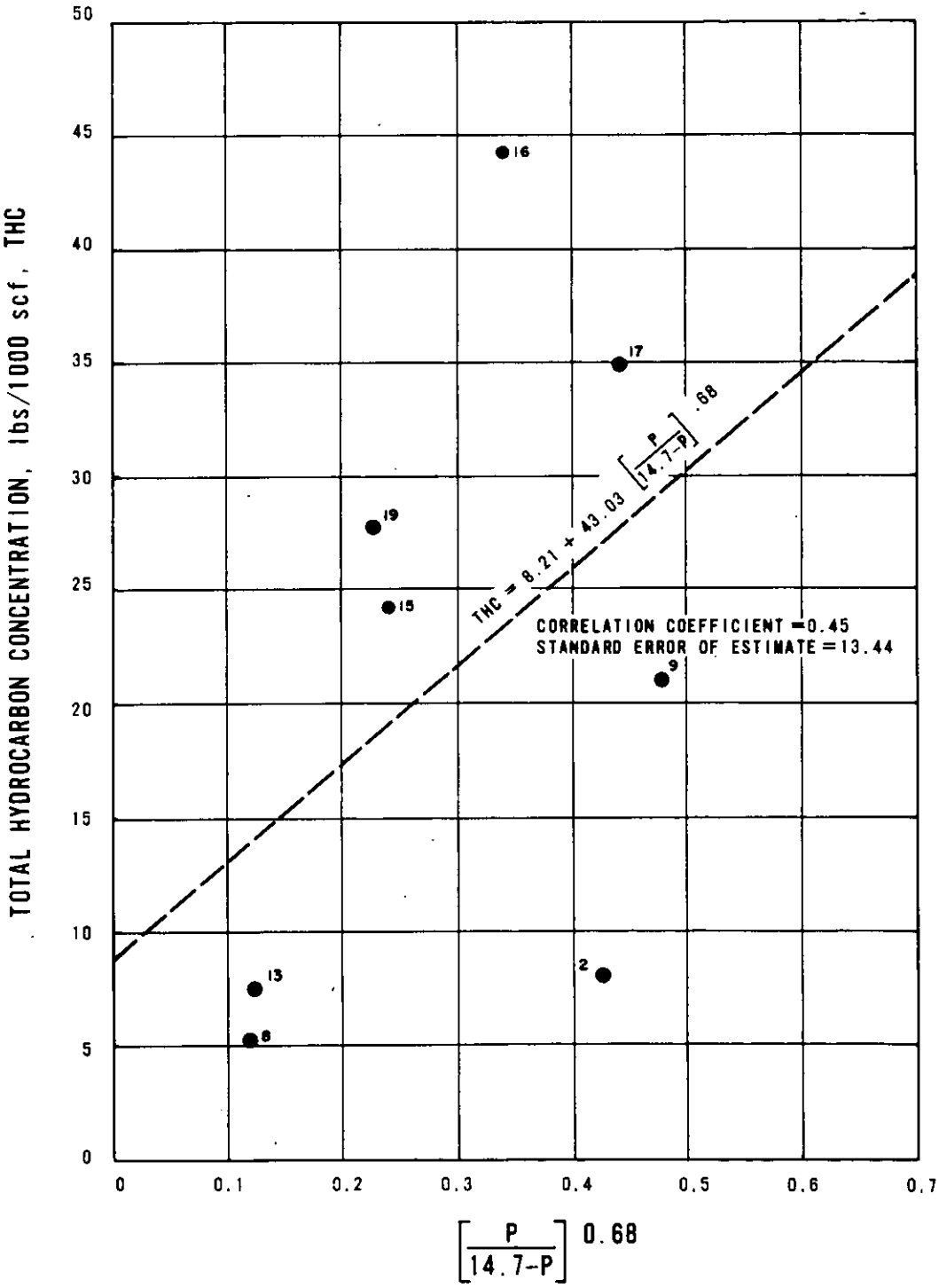


$$L_B = 0.58 \left(\frac{24}{1000}\right) \left[\frac{P}{14.7-P}\right] .68 D^{1.73} H^{.51} \Delta T^{.50} F_p C$$

△ API ORIGINAL DATA BASE

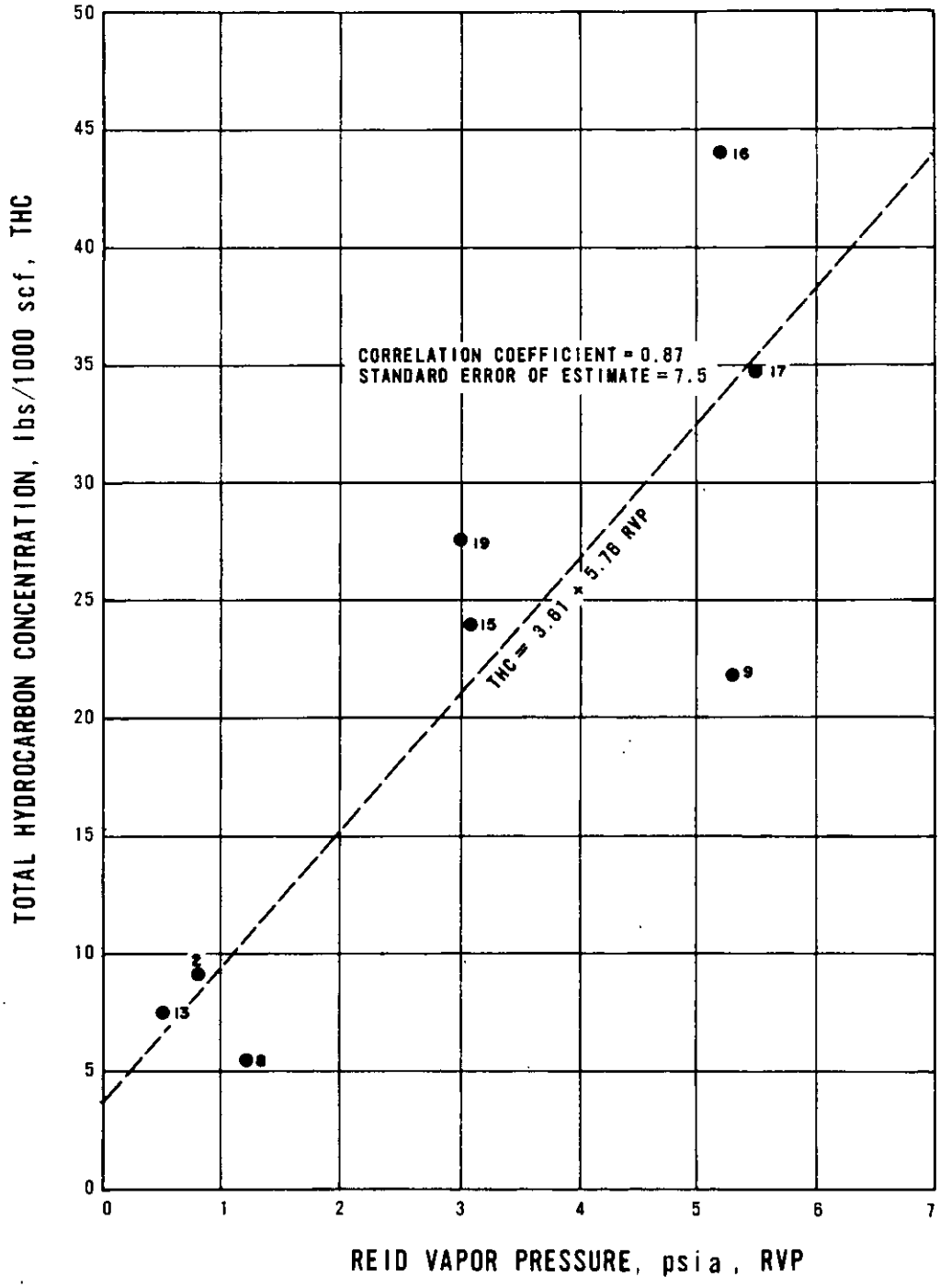
● ES DATA BASE (#) NUMBER REFERS TO TEST NUMBER

HYDROCARBON VAPOR CONCENTRATION VERSUS $\left[\frac{P}{14.7-P}\right]^{0.68}$
FOR CRUDE OIL STANDING STORAGE TANKS



● (#) NUMBER REFERS TO TEST NUMBER

EMISSION CONCENTRATION VERSUS CRUDE OIL RVP, STANDING STORAGE TANKS



(#) NUMBER REFERS TO TEST NUMBER

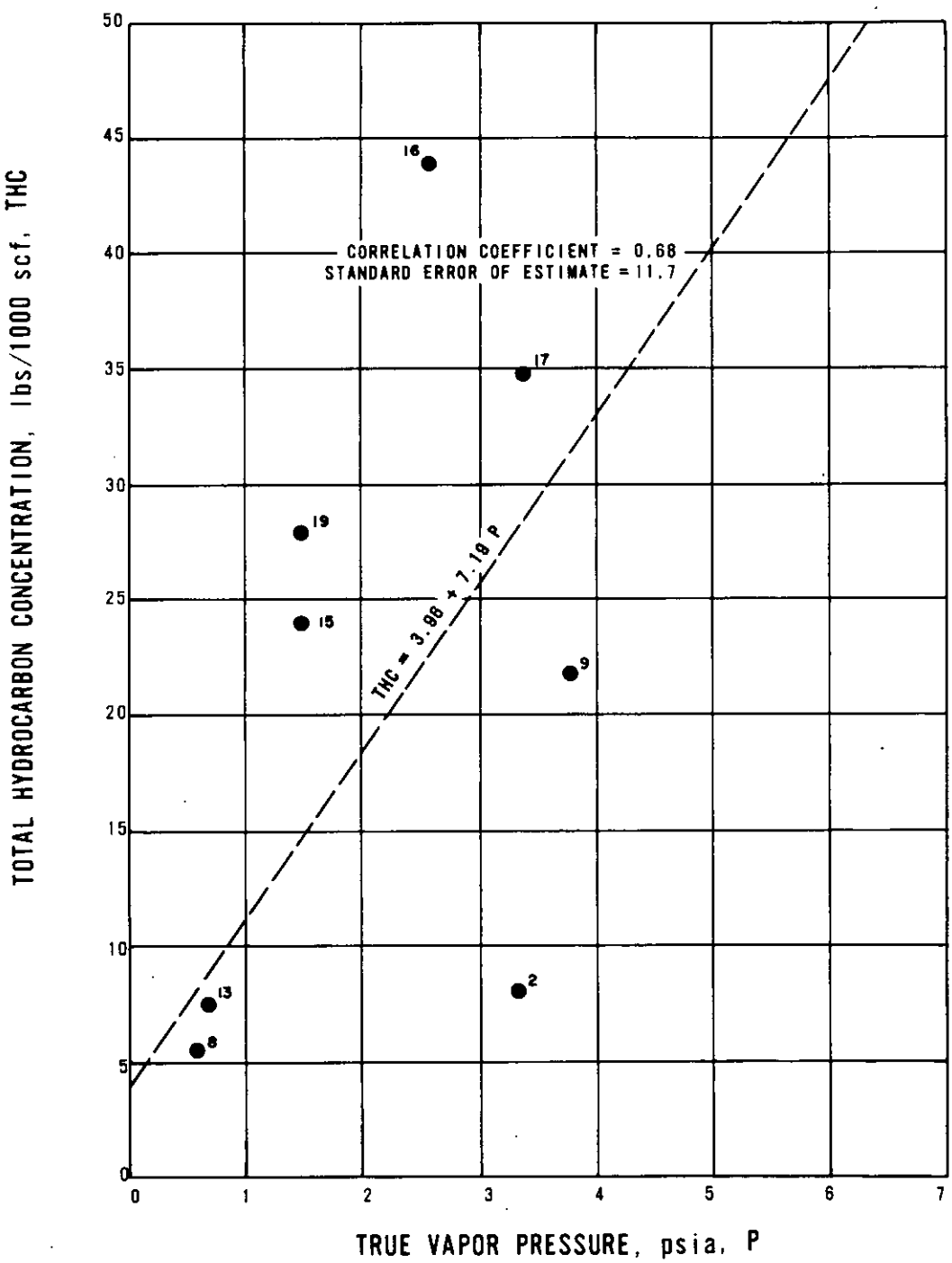
One other parameter, true vapor pressure, was plotted to determine the possible relationship with hydrocarbon concentrations. The correlation coefficient for eight tanks was less than for the same plot using Reid vapor pressure.

One would expect the other major grouping of parameters in the API breathing loss equation, $(D^{1.73}H^{.51}T^{.5}F_pC)$ to be closely related to the volume of vapors discharged. A plot was developed of the measured vapor discharged versus the grouped parameter (Figure VI-8). No strong relationship was apparent. In fact for any given value of the grouped parameter a wide variation was noted in the volume of measured vapor discharged.

One would expect the volume of expelled vapors to increase as the tank vapor space increased. One might also expect changes in ambient temperature and differences in tank color to affect the volume of vapor expelled. A plot of vapor space volume (outage) versus expelled vapor volume showed that for a given outage wide variations could be observed in the volume of discharged vapors (Figure VI-9). In reviewing each data point, no clear trend could be observed between change in temperature, outage height, paint factor or small tank diameter correction factor.

In summary, the above mentioned analyses of data tend to show that the scatter observed in the measured emission rates versus API predicted emission rates (Figure VI-3) may be due to all the parameters in the equation. No one measured parameter or grouping of parameters was evident that would reduce the total scatter. While a relationship may be developed for RVP and the total hydrocarbon concentration of the expelled vapors, no relationship was evident from the data that would relate to the volume of expelled vapors.

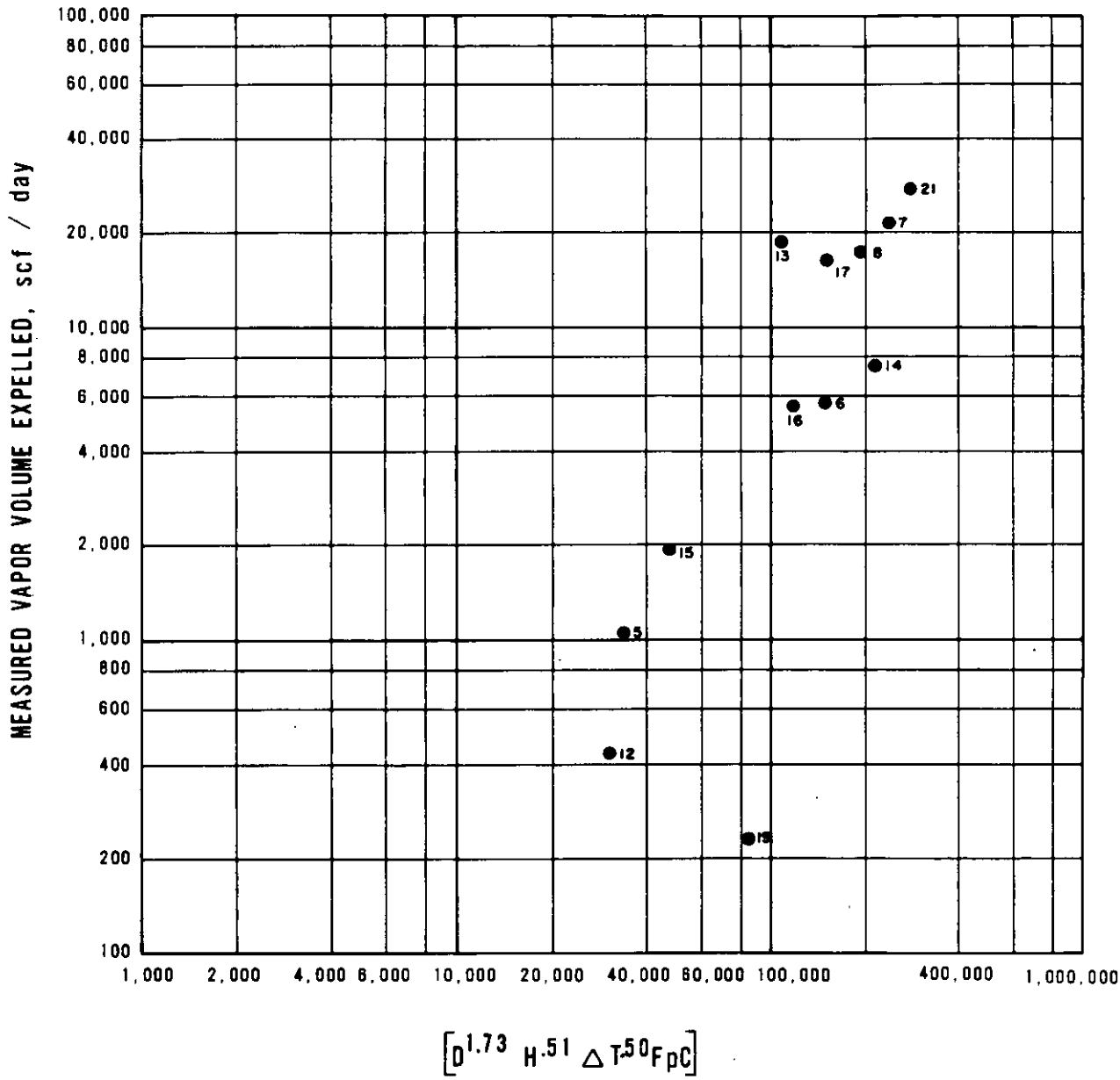
EMISSION CONCENTRATION VERSUS CRUDE OIL TRUE VAPOR PRESSURE, STANDING STORAGE TANKS



● (#) NUMBER REFERS TO TEST NUMBER

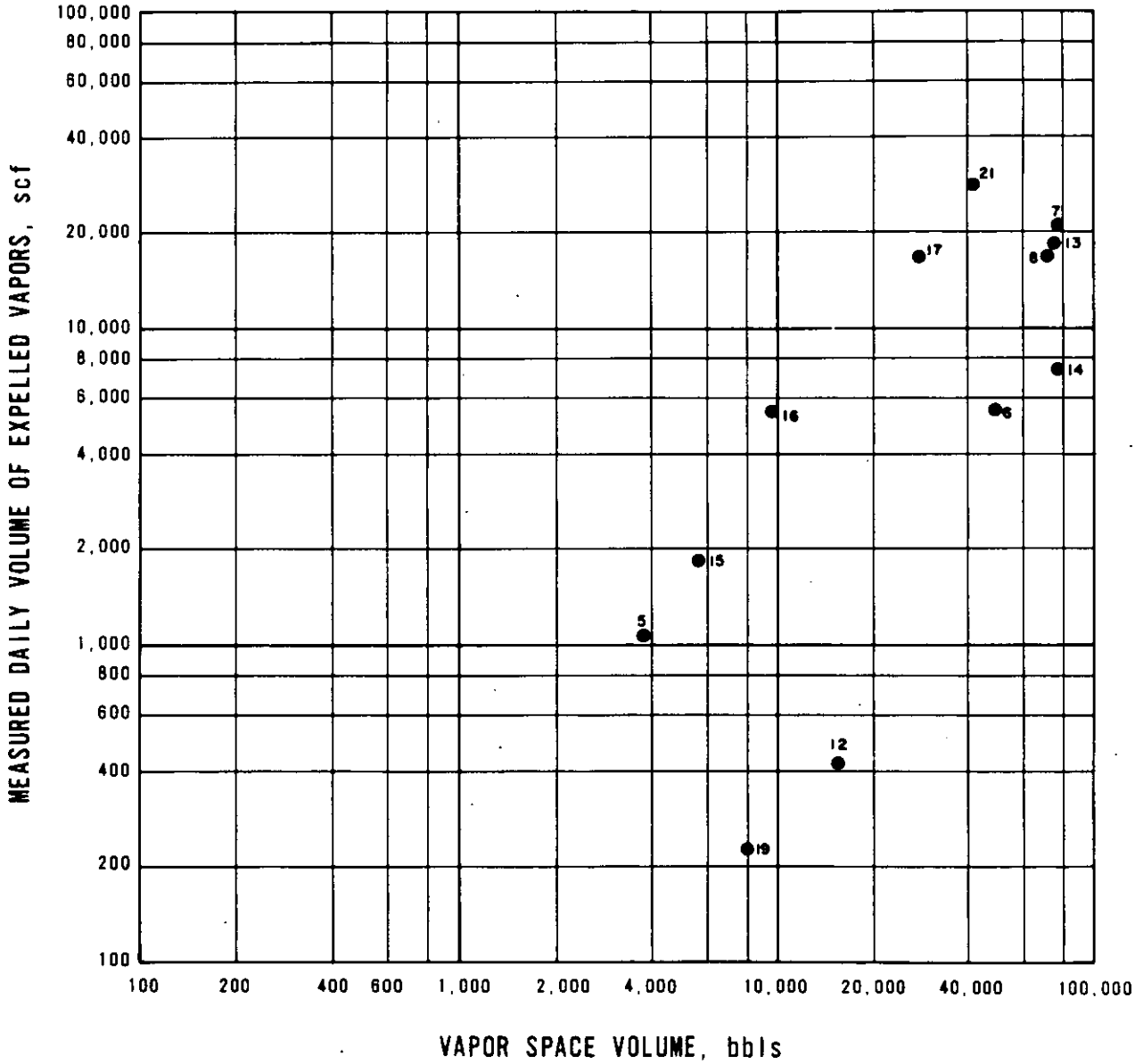
MEASURED VOLUME FLOW VERSUS

$[D^{1.73}\ H^{.51}\ \Delta T^{.50}\ FpC]$



●(#) NUMBER REFERS TO TEST NUMBER

DAILY VAPOR VOLUME EXPELLED VERSUS VAPOR SPACE VOLUME FOR STANDING STORAGE TANKS



●(#) NUMBER REFERS TO TEST NUMBER

WORKING LOSSES

The API working loss equation for crude oil is:

$$F = \frac{2.25\ PV}{10,000}\ K_T$$

where:

F = working loss (bbls)

P = true vapor pressure at bulk liquid temperature (psia)

V = volume of liquid pumped into tank (bbls)

K_T = turnover factor (from equation (5) or Figure 11 in API 2518)

This same equation was used to calculate the working losses for tanks containing distillates and fuel oil.

Working loss correlations for gasoline in fixed-roof storage tanks were developed by API mainly by comparing test data on 123 working tanks to the theoretical working loss equation developed in API 2513. The only adjustment made to the theoretical amount of saturated gasoline vapors displaced by the filling of the tank was to multiply the theoretical equation by a factor that depends upon the rate at which the tank was operated during the test period, expressed as turnovers per year. The available API test data on crude oil working loss were scattered and were not sufficiently definite to permit a formal correlation. A review of the scattered data as well as a theoretical evaluation of the differences between crude oil storage and gasoline storage led API to use the gasoline working loss equation for crude oil after multiplying by a factor of 0.75.

The conversion to relate volumetric losses to mass emission rates was presented earlier in the chapter (Figure VI-2) and was used for these calculations. Subsequent discussion presents comparisons of the measured versus calculated hydrocarbon losses for the working tanks: batch, continuous, and special boiling operations.

Working loss was defined earlier as that loss resulting from the filling and emptying of the fixed-roof tank. Emissions measured for each tank included both the working and breathing loss for each test day. Therefore, both the API working loss and breathing loss equations were used to estimate total calculated emissions.

Batch Tanks

The volumetric flow rates from the batch tanks for three tanks exceeded the capacity of the metering system. The other batch tanks were small capacity, bolted tanks with very low filling rates. No leaks could be detected in the metering system. However, both of these tanks were suspected of having very small leaks around the gauge hatches and other bolted attachments to the tank roof which would relieve the small pressure generated by the low filling rates. No conclusions, therefore, could be drawn from the measured results. Normally such failures would have voided the tests. However, in the interest of preserving that portion of the data which was valid, calculations of the discharged vapor volume were based upon the amount of liquid added to the tank.

During each of the batch tank tests, only filling occurred. The total working losses from a batch tank over a complete cycle would include losses associated with filling, breathing and emptying. Therefore, the collected data represent only the filling portion of the complete batch cycle. Hydrocarbon emissions for the filling portion of the cycle were calculated from the vapor volumes displaced by the added liquid as presented below:

Chevron 490	99	lbs/filling day
Conoco 5389	5	lbs/filling day
Getty 55709	2597	lbs/filling day
Getty 80712	2757	lbs/filling day
Union 6761	21	lbs/filling day

Note that these volumes do not include any amounts for the anticipated emissions associated with breathing loss during the filling process.

Because of the short-term measurements on these batch tanks, the difficulty experienced with the flow measurements, and the fact that there were only five tanks available, no further correlations were attempted.

Continuous Tanks

Testing included 13 fixed-roof tanks subject to filling, emptying and breathing losses. These were continuous tanks and included typical surge operations, Lease Automatic Custody Transfer (LACT) tanks and wash tanks.

The API working loss equation applicability to continuously operating tanks is questionable. The liquid level does not always function directly with the volume pumped into the tank and, therefore, the short-term emissions, and perhaps the long-term emissions, can be highly variable with respect to the oil volume added. The API equation calculates working losses with the total volume of product pumped into the tank as a part of the equation.

Table VI-3 lists the breathing and working losses calculated by the API equation compared with measured emissions for each of the continuous tanks. The calculated losses from working tanks again represent the sum of losses due to breathing and working. Note that of the 13 tanks tested, only three have measured emissions that were greater than the API calculated emissions. It could be expected that emissions from wash tanks should be much closer to those calculated by breathing alone than by the working equation. This should be due to the fact that liquid level in the wash tank does not vary although large amounts of oil can be pumped through the tank. The emissions data presented in Table VI-3 supports this hypothesis.

The other continuous tanks have liquid level movement but again, the measured emissions tend to be significantly less than estimated by the API equation when using the volume pumped into the tank. The LACT tank's level movement fluctuates between two set points. In each of the tested tanks, the LACT tank's cycle was short compared to the length of the test; therefore, measured emissions would logically seem to be more closely related to the liquid pumped into the tank.

TABLE VI-3

MEASURED HYDROCARBON EMISSIONS COMPARED WITH API 2518 CALCULATED EMISSIONS FOR TANKS IN CONTINUOUS WORKING OPERATION

Test Number	Company	Tank Number	Tank Type	Measured Hydrocarbon Losses lbs/day	Measured Hydrocarbon Losses bbls/yr	Calculated Hydrocarbon Losses Breathing bbls/yr	Calculated Hydrocarbon Losses Working bbls/yr	Calculated Hydrocarbon Losses Total bbls/yr
27	Aminoil	25697	LACT	255	452	48	983	1031
28	Atlantic Richfield	R-26	Cont	0	0	46	3	49
29	Champlin	2030D	Wash	0	0	27	208	235
30	Chevron	821	Cont	67	97	629	1449	2078
31	Edgington	12005	Cont	0	0	33	13	46
32	Getty	1SB3	LACT	3	6	219	23	242
33	Getty	5729	LACT	1289	2699	227	828	1055
34	Getty	5793	Wash	17	33	44	901	945
35	Mobil	20X1160	LACT	8	25	48	9	57
36	Shell	550S4	Cont	195	338	32	1183	1215
37	Union	8826	LACT	21	32	7	2	9
38	Union	10001	Cont	106	184	41	86	127
39	Union	37402	Cont	174	292	176	307	483
	Total			2314	4158	1668	6083	7572

$$\frac{4158}{7572} = 0.55$$

ENGINEERING-SCIENCE ES

Figure VI-10 shows the measured loss versus the sum of the breathing and working loss calculated by the API equation. It is evident that using the API equations with total volume of liquid flow can lead to calculated losses much greater than observed. Overall, measured hydrocarbon losses on the continuous working tanks were about 55 percent of the sum of the losses calculated by the API equations. However, results are somewhat biased by one test on Getty 5729 which showed extremely high emissions. If this test is excluded, then the measured losses on 12 tanks are only about 30 percent of those calculated by API 2518. Table VI-4 lists the calculated true vapor pressures, paint factors and turnover factors used in the API equation for working tanks.

Working Loss Versus Measured Parameters

While the API equation ($F = \frac{2.25}{10,000} PVK_T$) for working losses is considerably simpler than its breathing loss counterpart, the equation can still be broken into two parts. One part relates to the hydrocarbon concentration in the vapor and the other part relates to the volume of vapors expelled.

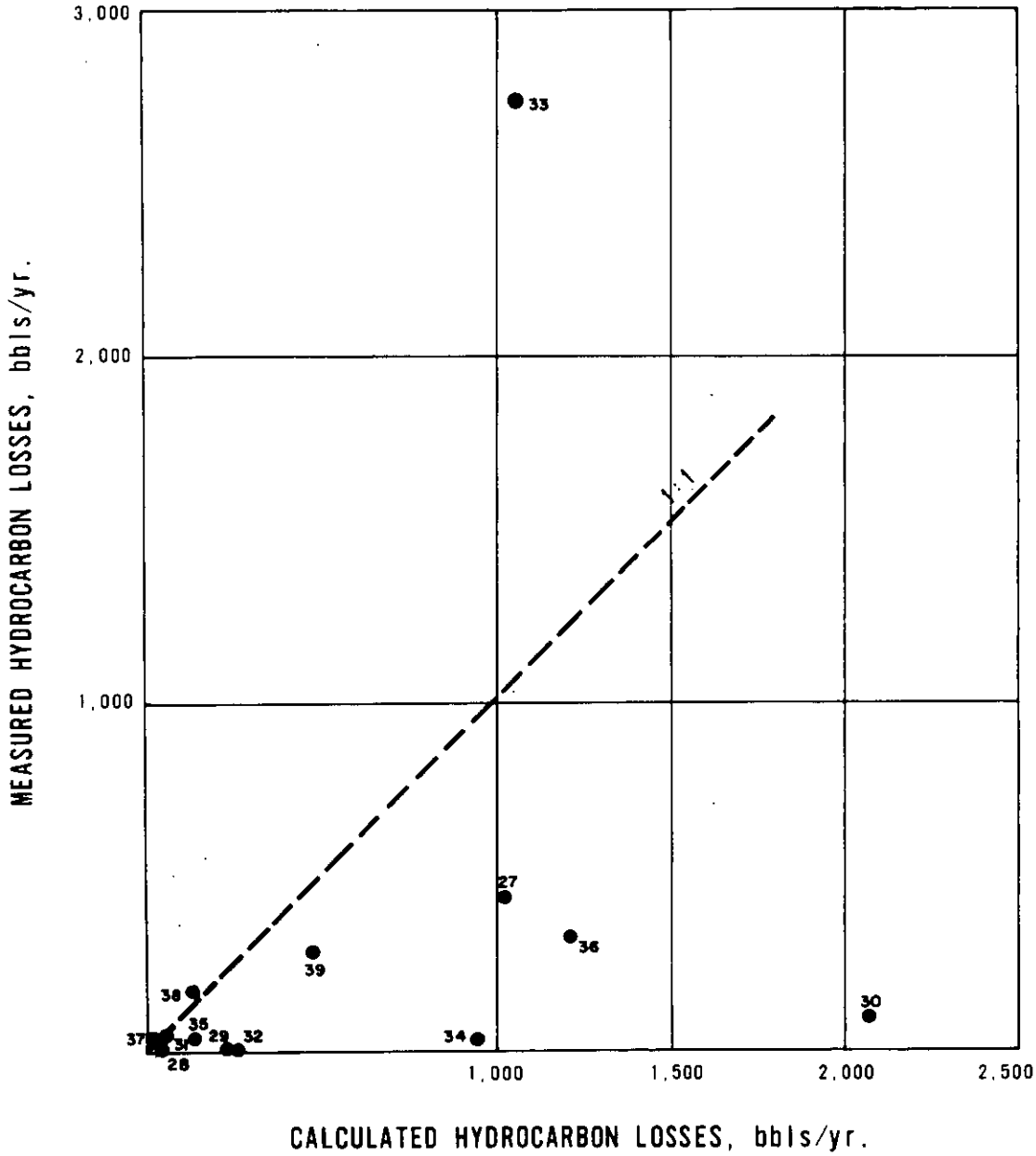
Since the true vapor pressure, P, and the turnover factor, K_T, are the terms in the equation that relate to the hydrocarbon concentration, the following analysis was done to check that relationship. Linear regression models were run relating total hydrocarbon concentration to both Reid and true vapor pressure for the batch and continuous tanks (Figures VI-11 and VI-12). Results tended to indicate that the total hydrocarbon concentration can be expressed as a function of either Reid or true vapor pressure. However, the relationships were not as pronounced as the Reid vapor pressure-hydrocarbon relationship found for breathing loss tanks. Figure VI-13 shows the relationship of total hydrocarbon concentration to the product of Reid vapor pressure and the turnover factor for continuous tanks. Similarly, Figure VI-14 is a plot of concentration versus the product of true vapor pressure and the turnover factor. The tested batch tanks were not included on the figures as the K_T factor is an annualized figure and the tests only recorded the filling cycles. Comparison of Figures VI-11 through

TABLE VI-4

CALCULATED TRUE VAPOR PRESSURE, PAINT FACTOR AND TURNOVER FACTOR FOR WORKING TANKS

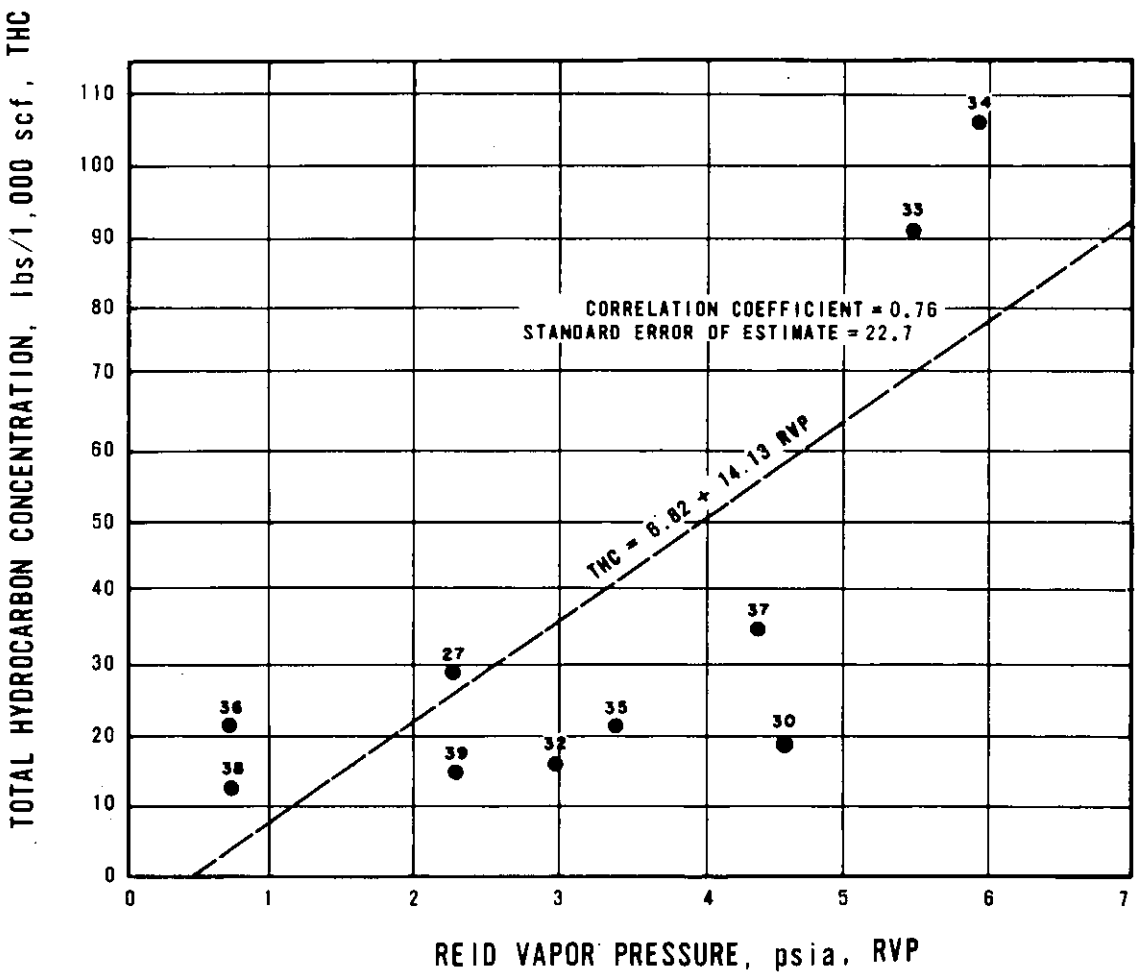
Test No.	True Vapor Pressure, P (psia)	Paint Factor, F_p	Turnover Factor, K_T
22	0.10	1.00	0.57
23	3.60	1.33	1.00
24	3.90	1.00	0.45
25	4.20	1.33	0.60
26	7.50	1.20	1.00
27	5.60	1.30	0.27
28	0.50	1.00	1.00
29	5.00	1.46	0.23
30	2.60	1.46	1.00
31	0.60	1.00	0.50
32	2.50	1.33	0.40
33	7.50	1.33	0.24
34	7.50	1.33	0.23
35	3.20	1.39	0.27
36	2.40	1.00	0.50
37	2.60	1.39	0.22
38	0.80	1.39	1.00
39	1.10	1.30	1.00

MEASURED HYDROCARBON EMISSIONS COMPARED WITH API 2518 CALCULATED EMISSIONS FOR TANKS IN CONTINUOUS WORKING OPERATION



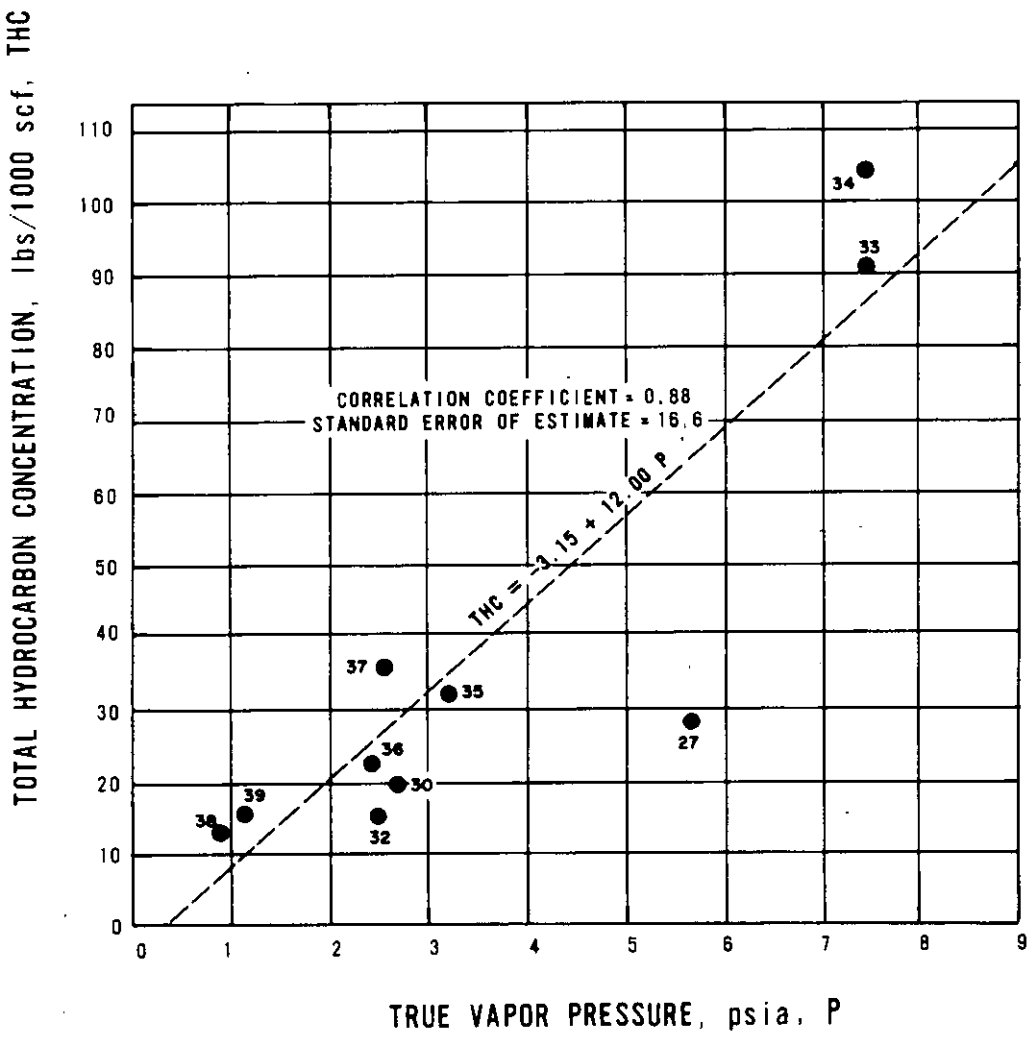
● (#) NUMBER REFERS TO TEST NUMBER

TOTAL HYDROCARBON CONCENTRATION VERSUS REID VAPOR PRESSURE FOR CONTINUOUS TANKS



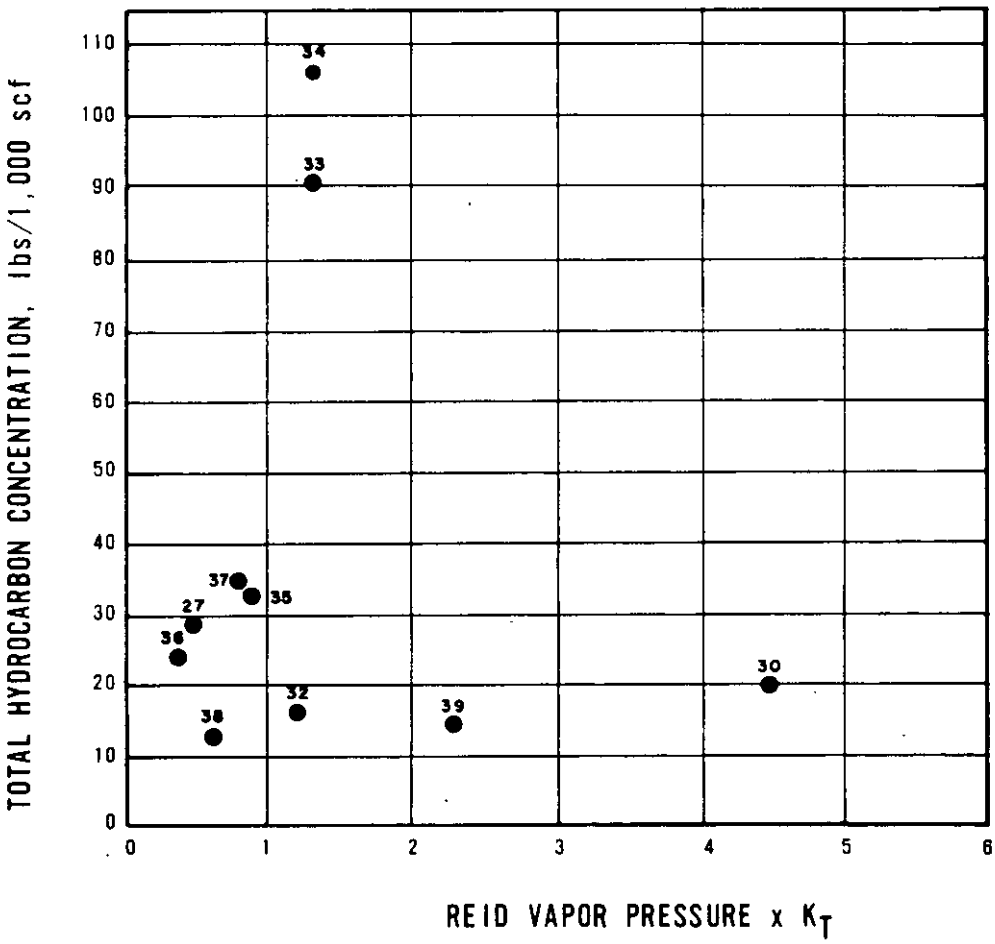
● (#) NUMBER REFERS TO TEST NUMBER

TOTAL HYDROCARBON CONCENTRATION VERSUS TRUE VAPOR PRESSURE FOR CONTINUOUS TANKS



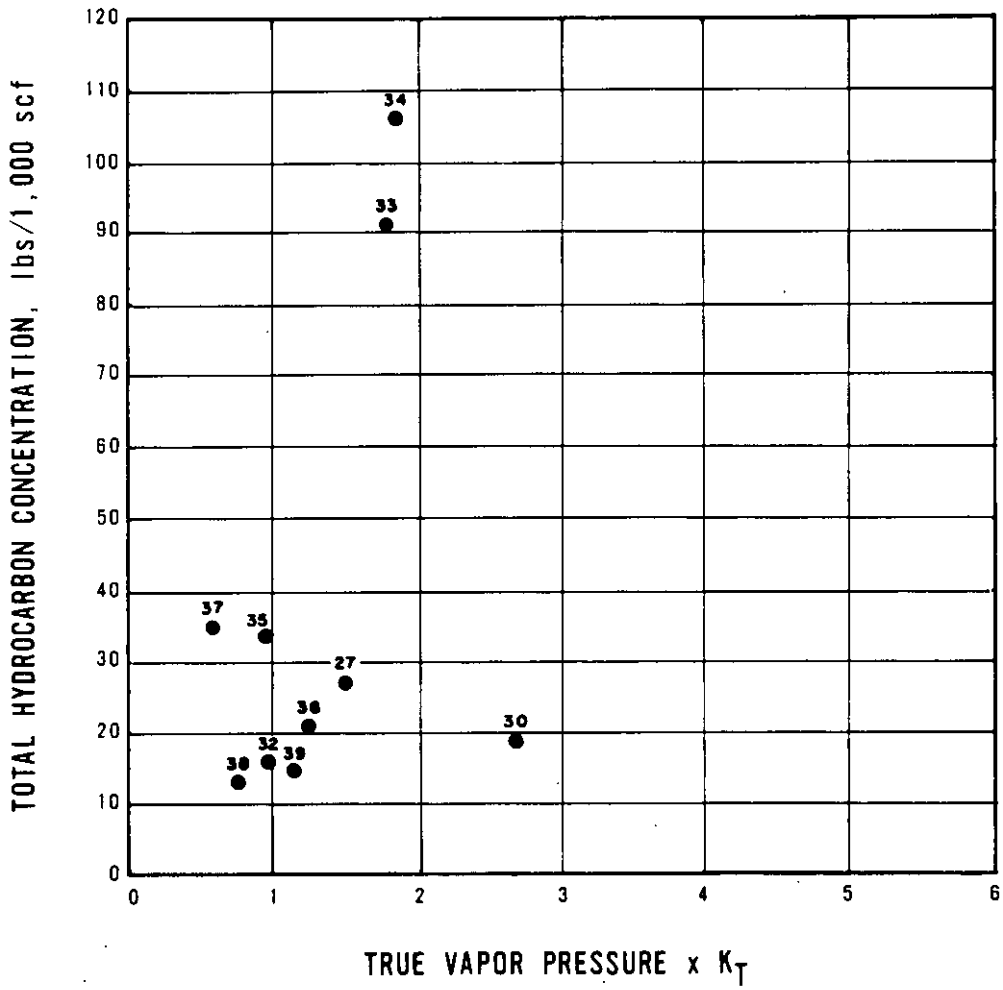
● (#) NUMBER REFERS TO TEST NUMBER

TOTAL HYDROCARBON CONCENTRATION
VERSUS
REID VAPOR PRESSURE x K_T
FOR CONTINUOUS TANKS



● (#) NUMBER REFERS TO TEST NUMBER

TOTAL HYDROCARBON CONCENTRATION VERSUS
TRUE VAPOR PRESSURE x K_T FOR CONTINUOUS TANKS



● (#) NUMBER REFERS TO TEST NUMBER

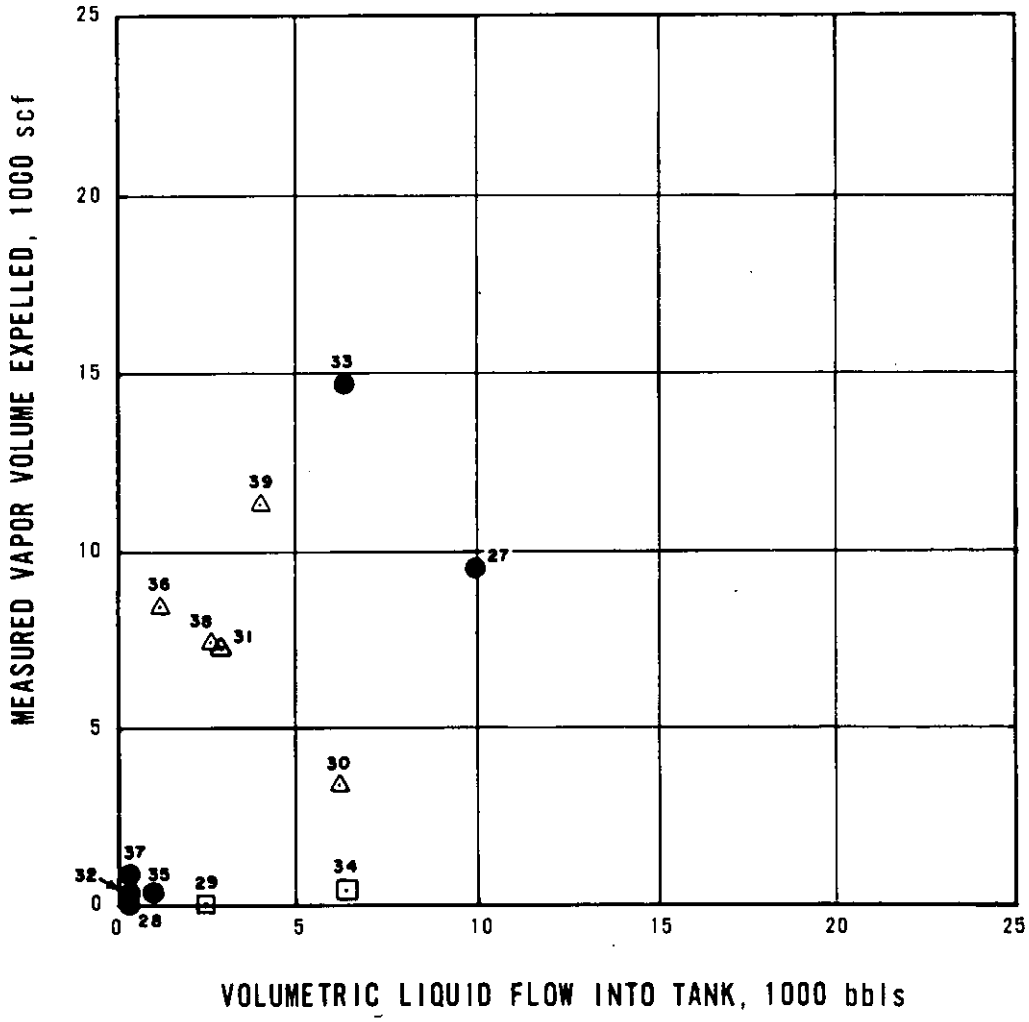
Figure VI-19 shows that the inclusion of the K_T factor tends to cause more scatter. It seems that the use of K_T to account for unsaturated vapors makes the PK_T term an unreliable predictor of total hydrocarbon concentration for continuous tanks.

Observations made during tests on the LACT tanks identified various cycles of the LACT tank operation. It was observed during these tests that as long as vapors were being expelled from the tank, the concentration profile was flat and that equilibrium or saturation was restored very quickly. It is therefore concluded that the turnover factor, K_T, may not provide an adequate description of the way in which turnover affects vapor concentration for continuous tanks.

The parameter, V, in the API working loss equation is defined as the volume of liquid pumped into the tank in barrels and it is related to the volume of vapor expelled from the tank. Figure VI-15 shows the relationship of the vapor volume expelled from continuous tanks and the liquid flow into the tank. It should be noted that these data are not typically available for LACT tanks as the LACT units record shipments from the tank but no record is made for flow into the tank. For LACT tanks, the flow into the tank was assumed equal to the flow out of the tank. These estimates of flow in and out of the tank, however, could vary by as much as the volume between the LACT set points.

Even though effects for breathing cannot be separated out of this plot, Figure VI-15 does show a basic trend for the relationship between the volume expelled and the liquid flow into the tank. As expected, the plot exhibits considerable scatter. In addition, Figure VI-15 depicts a rather limited number of tests due to the fact that all seven batch tank tests were unusable for a variety of reasons. Therefore, the data base for working tanks was considered too limited and too scattered to extrapolate to a general relationship between volume expelled and volume pumped into the tank. As a result of the limited and scattered data and the interference by breathing loss factors, no suggestions can be made for developing a new correlation for vapor losses from working tanks.

MEASURED VAPOR VOLUME EXPELLED VERSUS
VOLUMETRIC LIQUID FLOW INTO TANK
FOR CONTINUOUS TANKS



● (#) LACT TANKS ; NUMBER REFERS TO TEST NUMBER

□ WASH TANKS

△ OTHER CONTINUOUS TANKS

SPECIAL TANKS SUBJECT TO PRESSURE DROP FLASHING

There were seven tanks in the study that were subject to flashing or "boiling" of the light components due to the upstream process units being under pressure. Table VI-5 lists the seven tanks, most of which normally operate with a vapor recovery system. Of course, for these tests, the vapor recovery system was disconnected. Five out of the seven tanks tested had much larger emission rates than were calculated by the API equation for breathing and working. The excess of emissions is attributable to the upstream pressure and the amount of light ends in the oil. It is difficult to correlate the flow rate, operating parameters and liquid analysis for only seven tanks, but it can be easily seen that a significant adjustment would have to be made in the API equations to account for flashing off light ends after a pressure drop. Table VI-6 lists the true vapor pressures, paint factor and turnover factors used in the API equation for special tanks.

An examination of the measured Reid vapor pressure and mole-percent of methane in the Appendix for each tank revealed a possible discrepancy. Some crude oils contained as much as 1.50 mole-percent of methane but had lower Reid vapor pressures than crude oils that contained less than 0.03 mole-percent. This was thought to be attributable to the fact that the methane may flash off when the Reid bomb is filled in the laboratory. In order to check that hypothesis, a computer program was used to simulate the Reid vapor pressure analysis for four different crude oils. The program,[1] which is available from the Gas Processors Association, uses an iterative flash point calculation to determine vapor liquid equilibrium for given temperature and pressure. The theoretical Reid vapor pressure was taken as the equilibrium pressure predicted by the program for a vapor to liquid volume ratio of 4:1.

[1] Gas Processors Association K&H Mod II Computer Program

TABLE VI-5

MEASURED HYDROCARBON EMISSIONS COMPARED WITH API 2518 CALCULATED EMISSIONS FOR SPECIAL TANKS RECEIVING CRUDE UNDER PRESSURE FROM AN UPSTREAM PROCESS

Test Number	Company	Tank Number	Tank Type	Measured Hydrocarbon Losses lbs/day	Measured Hydrocarbon Losses bbls/yr	Calculated Hydrocarbon Losses[1] Breathing bbls/yr	Calculated Hydrocarbon Losses[1] Working bbls/yr	Calculated Hydrocarbon Losses[1] Total bbls/yr
40	Conoco	Kemp	Wash	7	16	33	35	68
41	Exxon	410	LACT	1712	4020	90	897	987
42	Getty	9682	Wash	302	610	31	434	465
43	Mobil	30X55	Wash	4	8	76	130	206
44	Texaco	2583	LACT	542	1036	37	64	101
45	Texaco	25024	LACT	983	1963	27	30	57
46	Texaco	25267	LACT	199	309	110	51	161

[1] Based on actual Reid vapor pressure.

ENGINEERING-SCIENCE ES

TABLE VI-6

CALCULATED TRUE VAPOR PRESSURE, PAINT FACTOR AND TURNOVER FACTOR FOR SPECIAL TANKS

Test No.	True Vapor Pressure, P (psia)	Paint Factor, F_p	Turnover Factor, K_T
40	7.30	1.33	1.00
41	5.40	1.33	0.21
42	4.40	1.30	0.50
43	5.80	1.39	0.76
44	5.00	1.39	0.33
45	2.60	1.39	0.35
46	4.80	1.33	0.30

Two crude oils had low methane concentrations (0.03 and 0.19 mole percent) and high Reid vapor pressures (3.0 and 5.9 respectively). The other two crudes had high methane content (1.22 and 1.50 mole percent) but low Reid vapor pressures (1.5 and 1.3 respectively). The program calculated Reid vapor pressures very similar to those observed for the crudes containing lower amounts of methane. However, for the crudes with a high methane content, the program calculated Reid vapor pressure values four to five times larger than the measured Reid vapor pressure. Table VI-4 lists the measured and calculated Reid vapor pressures. This calculation seems to confirm the conclusion that the lighter, more volatile hydrocarbons in the crude will flash off while filling the Reid bomb. Therefore, the Reid vapor pressure would be an undependable basis for estimating the true vapor pressure for those crudes containing higher amounts of light ends (methane concentration greater than about 0.25 mole percent).

It should be reiterated that the API equation was not intended for use with boiling liquids as these two quotations from API 2518 indicate:

"D. Scope

This bulletin is the result of a study of the available test data on evaporation loss from cone-roof tanks. Inasmuch as the test data did not include crude oil containing significant amounts of ethane and methane, the equations in this bulletin may or may not apply to production lease tanks. The test data, and hence the results, are limited to tanks with vertical cylindrical shells and fixed roofs. The tanks are substantially liquid and vapor tight. They are equipped with tight fittings and operate at approximately atmospheric pressure." (pg. 6)

"Breathing Loss of Gasoline

Breathing loss may be defined as vapor expelled from a tank because of the thermal expansion of existing vapors, and/or expansion caused by barometric pressure changes, and/or an increase in the amount of vapor from added vaporization in the absence of liquid-level change, except that which results from boiling. The term 'vapor' denotes any mixture of hydrocarbon vapor and air. The term 'hydrocarbon vapor' refers to hydrocarbons in the gaseous state independent of the presence or absence of air." (pg. 6)

TABLE VI-7

CALCULATED VERSUS MEASURED
REID VAPOR PRESSURE

Tank	Methane Concentration (Mole Percent)	Measured Reid Vapor Pressure (psi)	Calculated Reid Vapor Pressure (psi)
GATX 178018	.03	3.0	2.7
Getty 5793	.19	5.9	6.5
Exxon 410	1.22	1.5	6.8
Texaco 25024	1.50	1.3	6.8

APPENDIX

APPENDIX

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER AMINOIL CO. OPERATOR AMINOIL

LOCATION HUNTINGTON BEACH TANK IDENTIFICATION OR NUMBER 25697

TANK OPERATION LACT MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1950 MANUFACTURER SUPERIOR

COLOR OF WALL LT. GRAY COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NO THICKNESS N/A** in. WALL COATING EPOXY ROOF COATING EPOXY

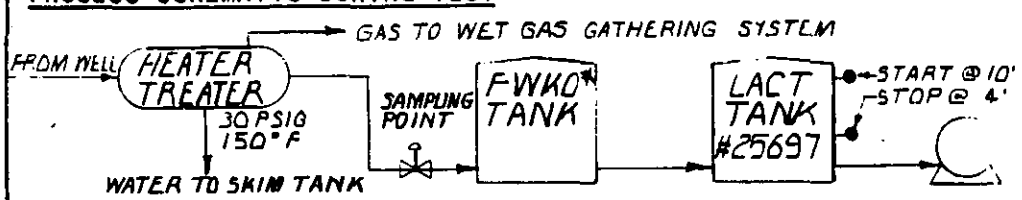
STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 29 ft. 0 in. CONSTRUCTION TYPE BOLTED

CAPACITY 2000 bbls. ROOF SLOPE 1 in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING 3.5 in. H_2O VACUUM ROOF VENT NORMAL SETTING N/A** in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME LOWER MAIN ZONE OIL FIELD HUNTINGTON BEACH

RVP 2.3 psia API GRAVITY 21.1 °

STOCK COMPOSITION (Mole Percent): CO_2 0.19 N_2 0.14

CH_4 0.16 C_2H_6 0.12 C_3H_8 0.56 iC_4 0.38 nC_4 1.02 iC_5 0.80 nC_5 0.79

C_6 1.43 C_7 PLUS 94.41 DENSITY OF C_7 PLUS 0.9278 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 312 lb/lb-mole API GRAVITY OF C_7 PLUS 20.9 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

The tank level varied from 4 feet to 10 feet as the LACT pump came on and went off. This tank was normally on vapor recovery but was taken off 24 hours prior to the test. Vapor flows are corrected to standard temperature. Hydrocarbon emissions for each day were calculated from the following bag samples: 5/7 (1529 bag); 5/8 (1305 bag); 5/9 (avg. of 1340, 1500 bags); 5/10 (0815 bags).

*FWKO: Free Water Knock-out
**Not Available

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** AMINOIL 25697

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
5/7	1529	.768	.893	5.294	9.247	4.509	1.296	5.139	2.863	.830	.172	0.	0.	0.	31.011	59.84
5/8	1305	.567	.748	5.944	8.357	3.967	1.870	4.265	2.253	.553	.071	0.	0.	0.	28.595	59.26
5/9	1340	.317	.544	3.687	6.367	3.415	1.686	3.967	2.040	.453	.057	0.	0.	0.	22.534	62.72
5/9	1500	.320	.664	3.926	6.768	3.693	1.861	4.581	2.577	.730	.186	0.	0.	0.	25.307	73.97
5/10	0815	.375	.702	3.508	6.256	3.976	2.017	5.102	3.055	.950	.322	0.	0.	0.	26.263	66.25

TEST SUMMARY **ONE WAY VALVE SETTING:** PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
5/6	1515	2400	3750	3750	9	61	50	145	N/A	2568	788	2260	600	3.3	187
5/7	0000	2400	10000	10000	9	67	49	145	N/A	8034	901	5698	700	6.4	257
5/8	0000	2400	10000	10000	9	63	55	145	N/A	9128	780	9074	800	5.3	266
5/9	0000	2400	10000	10000	9	62	53	145	N/A	9474	1088	9612	750	3.0	245

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER ATLANTIC RICHFIELD CO. OPERATOR ATLANTIC RICHFIELD CO.

LOCATION OJAI TANK IDENTIFICATION OR NUMBER C 1003

TANK OPERATION WASH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION NA MANUFACTURER NA

COLOR OF WALL ALUMINUM(SPEC) COLOR OF ROOF ALUMINUM(SPEC) PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 21 ft. 7 in. CONSTRUCTION TYPE BOLTED

CAPACITY 1000 bbls. ROOF SLOPE .02 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 2 in. H_2O VACUUM ROOF VENT NORMAL SETTING NA in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME UPPER OJAI OIL FIELD UPPER OJAI

RVP 1.8 psia API GRAVITY 22.2 °

STOCK COMPOSITION (Mole Percent): CO_2 .14 N_2 .12

CH_4 .03 C_2H_6 .05 C_3H_8 .43 iC_4 .29 nC_4 1.29 iC_5 1.10 nC_5 1.10

C_6 2.28 C_7 PLUS 93.17 DENSITY OF C_7 PLUS .9271 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 304 lb/lb-mole API GRAVITY OF C_7 PLUS 21.00 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

No flow was monitored either into or out of the tank while the tank was in the standing mode. Leaks in the vapor system were suspected but none could be detected; and if leaks did occur, they were of very small magnitude. The tank was not sufficiently warm to warrant usage of the vapor condensate system.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** ARCO C1003

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/1	1100	.014	.316	1.521	7.632	7.459	2.345	2.539	1.506	.481	.115	.048	0	0	23.976	68.3
4/2	0915	.065	.602	2.353	8.664	7.144	3.156	3.278	1.915	.667	.151	.014	0	0	28.009	67.0
4/3	1010	.029	.525	2.276	7.818	4.959	2.472	3.421	1.532	.583	.182	.044	0	0	23.842	66.9
4/3	1133	.035	.423	3.769	7.259	3.793	1.911	1.955	1.167	.416	.102	.005	0	0	20.833	62.2

TEST SUMMARY **ONE WAY VALVE SETTING: PRESSURE** .86 in H_2O **VACUUM** .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/1	0000	2400	0	0	6.2	65	45	113	N/A	0	0	0	0	0	0
4/2	0000	2400	0	0	6.2	66	46	98	N/A	0	0	0	0	0	0
4/3	0000	2400	0	0	6.2	67	39	90	N/A	0	0	0	0	0	0

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER ATLANTIC RICHFIELD CO. OPERATOR ATLANTIC RICHFIELD CO.

LOCATION CARSON TANK IDENTIFICATION OR NUMBER R-26

TANK OPERATION CONTINUOUS MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION UNKNOWN MANUFACTURER UNKNOWN

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NONE THICKNESS ___ in. WALL COATING NONE ROOF COATING NONE

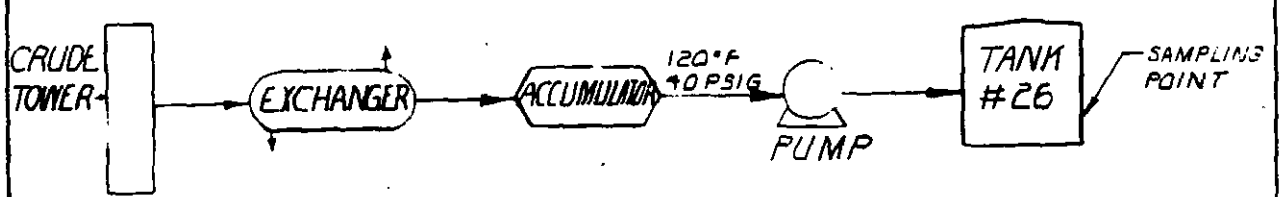
STRAIGHT WALL HEIGHT 48 ft. 0 in. DIAMETER 120 ft. 0 in. CONSTRUCTION TYPE WELDED

CAPACITY 96,690 bbls. ROOF SLOPE N/A in./ft. INTERNAL HEATER TYPE NO

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NO

PRESSURE ROOF VENT NORMAL SETTING N/A in. H_2O VACUUM ROOF VENT NORMAL SETTING N/A in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE DISTILLATE COMMON NAME JET FUEL FLASH POINT 125 °F

REFLUX METHOD

PRESSURE, mmHg	TEMP. °C
100	105
200	133
300	151
400	163
600	181
757	191

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

There was a net decrease in the liquid level of Tank R-26 during each of the testing days. No positive vapor flow was measured during the testing and both the continuous OVA analyzer and the samples analyzed on the gas chromatograph indicated ambient hydrocarbon concentrations.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION ARCO R-26

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/1	1200	.018	.035	.070	.122	.065	.066	.109	.131	.093	.093	.039	.022	-	0.862	80.41
3/2	0900	.018	.035	.103	.117	.280	.070	.068	.109	.121	.070	.043	.028	-	1.063	76.65

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/28	0000	2400	84	126	308	76	44	64	N/A	0	0	265	165	0	0
3/1	0000	2400	63	103	308	63	49	64	155	0	0	634	280	0	0
3/2	0000	2400	0	63	3.1	64	38	64	290	0	0	486	190	0	0

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER ATLANTIC RICHFIELD CO. OPERATOR ATLANTIC RICHFIELD CO.

LOCATION CARSON TANK IDENTIFICATION OR NUMBER R-49

TANK OPERATION CONTINUOUS MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION NA MANUFACTURER NA

COLOR OF WALL ALUMINUM(DIF) COLOR OF ROOF BLACK PAINT CONDITION GOOD

INSULATION YES THICKNESS 2 in. WALL COATING NONE ROOF COATING TAR PAPER

STRAIGHT WALL HEIGHT 40 ft. 0 in. DIAMETER 135 ft. 0 in. CONSTRUCTION TYPE N/A

CAPACITY 101,000 bbls. ROOF SLOPE 0 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING NA in. H_2O VACUUM ROOF VENT NORMAL SETTING NA in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE DISTILLATE COMMON NAME FUEL OIL FLASH POINT N/A °F

REFLUX METHOD

PRESSURE, mmHg	TEMP. °C
100	178
200	205
300	223

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

The low sulfur fuel oil was continuously circulated through a fuel system and heat exchanger which maintained the stock temperature at 150°F. The vapor condensate system was not utilized during this test.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION ARCO R-49

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/26	0200	0.016	.010	.024	.013	.013	0	0	0	0	0	0	0	0	.076	33.3
2/26	1400	0	0	0	.096	0	.002	0	0	0	0	0	0	0	.098	58.4
2/27	1200	0.129	.016	.016	.020	.021	.129	.180	.241	.080	0	0	0	0	.832	53.4
2/27	1400	0.135	.016	.016	.048	.032	.064	.129	.225	.096	.035	0	0	0	.798	51.1

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/26	0000	2400	0	0	4.0	67	37	150	255	0	0	0	0	0	0
2 /27	0000	2400	0	0	4.0	76	40	150	355	0	0	0	0	0	0

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER ATLANTIC RICHFIELD CO. OPERATOR ATLANTIC RICHFIELD CO.

LOCATION SOLADINO FEE TANK IDENTIFICATION OR NUMBER NONE

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION NA MANUFACTURER NA

COLOR OF WALL LT. GRAY COLOR OF ROOF LT. GRAY PAINT CONDITION GOOD

INSULATION YES THICKNESS 1.5 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 30 ft. 0 in. CONSTRUCTION TYPE BOLTED

CAPACITY 2,000 bbls. ROOF SLOPE .75 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING 2 in. H_2O VACUUM ROOF VENT NORMAL SETTING NA in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME CASMALIA HEAVY OIL FIELD CASMALIA

RVP 0.8 psia API GRAVITY 12.5 °

STOCK COMPOSITION (Mole Percent): CO_2 .29 N_2 .14

CH_4 .06 C_2H_6 .04 C_3H_8 .03 iC_4 .01 nC_4 .01 iC_5 NIL nC_5 NIL

C_6 NIL C_7 PLUS 99.42 DENSITY OF C_7 PLUS .9816 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 427 lb/lb-mole API GRAVITY OF C_7 PLUS 12.5°

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

All positive flow data were corrected to standard temperature. All of the grab samples were averaged to estimate the concentration during the period of positive flow. Vapor recovery system disconnected prior to test.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** ARCO SOLADINO

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/1	0900	.760	.910	.820	.920	1.42	.225	.700	.761	.585	.300	0	0	0	7.431	50
2/1	1200	.467	.995	.527	.480	.926	.166	.457	.512	.585	.215	.016	0	0	5.346	49
2/1	1500	0	0	.152	.245	.258	.110	.208	.143	.038	0	0	0	0	1.154	77
2/1	1800	1.140	1.110	.720	.660	1.000	.504	.109	.292	.283	.171	0	0	0	5.989	37
2/2	0600	2.780	1.090	1.040	.950	1.260	.365	1.020	.998	.841	.090	.044	0	0	10.480	36

TEST SUMMARY **ONE WAY VALVE SETTING:** PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/1	0000	2400	0	0	9.3	73	37	150	N/A	31	31	0	0	0.04	0.2
2.2	0000	2400	0	0	9.3	65	37	150	N/A	42	16	30	30	0.05	0.3

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER BEREN CORP. OPERATOR BEREN CORP.

LOCATION COMPTON TANK IDENTIFICATION OR NUMBER 1336

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1949 MANUFACTURER CONSOLIDATED TANK CO.

COLOR OF WALL ALUMINUM(DIF) COLOR OF ROOF ALUMINUM(DIF) PAINT CONDITION POOR

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 21 ft. 1 in. CONSTRUCTION TYPE N/A

CAPACITY 1,000 bbls. ROOF SLOPE 0 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 3.5 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0.7 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME LOWER 2 INS. OIL FIELD ROSECRANS

RVP 1.3 psia API GRAVITY 35.4 °

STOCK COMPOSITION (Mole Percent): CO_2 .01 N_2 .10

CH_4 NIL C_2H_6 NIL C_3H_8 .08 iC_4 .11 nC_4 .59 iC_5 .76 nC_5 1.11

C_6 .63 C_7 PLUS 96.61 DENSITY OF C_7 PLUS .8527 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 199 lb/lb-mole API GRAVITY OF C_7 PLUS 34.3 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Due to electrical power and weather problems, only two full days of valid data are available, March 25 and 26, out of a total of ten testing days. On those two days, no flow was observed either into or out of the tank.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION BEREN 1336

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/29	1530	.016	.030	.121	.189	.123	.090	.173	.169	.072	.042	0	0	0	1.025	69.28
3/27	0910	.084	.157	1.036	2.039	1.588	1.072	1.423	.703	.158	.028	0	0	0	8.289	66.15

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/25	0000	2400	0	0	12.4	78	50	55	N/A	0	0	0	0	0	0
3/26	0000	2400	0	0	12.4	68	50	55	N/A	0	0	0	0	0	0

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHAMPLIN OIL OPERATOR CHAMPLIN OIL

LOCATION WILMINGTON TANK IDENTIFICATION OR NUMBER 2030D

TANK OPERATION WASH (Dehydration) MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION N/A MANUFACTURER N/A

COLOR OF WALL DARK GRAY COLOR OF ROOF ALUMINUM (DIFFUSE) PAINT CONDITION POOR

INSULATION NO THICKNESS - in. WALL COATING EPOXY - 20 MILS ROOF COATING NONE

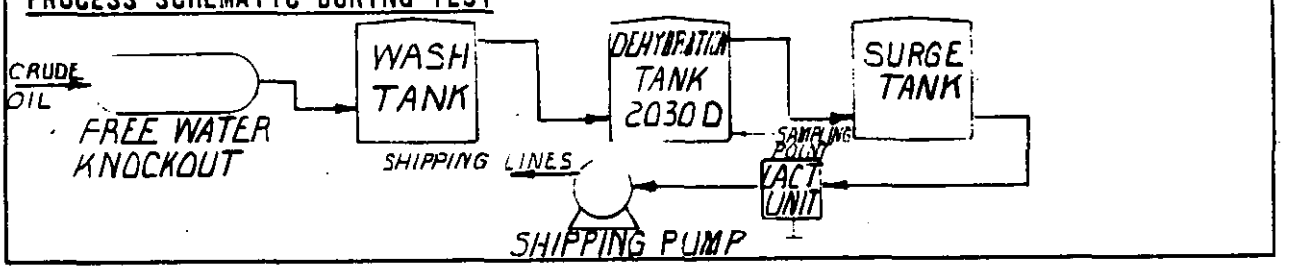
STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 30 ft. 0 in. CONSTRUCTION TYPE BOLTED

CAPACITY 2000 bbls. ROOF SLOPE N/A in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING 1.73 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0.1 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME N/A OIL FIELD WILMINGTON FIELD

RVP N/A psia API GRAVITY 20 °

STOCK COMPOSITION (Mole Percent): CO_2 0.38 N_2 1.89

CH_4 0.22 C_2H_6 0.15 C_3H_8 0.86 iC_4 0.42 nC_4 1.40 iC_5 0.91 nC_5 1.04

C_6 7.28 C_7 PLUS 91.45 DENSITY OF C_7 PLUS 0.9369 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 317 lb/lb-mole API GRAVITY OF C_7 PLUS 79.4 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST On 3/16 .70 inches of rain fell. The approximate flow rate through the tank was 2200 bbl/day. There was no measurable vapor flow during the two complete 24-hour testing days and tank pressures were consistently in the range of 0-0.3 in. H_2O. Minor leaks were suspected but none were detected.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION CHAMPLIN 2030 D

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/14	1800	1.476	1.139	3.953	4.272	2.427	1.046	1.308	.480	.135	0	0	0	0	16.236	45.46
3/15	0600	3.139	1.802	6.975	7.150	3.778	1.715	2.334	.988	.134	0	0	0	0	28.014	43.64
3/15	1200	2.242	1.451	4.747	5.143	2.522	1.322	1.896	1.114	.462	.280	.103	.058	0	21.291	45.38
3/16	1104	.581	.436	1.366	1.715	.843	.349	.552	.233	1.119	.007	0	0	0	7.200	50.26
3/17	0815	3.662	7.615	7.440	3.488	1.000	1.500	.936	.116	.006	0	0	0	0	25.262	33.82

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/15	0000	2400	2200	2200	1.6	63	39	107	393	0	0	0	0	0	0
3/16	0000	2400	2200	2200	1.6	60	45	103	232	0	0	0	0	0	0

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHEVRON OPERATOR CHEVRON

LOCATION EL SEGUNDO TANK IDENTIFICATION OR NUMBER 281

TANK OPERATION CONTINUOUS MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1911 MANUFACTURER STANDARD OIL

COLOR OF WALL ALUMINUM(DIF) COLOR OF ROOF BLACK PAINT CONDITION POOR

INSULATION YES THICKNESS 1.5 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 28 ft. 8 in. DIAMETER 95 ft. 6 in. CONSTRUCTION TYPE N/A

CAPACITY 33,944 bbls. ROOF SLOPE 0 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE FUEL OIL COMMON NAME BUNKER C FUEL OIL FLASH POINT UNKNOWN °F

REFLUX METHOD

PRESSURE, mmHg	TEMP. °C
100	137
200	166
300	185
400	196
500	205
600	215

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Data on March 16 was lost due to a leak discovered in the tank. The tank began to withdraw stock on the 18th, leaving only one full day's data (March 17) available for this tank. The tank contained Bunker C fuel oil (flash point = 177°F) which resulted in very low concentrations of hydrocarbons. Positive flows from the tank were corrected to standard temperature. Reflux values ranged from 100 mm HG @ 137°C to 600 Hg @ 215°C.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** CHEVRON 281

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/16	1130	.008	0	0	.009	.026	.047	.112	.169	.173	.157	.160	.198	.170	1.228	126.5
3/17	1500	0	0	0	0	0	0	0	.005	.039	.104	.021	.003	0	.172	139.7
3/18	1220	.031	.005	.003	.006	.019	.021	.077	.121	.127	.126	.151	.189	.094	.970	107.1

TEST SUMMARY **ONE WAY VALVE SETTING:** PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/17	0000	2400	0	0	3.3	59	44	180	N/A	1030	450	1100	400	.01	1.3

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHEVRON OPERATOR CHEVRON

LOCATION EL SEGUNDO TANK IDENTIFICATION OR NUMBER 490

TANK OPERATION BATCH MODE DURING TEST WORKING AND STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1949 MANUFACTURER UNKNOWN

COLOR OF WALL PEACH COLOR OF ROOF PEACH PAINT CONDITION GOOD

INSULATION NONE THICKNESS -- in. WALL COATING NONE ROOF COATING NONE

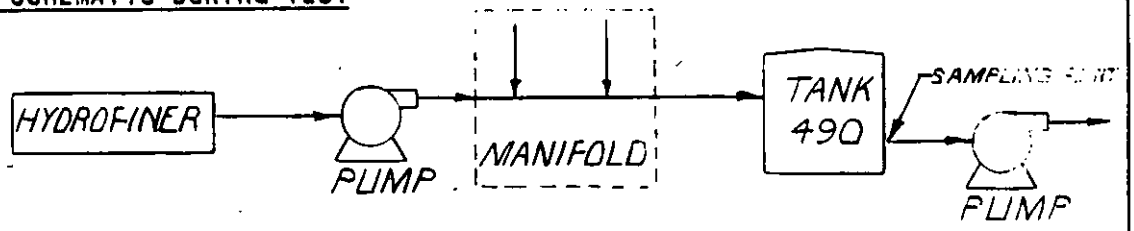
STRAIGHT WALL HEIGHT 38 ft. 3 in. DIAMETER 120 ft. 0 in. CONSTRUCTION TYPE WELDED

CAPACITY 75,238 bbls. ROOF SLOPE 0.75 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1.0 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1.0 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE DISTILLATE COMMON NAME DIESEL FLASH POINT 173 °F

REFLUX METHOD

PRESSURE, mmHg	TEMP. °C
100	29
200	163
300	179
400	195

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

The tank was filling at an average rate of 6400 cfh (or 27,430 bbl/day) based on gaugings from 1600 hours on 3/12/77 to 1300 hours on 3/13/77. The fluid level in the tank was then maintained at a constant level for the duration of the test. On 3/12/77, it was observed that the 2-foot diameter VAREC relief valve was opening at pressures slightly greater than 1 inch H_2O. This was due to lack of sufficient weight being placed on the large pallet area of the valve. The most representative values for working loss volumes, then, are the measured filling rates for 3/12/77. Total hydrocarbon emission rates for this day were computed from the filling rate volumes and maximum daily concentrations.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** CHEVRON #490

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/12	0200	.001	.002	.024	.059	.070	.064	.116	.131	.073	.051	.023	.014	.023	0.652	92.89
3/13	1100	.005	.001	.020	.074	.093	.095	.167	.207	.152	.139	.076	.053	.089	1.172	102.72
3/13	2300	.002	.002	.025	.062	.073	.059	.115	.127	.074	.043	.025	.023	.014	0.644	91.51

TEST SUMMARY **ONE WAY VALVE SETTING:** PRESSURE 0.86 in H_2O VACUUM 0.86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS** (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/12	0000	2400	14630	0	12	73	46	94	393	81930 *		828	769	0.16	98.89
3/13	0000	2400	0	0	8.5	63	49	90	426	0	0	0	0	0	0

*Meter Volume: 30,500 scf; calculated volume: 81930 cf ** calculated based on 81930 scf

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHEVRON OPERATOR CHEVRON

LOCATION LA MIRADA TANK IDENTIFICATION OR NUMBER 499

TANK OPERATION BATCH MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1922 MANUFACTURER UNKNOWN

COLOR OF WALL ALUMINUM SPECULAR COLOR OF ROOF ALUMINUM SPECULAR PAINT CONDITION N/A

INSULATION NONE THICKNESS - in. WALL COATING N/A ROOF COATING N/A

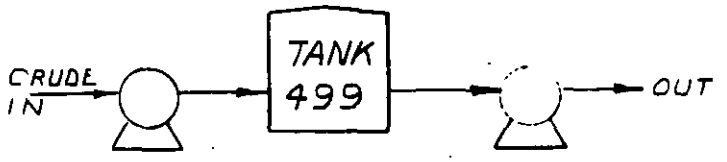
STRAIGHT WALL HEIGHT 32 ft. 5 in. DIAMETER 90 ft. 0 in. CONSTRUCTION TYPE RIVETED

CAPACITY 35,844 bbls. ROOF SLOPE _____ in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING N/A in. H_2O VACUUM ROOF VENT NORMAL SETTING N/A in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME HUNTINGTON BEACH OIL FIELD HUNTINGTON BEACH

RVP _____ psia API GRAVITY _____ °

STOCK COMPOSITION (Mole Percent): CO_2 _____ N_2 _____

CH_4 _____ C_2H_6 _____ C_3H_8 _____ iC_4 _____ nC_4 _____ iC_5 _____ nC_5 _____

C_6 _____ C_7 PLUS _____ DENSITY OF C_7 PLUS _____ g/cc.

MOLECULAR WEIGHT OF C_7 PLUS _____ lb/lb-mole API GRAVITY OF C_7 PLUS _____ °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

All flow data corrected to standard temperature. Grab samples with highest amount of total hydrocarbons for each day used in emission calculations. Liquid sample may not be representative of sampling period; therefore, data are not presented.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION CHEVRON 499 VOIDED TEST

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/2	1400	.099	.165	1.253	3.066	3.132	1.385	2.324	.745	.824	.346	.033	0	0	13.372	69.98
	1800	.033	.066	.626	1.615	1.714	.725	.323	.363	.103	.049	.021	0	0	5.649	65.53
2/5	1200	.029	.057	.485	1.226	1.098	.684	1.175	.391	.413	.061	.006	0	0	5.624	72.33
	1800	.029	.057	.513	1.312	1.255	.478	.998	.262	.148	.006	0	0	0	5.057	68.10
2/6	0000	.014	.029	.285	.756	.784	.399	.741	0	0	0	0	0	0	3.008	68.06
	0600	.057	.086	.713	1.711	.798	1.597	1.226	.336	.291	.029	0	0	0	6.843	68.96
	1800	.066	.132	.923	2.308	1.978	1.220	2.011	.577	.664	.124	0	0	0	10.003	70.50

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE 0.86 in H_2O VACUUM 0.86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/5	0000	2400	2262	12	76.9	72	39	78	277	11830	1936	0	0	VOID	VOID
2/6	0000	2400	7150	0	12.6	65	44	77	245	40307	2920	0	0	VOID	VOID

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHEVRON USA INC. OPERATOR CHEVRON USA INC.

LOCATION LAKEWOOD TANK IDENTIFICATION OR NUMBER 817 Test #1

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1923 MANUFACTURER RUNES BROTHERS

COLOR OF WALL MED. GRAY COLOR OF ROOF MED. GRAY PAINT CONDITION GOOD/POOR

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 40 ft. 0 in. DIAMETER 120 ft. 0 in. CONSTRUCTION TYPE RIVETED/WELDED

CAPACITY 79,200 bbls. ROOF SLOPE .75 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING NA in. H_2O VACUUM ROOF VENT NORMAL SETTING NA in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME SEAL BEACH OIL FIELD BELMONT

RVP 3.4 psia API GRAVITY 24.4°

STOCK COMPOSITION (Mole Percent): CO_2 .03 N_2 .03

CH_4 .08 C_2H_6 .14 C_3H_8 1.12 iC_4 .61 nC_4 1.96 iC_5 1.24 nC_5 1.44

C_6 2.95 C_7 PLUS 90.40 DENSITY OF C_7 PLUS .9123 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 297 lb/lb-mole API GRAVITY OF C_7 PLUS 23.5 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Flow data corrected to standard temperature. Grab samples with the highest concentrations on each day were used to calculate hydrocarbon emissions. Liquid sample may not be representative of test period. This tank retested May 12-16, 1977.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION CHEVRON 817 TEST #1

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/18	0600	.032	.026	.320	.601	.553	.320	.575	.256	.096	.025	.017	0	0	2.820	69.08
2/18	1100	0	0	.160	.464	.537	.281	.262	.099	.038	.004	0	0	0	1.846	70.66
2/18	1500	.074	.051	.489	1.135	1.114	.799	1.349	.364	.304	.233	.118	0	0	6.031	72.63
2/19	0700	.068	.051	.630	1.327	1.157	.868	1.368	.320	.268	.009	0	0	0	6.065	69.11
2/19	1200	.104	.072	.575	1.304	1.324	.898	1.381	.291	.141	.575	.026	0	0	6.691	70.61
2/20	0900	.141	.134	.876	1.803	2.155	.863	.649	.256	.118	.036	.008	0	0	7.036	61.77

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/18	0000	2400	0	0	39.6	75	53	64 56	N/A	15300	4700	22300	4400	1.1	92
2/19	0000	2400	0	0	39.6	79	53	66 56	253	29200	4900	17800	3400	3.0	196
2/20	0000	2400	0	0	39.6	71	52	61.5 56	N/A	15800	4500	17600	4000	2.2	111

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHEVRON USA INC. OPERATOR CHEVRON USA INC.

LOCATION LAKEWOOD TANK IDENTIFICATION OR NUMBER 817 Test #2

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1923 MANUFACTURER RUNES BROTHERS

COLOR OF WALL MED. GRAY COLOR OF ROOF MED. GRAY PAINT CONDITION GOOD/POOR

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 40 ft. 0 in. DIAMETER 120 ft. 0 in. CONSTRUCTION TYPE RIVETED/WELDED

CAPACITY 79,200 bbls. ROOF SLOPE .75 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING NA in. H_2O VACUUM ROOF VENT NORMAL SETTING NA in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME SEAL BEACH OIL FIELD BELMONT

RVP 1.2 psia API GRAVITY 23.7 °

STOCK COMPOSITION (Mole Percent): CO_2 .06 N_2 .09

CH_4 .18 C_2H_6 .26 C_3H_8 1.84 iC_4 .91 nC_4 2.77 iC_5 1.58 nC_5 1.75

C_6 2.41 C_7 PLUS 88.15 DENSITY OF C_7 PLUS .8944 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 312 lb/lb-mole API GRAVITY OF C_7 PLUS 26.5 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Flow data for this test were corrected for temperature. Grab sample taken 5/13, 1300 was used to calculate hydrocarbon emissions.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION CHEVRON 817 TEST #2

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
5/15	1300	.056	.037	.501	1.723	1.178	.505	.852	.372	.095	.063	0	0	0	5.382	66.6

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
5/13	0000	2400	0	0	37.3	72	52	62 65	482	14930	4230	14700	3600	0.8	80
5/19	0000	2400	0	0	37.3	72	56	64 65	N/A	19220	5520	21350	3000	1.1	103
5/15	0000	2400	0	0	37.3	71	58	65	N/A	19300	4190	20470	3100	1.1	104

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHEVRON USA, INC. OPERATOR CHEVRON

LOCATION LAKEWOOD, CA. TANK IDENTIFICATION OR NUMBER 821 TEST #1

TANK OPERATION CONTINUOUS MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1923 MANUFACTURER LACY MFG. CO. (L.A.)

COLOR OF WALL MED. GRAY COLOR OF ROOF MED. GRAY PAINT CONDITION GOOD

INSULATION NONE THICKNESS - in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 36 ft. 0 in. DIAMETER 117 ft. 0 in. CONSTRUCTION TYPE RIVETED

CAPACITY 63,200 bbls. ROOF SLOPE 1'-3" in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING -- in. H_2O VACUUM ROOF VENT NORMAL SETTING -- in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME SEAL BEACH OIL FIELD BELMONT

RVP 4.5 psia API GRAVITY 25.8 °

STOCK COMPOSITION (Mole Percent): CO_2 0.2 N_2 .05

CH_4 .07 C_2H_6 .13 C_3H_8 1.19 iC_4 .67 nC_4 2.20 iC_5 1.31 nC_5 1.53

C_6 1.93 C_7 PLUS 90.90 DENSITY OF C_7 PLUS .8996 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 270 lb/lb-mole API GRAVITY OF C_7 PLUS 25.6 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

The emissions were calculated by averaging the grab samples collected during each exhaust cycle. Vapor flows are corrected to standard temperature. Liquid sample may not be representative of stock during test. This tank retested during May 12 through 16.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION CHEVRON #821 TEST #1

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/18	0900	.834	1.252	2.444	4.768	2.682	.954	1.252	.641	.140	.003	0	0	0	14.970	50.14
2/18	1200	.134	.447	2.086	5.603	2.861	.998	1.237	.396	.212	.012	0	0	0	13.986	59.34
2/18	1300	.075	.358	3.219	4.947	2.354	.978	1.228	.411	.268	.026	0	0	0	13.863	58.56
2/18	1500	.060	.268	2.486	3.684	1.913	.766	.983	.381	.197	.060	.004	0	0	10.801	59.05
2/19	0900	.224	.700	1.788	6.556	3.695	1.162	1.371	.462	.119	.015	0	0	0	16.093	58.73
2/19	1200	.030	.286	3.248	4.709	2.313	.790	.990	.298	.161	.005	0	0	0	12.838	58.06
2/19	1300	.209	.596	3.934	6.616	3.237	1.195	1.490	.471	.328	.034	0	0	0	18.109	57.24
2/20	0900	.083	.420	3.517	5.156	2.563	.778	1.115	.316	.194	.006	0	0	0	14.147	57.13
2/20	1300	.204	.626	4.083	6.676	3.278	1.234	1.490	.468	.319	.030	0	0	0	18.412	57.06

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/18	0000	2400	6142	6441	18.4	75	53	65	N/A	2450	1640	2870	1500	1.1	42
2/19	0000	2400	6785	6586	18.8	79	51	65	253	3700	1810	3760	2000	0.7	70
2/20	0000	2400	5970	6369	18.5	71	49	65	N/A	4370	2520	5700	1700	0.7	85

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHEVRON, USA, INC. OPERATOR CHEVRON

LOCATION LAKEWOOD, CA. TANK IDENTIFICATION OR NUMBER 821 TEST #2

TANK OPERATION CONTINUOUS MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1923 MANUFACTURER LACY MFG. CO. (LA)

COLOR OF WALL MED. GRAY COLOR OF ROOF MED. GRAY PAINT CONDITION GOOD

INSULATION NONE THICKNESS -- in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 36 ft. 0 in. DIAMETER 117 ft. 0 in. CONSTRUCTION TYPE RIVETED

CAPACITY 63,200 bbls. ROOF SLOPE 1'-3 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING -- in. H_2O VACUUM ROOF VENT NORMAL SETTING -- in. H_2O

PROCESS SCHEMATIC DURING TEST

STOCK PARAMETERS

TYPE CRUDE COMMON NAME SEAL BEACH OIL FIELD BELMONT

RVP 5.3 psia API GRAVITY 23.4 °

STOCK COMPOSITION (Mole Percent): CO_2 .06 N_2 .09

CH_4 .18 C_2H_6 .26 C_3H_8 1.84 iC_4 .91 nC_4 2.77 iC_5 1.58 nC_5 1.75

C_6 2.41 C_7 PLUS 88.15 DENSITY OF C_7 PLUS .8944 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 312 lb/lb-mole API GRAVITY OF C_7 PLUS 26.5 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

During May 12 through May 16, the tank was withdrawing stock and no flows were observed for the latter portion of the last day of withdrawal. Only that portion of the test that the tank was at static storage May 17, 18, 19, was used to estimate standing storage emissions. All flow data were corrected for temperature. Grab samples with the highest concentrations were used to calculate emissions.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** CHEVRON #821 TEST #2

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
5/12	1328	.297	1.024	8.363	0.636	3.030	1.108	1.536	.870	.428	.210	.186	.270	.123	28.080	54.92
5/15	1130	.215	.707	6.697	8.010	2.702	1.017	1.269	.575	.161	.039	0	0	0	21.391	54.15
5/15	1130	.205	.087	6.631	7.681	2.637	.989	1.227	.547	.144	.032	0	0	0	20.780	54.03
5/16	1152	.195	.710	6.835	8.612	2.979	1.113	1.426	.672	.226	.106	0	0	0	22.876	55.02
5/16	1213	.195	.672	6.835	8.202	2.804	1.095	1.395	.657	.215	.089	0	0	0	22.159	54.83
5/17	1215	.219	.716	7.205	8.886	3.066	1.168	1.482	.701	.245	.120	0	0	0	23.807	54.93
5/17	1353	.182	.603	5.784	7.230	2.589	1.008	1.324	.666	.254	.158	0	0	0	19.798	55.51
5/18	1150	.177	.627	6.060	7.671	2.687	1.048	1.272	.610	.202	.088	0	0	0	20.442	55.12
5/19	1200	.195	.742	6.950	8.994	3.115	1.164	1.463	.717	.244	.116	.036	0	0	23.737	55.24
5/19	1300	.213	.699	6.950	8.721	2.999	1.164	1.452	.746	.251	.138	.051	0	0	23.384	55.22
5/19	1100	.102	.451	4.709	5.996	2.285	.837	1.084	.509	.164	.062	0	0	0	16.260	55.87
5/19	1000	.189	.670	6.541	8.347	2.838	1.055	1.310	.608	.182	.066	0	0	0	21.805	54.81
5/20	0755	.142	.490	5.051	6.247	2.570	.902	1.090	.573	.183	0	0	0	0	17.247	55.54

TEST SUMMARY **ONE WAY VALVE SETTING:** PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
5/17	0000	2400	0	0	23.2	71	49	73	556	4740	1650	3220	1700	1.0	113
5/18	0000	2400	0	0	23.2	72	54	73	555	5800	1970	5200	1800	1.0	119
5/19	0000	2400	0	0	23.2	72	55	73	503	5800	2000	4420	1600	1.0	124

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHEVRON OPERATOR CHEVRON

LOCATION EL SEGUNDO TANK IDENTIFICATION OR NUMBER 9407

TANK OPERATION CONTINUOUS MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1911 MANUFACTURER STANDARD OIL

COLOR OF WALL PEACH COLOR OF ROOF PEACH PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 30 ft. 5 in. DIAMETER 114 ft. 6 in. CONSTRUCTION TYPE RIVETED

CAPACITY 54,120 bbls. ROOF SLOPE 1.0 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE DISTILLATE COMMON NAME JET COMPONENT FLASH POINT 135 °F

REFLUX METHOD

PRESSURE, mmHg	TEMP. °C
100	113
200	138
300	153
400	168
600	184
756	195

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Power generators provided failed to produce adequate power throughout the test. However, grab samples were taken periodically when the power was available although concentrations were very low.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION CHEVRON 9407

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/11	1200	.002	.002	.007	.010	.014	.024	.052	.069	.047	.037	.018	.034	.171	.487	122.2
3/11	1800	.002	.001	.002	.003	.005	.004	.026	.047	.041	.042	.044	.021	.236	.473	142.9
3/12	1100	.001	.001	.007	.013	.013	.018	.043	.060	.045	.037	.024	.024	.046	.332	112.3
3/12	1500	0	.001	.002	.005	.006	.008	.026	.044	.032	.037	.026	.015	.006	.208	116.4
3/12	1800	0	0	.001	.001	.001	.001	.013	.026	.019	.023	.016	.016	.012	.129	130.4
3/13	0900	.001	.002	.007	.013	.012	.019	.040	.049	.031	.027	.020	.017	0	.237	101.4

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/11	0000	2400	0	0	3.6	68	47	60	N/A	0	0	0	0	0	0
3/12	0000	2400	0	0	3.6	73	46	60	393	0	0	0	0	0	0
3/13	0000	2400	0	0	3.6	63	49	60	426	0	0	0	0	0	0

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHEVRON USA INC. OPERATOR CHEVRON USA INC.

LOCATION TOMPKINS LEASE TANK IDENTIFICATION OR NUMBER 25302

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1965 MANUFACTURER TRICO SUPERIOR

COLOR OF WALL ALUMINUM(DIF) COLOR OF ROOF RED PAINT CONDITION POOR

INSULATION YES THICKNESS N/A in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 16 ft. 1 in. DIAMETER 29 ft. 8.5 in. CONSTRUCTION TYPE BOLTED

CAPACITY 1985 bbls. ROOF SLOPE .50 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME SANTA MARIA VALLEY OIL FIELD CASMALIA

RVP 0.1 @ 70°F psia API GRAVITY 11.0 °

STOCK COMPOSITION (Mole Percent): CO_2 .30 N_2 .07

CH_4 .15 C_2H_8 .02 C_3H_8 .01 iC_4 .01 nC_4 .01 iC_5 NIL nC_5 NIL

C_8 NIL C_7 PLUS 99.43 DENSITY OF C_7 PLUS .9920 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 508 lb/lb-mole API GRAVITY OF C_7 PLUS 11.0 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

All flow data were corrected for temperature. The highest measured grab sample concentration for each day was used to estimate that day's emissions. The internal steam heater was operating during the test. The vapor condensate system was not used during this test.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION: CHEVRON 25302

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/4	0300	1.385	.264	.165	.099	.040	0	0	0	0	0	0	0	0	1.952	19.3
2/4	0900	1.083	.389	.083	.167	.016	0	0	0	0	0	0	0	0	1.737	20.3
2/4	0930	1.206	.241	.094	.062	.021	.004	.023	.083	.130	.109	.047	.004	0	2.023	22.5
2/4	1500	1.253	.148	.099	.099	.007	.020	.041	.106	.211	.214	.152	.004	.004	2.419	26.0
2/4	1800	.666	.278	.056	.083	.026	.013	.034	.061	.083	.091	.118	.009	.004	1.590	27.7
2/4	2100	1.111	.194	.097	.121	.038	.024	.028	.067	.090	.087	.080	.009	.009	2.025	24.1
2/5	0600	.722	.194	.167	.097	.036	.025	.037	.095	.126	.108	.078	0	.009	1.746	28.4
2/5	0900	1.319	.363	.165	.115	0	0	0	0	0	0	0	0	0	1.962	19.6
2/5	1200	.422	.105	.092	.117	.021	.008	.023	.084	.142	.151	.127	0	0	1.327	34.5
2/5	1500	1.055	.198	.099	.073	0	0	0	0	0	0	0	.003	0	1.424	18.8
2/5	1800	.167	.056	.028	.084	.049	.067	.078	.088	.152	.160	.093	0	.003	1.049	51.5
2/5	2100	.361	.056	.028	.056	.021	.009	.019	.010	.021	.061	.009		0	.649	23.8

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/4	0000	2400	0	0	2.0	74	33	158	292	33	5	0	0	0.05	0.1
2/5	0000	2400	0	0	2.0	75	37	158	N/A	7	5	0	0	0.01	0.02

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CHEVRON OPERATOR CHEVRON

LOCATION MORTENSEN LEASE TANK IDENTIFICATION OR NUMBER 25699

TANK OPERATION CONTINUOUS MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1965 MANUFACTURER TRICO SUPERIOR

COLOR OF WALL ALUMINUM (DIFFUSE) COLOR OF ROOF ALUMINUM (DIFFUSE) PAINT CONDITION

INSULATION NONE THICKNESS - in. WALL COATING NONE ROOF COATING NONE

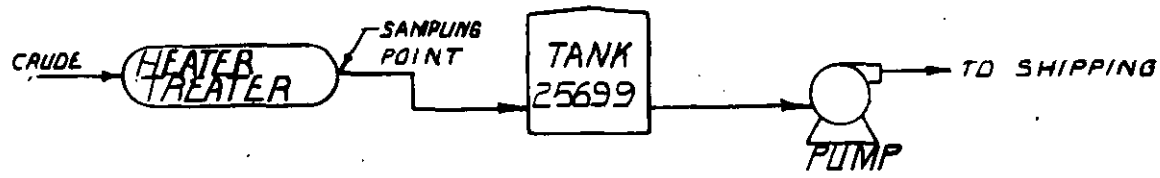
STRAIGHT WALL HEIGHT 16 ft. 1 in. DIAMETER 29 ft. 8 1/2 in. CONSTRUCTION TYPE BOLTED

CAPACITY 2,000 bbls. ROOF SLOPE 1/2 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME SANTA MARIA VALLEY OIL FIELD BRADLEY CANYON

RVP psia API GRAVITY °

STOCK COMPOSITION (Mole Percent): CO_2 N_2

CH_4 C_2H_6 C_3H_8 iC_4 nC_4 iC_5 nC_5

C_6 C_7 PLUS DENSITY OF C_7 PLUS g/cc.

MOLECULAR WEIGHT OF C_7 PLUS lb/lb-mole API GRAVITY OF C_7 PLUS °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This test voided due to very high vapor temperatures at the sampling manifold (240°F) which overloaded the condensation trap and buckled the vinyl hoses.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION CHEVRON 25699

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
						NO DATA TAKEN										
							VOIDED TEST									

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE ____ in H_2O VACUUM ____ in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
	VOIDED TEST														
							NO DATA TAKEN								

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CONOCO OIL CO. OPERATOR CONOCO

LOCATION KEMP LEASE TANK IDENTIFICATION OR NUMBER 5389

TANK OPERATION BATCH SHIPPING MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1948 MANUFACTURER UNKNOWN

COLOR OF WALL BEIGE COLOR OF ROOF BEIGE PAINT CONDITION GOOD

INSULATION YES THICKNESS 2 in. WALL COATING N/A ROOF COATING N/A

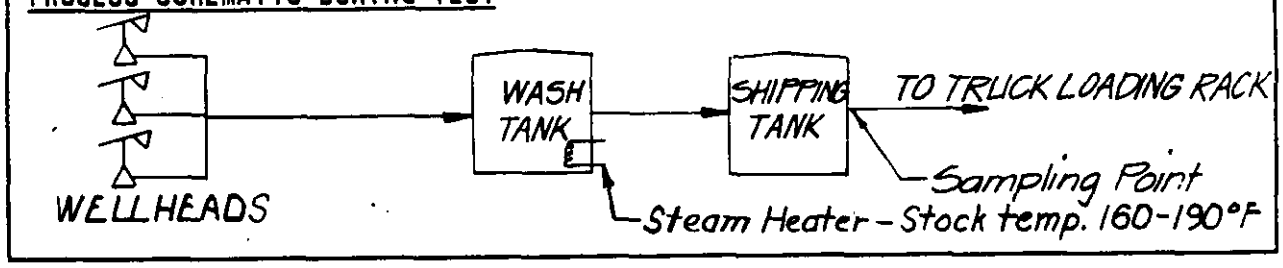
STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 34 ft. 0 in. CONSTRUCTION TYPE BOLTED

CAPACITY 2500 bbls. ROOF SLOPE 1 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION N/A

PRESSURE ROOF VENT NORMAL SETTING N/A in. H_2O VACUUM ROOF VENT NORMAL SETTING N/A in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME 60% SANTA MARIA CRUDE 40% GRUBB CRUDE OIL FIELD KEMP LEASE

RVP 0.1 psia API GRAVITY 17.7°

STOCK COMPOSITION (Mole Percent): CO_2 TRACE N_2 0.24

CH_4 0.09 C_2H_6 0.01 C_3H_8 0.03 iC_4 0.01 nC_4 0.05 iC_5 0.02 nC_5 0.03

C_6 0.15 C_7 PLUS 99.37 DENSITY OF C_7 PLUS 0.9481 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 336 lb/lb-mole API GRAVITY OF C_7 PLUS 17.6°

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This tank filled continuously shipping once per month but not during this test. This tank was connected to a new vapor recovery system which was not operational yet. It was blinded throughout the test, however. Vapor flows were corrected to standard temperature. Data obtained on 4/19 were considered invalue due to leaks in the condensate system.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION CONOCO 5389

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/18	1910	.713	.159	.571	1.152	1.575	1.317	1.284	1.224	1.036	.145	0	0	0	9.176	60.28
4/19	1130	.413	.122	.351	.801	1.116	1.017	1.645	1.655	1.017	.516	.281	.136	.019	9.089	73.33
4/19	1450	1.177	.331	.710	1.550	1.710	1.664	2.216	1.655	.828	.349	0	0	0	12.191	56.52
4/20	0930	1.398	.257	.775	1.560	1.517	1.710	2.455	2.161	1.287	.634	0	0	0	13.756	57.58
4/20	1305	1.306	.239	.721	1.496	1.646	1.669	2.280	1.752	.892	.322	0	0	0	12.322	55.78
4/20	1415	1.067	.202	.667	1.367	1.379	1.628	2.556	2.455	1.729	.809	.303	0	0	14.162	64.97
4/21	1000	1.388	.249	.708	1.500	1.709	1.709	2.367	1.949	1.130	.525	0	0	0	13.235	56.71

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS** (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/20	0000	2400	59	0	4.4	79	45	195	486	333*	45	369	123	0.4	4.7

* Calculated based on liquid flow ** Based on 333 cf flow

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER CONOCO OIL CO. OPERATOR CONOCO

LOCATION KEMP LEASE TANK IDENTIFICATION OR NUMBER NONE

TANK OPERATION WASH MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1948 MANUFACTURER UNKNOWN

COLOR OF WALL BEIGE COLOR OF ROOF BEIGE PAINT CONDITION GOOD

INSULATION YES THICKNESS 2 in. WALL COATING N/A ROOF COATING N/A

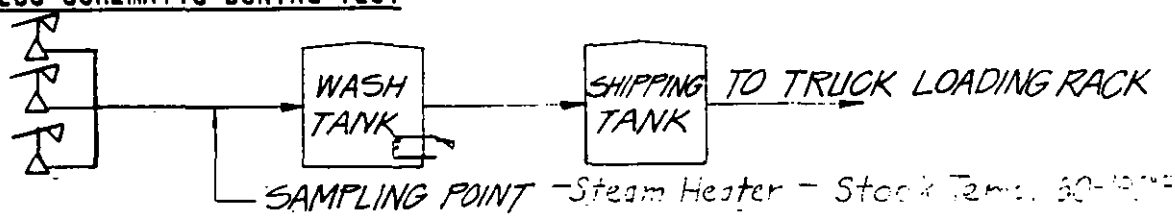
STRAIGHT WALL HEIGHT 24 ft. 0 in. DIAMETER 21 ft. 6 in. CONSTRUCTION TYPE N/A

CAPACITY 1500 bbls. ROOF SLOPE NA in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING NA in. H_2O VACUUM ROOF VENT NORMAL SETTING NA in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME 60% SANTA MARIA VALLEY 40% GRUBB OIL FIELD KEMP LEASE

RVP 1.6 psia API GRAVITY 15.8 °

STOCK COMPOSITION (Mole Percent): CO_2 0.34 N_2 0.02

CH_4 2.24 C_2H_6 0.07 C_3H_8 0.14 iC_4 0.04 nC_4 0.17 iC_5 0.12 nC_5 0.10

C_6 0.06 C_7 PLUS 96.70 DENSITY OF C_7 PLUS 0.9550 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 356 lb/lb-mole API GRAVITY OF C_7 PLUS 16.5 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

All flow data corrected to standard temperature. Tank disconnected from vapor recovery system prior to testing. Grab samples with highest amount of total hydrocarbons for each day used in emission calculations.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION CONOCO KEMP WASH

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/21	1540	9.541	1.282	2.666	3.333	2.759	2.127	2.848	2.430	1.691	.979	.312	0	0	29.967	33.68
4/22	0815	8.544	1.709	2.916	3.166	2.893	2.096	2.643	2.083	1.175	.587	0	0	0	27.812	33.42
4/22	1045	8.117	1.139	2.666	3.333	2.768	2.065	2.554	1.949	1.193	.668	0	0	0	26.451	33.89
4/23	0800	8.506	1.952	3.019	3.810	2.989	2.205	2.863	2.615	1.856	1.170	.719	.340	.471	32.465	36.93
4/23	0825	9.901	1.813	3.264	4.120	3.090	2.231	2.728	2.205	1.447	.743	.296	.166	0	32.003	33.44
4/23	1410	9.203	1.673	3.019	3.998	2.963	2.066	2.571	2.127	1.429	.654	.479	.194	0	30.376	33.91
4/23	1590	8.706	1.559	1.671	4.409	3.622	2.172	2.618	1.989	.761	.748	.502	.323	.043	29.123	34.52
4/24	0940	8.637	1.203	2.534	3.288	2.417	2.053	2.419	2.621	.093	.199	0	0	0	25.465	31.87
4/24	1120	9.482	1.645	2.970	3.916	3.129	2.161	2.789	2.161	1.464	.802	.462	.192	.052	31.226	34.05
4/24	1615	8.506	1.325	3.807	3.688	2.946	2.113	2.562	1.987	1.255	.584	.318	.187	0	28.278	34.21

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/22	0000	2400	58.6	58.6	3.0	76	48	185	510	262	30	64	64	2.2	7.3
4/23	0000	2400	58.6	58.6	3.0	82	48	185	542	211	30	0	0	1.8	6.9

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER EDGINGTON OIL CO. OPERATOR EDGINGTON OIL TEST #1

LOCATION SIGNAL HILL TANK IDENTIFICATION OR NUMBER 107

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1954 MANUFACTURER SOUTHWEST WELDING MFG. CO.

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NONE THICKNESS - in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 48 ft. 0 in. DIAMETER 120 ft. 0 in. CONSTRUCTION TYPE WELDED

CAPACITY 100,000 bbls. ROOF SLOPE 0.75 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 3.47 in. H_2O VACUUM ROOF VENT NORMAL SETTING .87 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME WILMINGTON OIL FIELD LONG BEACH OIL DEVELOPMENT

RVP 15.1 psia API GRAVITY 18.5°

STOCK COMPOSITION (Mole Percent): CO_2 .10 N_2 .80

CH_4 .16 C_2H_6 .11 C_3H_8 .44 iC_4 .33 nC_4 .82 iC_5 .69 nC_5 .68

C_6 1.05 C_7 PLUS 94.82 DENSITY OF C_7 PLUS 94.74 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 312 lb/lb-mole API GRAVITY OF C_7 PLUS 17.7 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Single test day of data available (2/23/77). Raining during test. All flow data corrected to standard temperature. The grab samples taken during the test day were averaged to obtain a total hydrocarbon concentration for use in emission calculations. Liquid sample may not be representative of liquid in the tank during the test. This tank retested May 9-12, 1977.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION EDGINGTON #107 TEST#1

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/23	0900	.102	.102	.286	.437	.211	.075	.136	.068	.060	.051	0	0	0	1.530	50.34
2/23	1200	.633	.799	1.733	3.617	1.356	.772	1.043	.482	.211	.034	0	0	0	10.680	50.42
2/23	1500	.362	.543	.934	2.502	1.100	.467	.567	.157	.069	0	0	0	0	6.701	50.36

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/23	0000	2400	0	0	7.6	54	48	72	N/A	430	175	0	0	0.3	4.6

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER EDGINGTON OIL CO. OPERATOR EDGINGTON OIL

LOCATION SIGNAL HILL, CA. TANK IDENTIFICATION OR NUMBER 107 TEST #2

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1954 MANUFACTURER SOUTHWEST WELDING & MFG. CO.

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NONE THICKNESS -- in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 48 ft. 0 in. DIAMETER 120 ft. 0 in. CONSTRUCTION TYPE WELDED

CAPACITY 100,000 bbls. ROOF SLOPE 0.75 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 3.47 in. H_2O VACUUM ROOF VENT NORMAL SETTING .87 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME WILMINGTON OIL FIELD LONG BEACH OIL DEVELOPMENT

RVP 0.5 psia API GRAVITY 18.6 °

STOCK COMPOSITION (Mole Percent): CO_2 0.08 N_2 0.08

CH_4 0.13 C_2H_6 0.06 C_3H_8 0.31 iC_4 0.21 nC_4 0.60 iC_5 0.47 nC_5 0.50

C_6 0.95 C_7 PLUS 96.61 DENSITY OF C_7 PLUS 0.9347 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 316 lb/lb-mole API GRAVITY OF C_7 PLUS 19.7 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Rained on first day of test (5/10/77). Air-in positive displacement meter inoperative during both days of test, 5/10, 5/11/77. All vapor flow data were corrected for temperature. The grab samples for each day of test were averaged to obtain total hydrocarbon concentrations for emissions calculations.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION: EDGINGTON #107 TEST #2

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
5/9	1705	.099	.142	.863	1.959	1.376	.702	1.113	.702	.234	.156	0	0	0	7.346	65.85
5/10	0930	.094	.137	.896	2.008	1.340	.716	1.074	.628	.191	.067	0	0	0	7.153	64.82
5/10	1000	.085	.142	.830	1.942	1.277	.567	.851	.383	.043	0	0	0	0	6.119	62.00
5/10	1105	.113	.156	.929	2.125	1.376	.752	1.128	.674	.209	.089	0	0	0	7.550	64.48
5/10	1450	.106	.156	.929	2.125	1.376	.723	1.103	.638	.177	.053	0	0	0	7.387	64.09
5/11	1100	.108	.146	1.043	2.343	1.491	.758	1.122	.672	.212	.084	.011	0	0	7.991	64.23
5/11	1420	.117	.166	1.043	2.337	1.476	.760	1.129	.676	.201	.088	.018	0	0	8.012	63.86
5/11	1620	.102	.170	1.050	2.326	1.491	.691	1.126	.680	.208	.080	.007	0	0	7.931	63.98
5/11	1700	.090	.076	.879	2.138	1.359	.716	1.056	.700	.172	.060	.004	0	0	7.251	65.63

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
5/10	0000	2400	0	0	35.8	69	54	92	381	18300	4020	NA	NA	1.8	129
5/11	0000	2400	0	0	35.8	67	54	83	438	18320	3260	NA	NA	2.0	146

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER EDGINGTON OIL CO. OPERATOR EDGINGTON

LOCATION N. LONG BEACH TANK IDENTIFICATION OR NUMBER 12005

TANK OPERATION CONTINUOUS MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1963 MANUFACTURER CHICAGO BRIDGE AND IRON

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NONE THICKNESS -- in. WALL COATING N/A ROOF COATING N/A

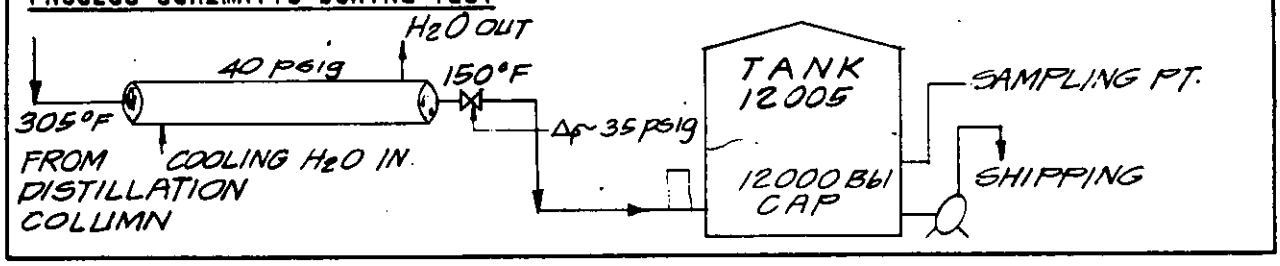
STRAIGHT WALL HEIGHT 45 ft. 0 in. DIAMETER 42 ft. 6 in. CONSTRUCTION TYPE WELDED

CAPACITY 12,000 bbls. ROOF SLOPE 0.75 in./ft. INTERNAL HEATER TYPE NO

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NO

PRESSURE ROOF VENT NORMAL SETTING 3.47 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0.87 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE DISTILLATE COMMON NAME DIESEL GAS OIL FLASH POINT 205 °F

REFLUX METHOD

PRESSURE, mmHg	TEMP. °C
100	151

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Vapor flow data were corrected to standard temperature. All grab samples showed only a trace of hydrocarbons or less due probably to the relatively low mole percent of light ends present in diesel gas oil.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION EDGINGTON 12005

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/8	0000	Trace														
2/8	0300	Trace														
2/8	0600	0														
2/8	1200	Trace														
2/8	1500	0														
2/8	1800	Trace														
2/8	2100	Trace														
2/9	0000	0														
2/9	0300	Trace														
2/9	0600	0														
2/9	0900	0														
2/9	1500	0														
2/9	1800	Trace														

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE 0.86 in H_2O VACUUM 0.86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/8	0000	2400	2832	2121	11	78	53	125	265	9200	685	7400	1300	Trace	Trace
2/9	0000	2400	2832	1309	9	79	53	125	256	5100	697	29000	3820	Trace	Trace

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER EDGINGTON OIL CO. OPERATOR EDGINGTON OIL

LOCATION N. LONG BEACH TANK IDENTIFICATION OR NUMBER 30004

TANK OPERATION CONTINUOUS PIPELINE MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1959 MANUFACTURER N/A

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NONE THICKNESS - in. WALL COATING NONE ROOF COATING N/A

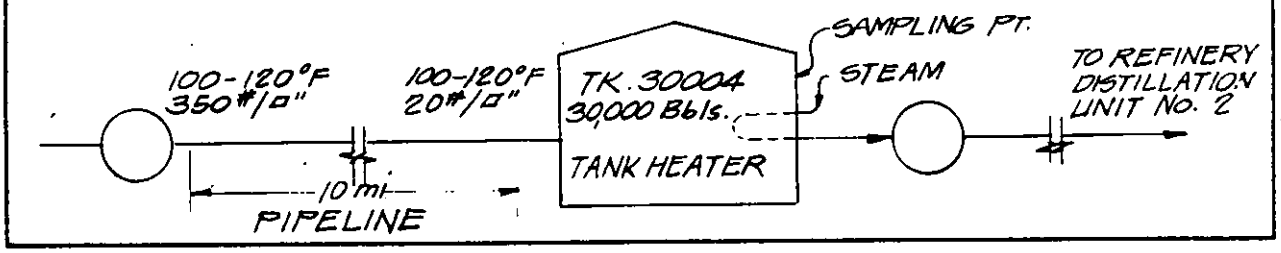
STRAIGHT WALL HEIGHT 45 ft. 0 in. DIAMETER 70 ft. 0 in. CONSTRUCTION TYPE WELDED

CAPACITY 30,000 bbls. ROOF SLOPE 3/4"/1 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 3.47 in. H_2O VACUUM ROOF VENT NORMAL SETTING .87 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME WILMINGTON OIL FIELD LONG BEACH OIL DEVELOPMENT

RVP 1.5 psia API GRAVITY 18.3 °

STOCK COMPOSITION (Mole Percent): CO_2 .09 N_2 .12

CH_4 .11 C_2H_6 .09 C_3H_8 .33 iC_4 .20 nC_4 .56 iC_5 .35 nC_5 .36

C_6 .51 C_7 PLUS 97.28 DENSITY OF C_7 PLUS .9435 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 339 lb/lb-mole API GRAVITY OF C_7 PLUS 18.3 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Due to undiscovered rusted holes in the roof which undoubtedly prevented a leak-tight seal especially during periods of maximum filling rates, the net volumetric input to the tank was considered to be a better estimate of the vapor flow than the metered volumes. Bag samples representing the highest concentrations were used to compute HC concentrations.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION EDGINGTON #30004

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/8	0300	.008	.008	.008	.041	.040	.025	.082	.025	.031	.016	0	0	0	.285	72.71
2/8	0600	.020	.024	.121	.289	.243	.145	.257	.185	.155	.217	.161	.028	.012	1.858	80.76
2/8	0900	.058	.058	.323	.758	.633	.313	.462	.231	.165	.010	.003	0	0	3.013	65.09
2/8	1200	.033	.016	.297	.659	.528	.218	.528	.145	.214	.165	.007	0	0	2.809	70.37
2/9	0000	.076	.105	.675	1.335	1.045	.482	.780	.281	.269	.109	.036	0	0	5.195	64.97
2/9	0600	.008	.008	.016	.041	.079	.049	.092	.066	.059	.049	.007	0	0	.476	80.85
2/9	1200	.032	.048	.289	.868	.611	.450	.759	.482	.286	.153	.048	0	0	4.029	74.30
2/9	1800	.041	.066	.267	.666	.610	.313	.303	.214	.178	.026	.007	0	0	2.692	65.85
2/10	0000	.056	.069	.305	.625	.437	.149	.233	.170	.139	.128	.066	0	0	2.377	63.47
							VOIDED TEST									

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/8	0000	2400	19200	16080	11	78	53	89	265	17500*	N/A	N/A	N/A	1.31*	68*
2/9	0000	2400	21155	15876	10	79	53	95	256	29600*	N/A	N/A	N/A	2.90*	154*
														VOIDED TEST	

* Estimated from liquid flow into tank (net)

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER EXXON OPERATOR EXXON

LOCATION WILMINGTON, CA. TANK IDENTIFICATION OR NUMBER 410

TANK OPERATION LACT MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1972 MANUFACTURER NATIONAL TANK

COLOR OF WALL LT. GREEN COLOR OF ROOF LT. BLUE PAINT CONDITION GOOD

INSULATION YES THICKNESS 1 in. WALL COATING EPOXY MASTIC ROOF COATING NONE

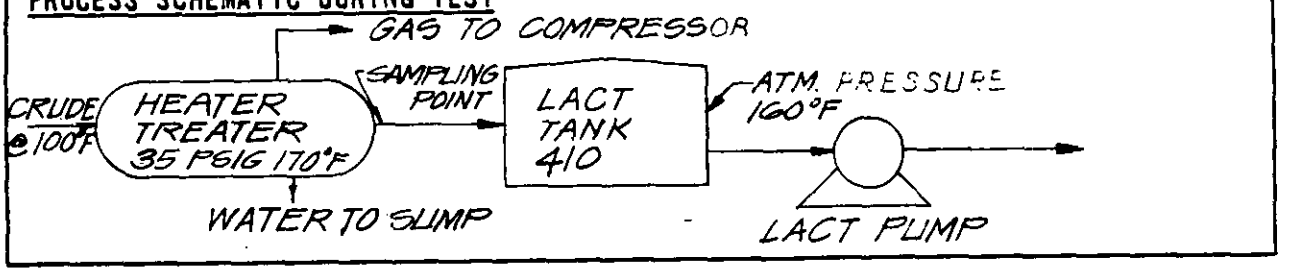
STRAIGHT WALL HEIGHT 24 ft. 1 in. DIAMETER 30 ft. 0 in. CONSTRUCTION TYPE WELDED

CAPACITY 3,000 bbls. ROOF SLOPE 1.25 in./ft. INTERNAL HEATER TYPE HOT WATER

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING N/A in. H_2O VACUUM ROOF VENT NORMAL SETTING N/A in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME WILMINGTON OIL FIELD WILMINGTON

RVP 1.5 psia API GRAVITY 16.7 °

STOCK COMPOSITION (Mole Percent): CO_2 0.28 N_2 0.09

CH_4 1.22 C_2H_6 0.17 C_3H_8 0.37 iC_4 0.21 nC_4 0.43 iC_5 0.28 nC_5 0.25

C_6 0.13 C_7 PLUS 96.57 DENSITY OF C_7 PLUS 0.9578 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 393 lb/lb-mole API GRAVITY OF C_7 PLUS 16.1 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This tank normally filled continuously with the level varying between 5 feet and 6 feet. This tank was disconnected from the vapor recovery system during this test. Vapor flows were corrected to standard temperature. Hydrocarbon emissions were calculated for each day from the following bag samples: 3/30 (1745 bag); and 3/31 (0815 bag.) The entire test was conducted with the vapor condensate system and refrigeration unit in operation with a total of 60 lbs of condensate collected throughout the test.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** EXXON 410

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/21	1540	9.527	3.897	6.334	7.665	2.923	2.226	2.064	1.665	.609	.507	.271	.271	.196	38.155	34.28
3/22	1500	9.743	4.330	8.108	9.628	3.751	1.874	2.209	1.637	.633	.463	.304	.261	.230	43.173	35.28
3/23	1400	11.476	4.006	8.108	8.298	3.789	1.927	2.321	1.786	.690	.535	.359	.183	0	43.476	33.41
3/23	1300	8.553	4.547	8.108	9.818	3.816	1.955	2.348	1.881	.812	.636	.304	.203	0	42.982	36.85
3/26	0900	9.743	4.330	7.855	9.312	3.573	1.732	1.942	1.407	.575	.392	.231	.217	.325	41.640	34.62
3/26	0930	9.094	4.439	7.981	9.058	7.680	1.676	1.881	1.374	.507	.338	.169	.203	0	44.403	36.59
3/26	1020	9.310	4.574	8.361	9.122	3.573	1.712	1.955	1.475	.595	.399	.217	.169	.156	41.591	34.93
3/30	1515	8.248	4.619	5.818	9.009	3.464	1.835	2.083	1.526	.557	.323	.151	.076	0	37.709	35.37
3/30	1600	7.259	4.729	8.752	9.701	3.877	1.911	2.206	1.636	.639	.351	.234	.137	0	41.431	37.77
3/30	1625	5.719	2.530	5.585	6.331	2.791	1.306	1.622	1.189	.426	.237	.110	.082	0	27.929	36.61
3/30	1745	12.595	5.510	9.365	10.379	3.936	2.271	2.558	1.886	.697	.738	.418	.402	.353	51.107	34.08
3/31	1815	12.726	4.198	8.444	8.659	3.739	1.755	1.960	1.320	.410	.131	.016	0	0	43.358	31.40
3/31	1030	9.446	5.510	9.212	8.597	3.444	1.697	1.927	1.312	.484	.172	.057	0	0	41.859	33.97

TEST SUMMARY **ONE WAY VALVE SETTING: PRESSURE** 0.86 in H_2O **VACUUM** 0.86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/30	1500	2400	3613	3613	18.5			160	N/A	13977	1750	N/A	N/A	470	1905
3/31	0000	1200	4818	4818	18.5			160	N/A	17493	2060	N/A	N/A	444	1518

NOTE: PARTIAL TEST DAYS

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GATX OPERATOR GATX

LOCATION CARSON TANK IDENTIFICATION OR NUMBER 80002

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1923 MANUFACTURER WESTERN PIPE AND STEEL

COLOR OF WALL WHITE COLOR OF ROOF BLACK PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING OIL AND SAND

STRAIGHT WALL HEIGHT 41 ft. 10 in. DIAMETER 117 ft. 2 in. CONSTRUCTION TYPE RIVETED

CAPACITY 76,800 bbls. ROOF SLOPE 0 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE DISTILLATE COMMON NAME FUEL OIL FLASH POINT 167 °F

REFLUX METHOD

PRESSURE, mmHg	TEMP. °C
100	158
200	186

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Only one full 24-hour period, March 9, was available for use in the emission calculations since the vapor positive displacement meter had to be taken out of service and general maintenance performed on March 8. All vapor flows were corrected to standard temperature.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION GATX 80002

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/9	1500	.003	.001	.008	.023	.028	.019	.046	.052	.027	.020	.008	0	0	.235	86.2
3/9	1800	0	0	0	0	.002	.002	.022	.037	.026	.024	.019	.003	0	.129	121.5

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/9	0000	2400	0	0	40.1	68	49	65	N/A	7675	2500	8500	2400	0.03	1.8

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GATX OPERATOR GATX

LOCATION CARSON TANK IDENTIFICATION OR NUMBER 80006

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1922 MANUFACTURER WESTERN PIPE & STEEL

COLOR OF WALL WHITE COLOR OF ROOF BLACK PAINT CONDITION GOOD

INSULATION NONE THICKNESS - in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 41 ft. 10 in. DIAMETER 117 ft. 2 in. CONSTRUCTION TYPE RIVETED

CAPACITY 76,800 bbls. ROOF SLOPE 0.0 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1. in. H_2O VACUUM ROOF VENT NORMAL SETTING 1. in. H_2O

PROCESS SCHEMATIC DURING TEST N/A

VOIDED TEST

STOCK PARAMETERS

TYPE CRUDE COMMON NAME ELK HILLS CRUDE OIL FIELD ELK HILLS

RVP _____ psia API GRAVITY _____ °

STOCK COMPOSITION (Mole Percent): CO_2 _____ N_2 _____

CH_4 _____ C_2H_6 _____ C_3H_8 _____ iC_4 _____ nC_4 _____ iC_5 _____ nC_5 _____

C_6 _____ C_7 PLUS _____ DENSITY OF C_7 PLUS _____ g/cc.

MOLECULAR WEIGHT OF C_7 PLUS _____ lb/lb-mole API GRAVITY OF C_7 PLUS _____ °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Test voided due to electrical power failure at tank. No liquid or vapor data taken.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION GATX 80006

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
						NO DATA OBTAINED			-	TEST VOIDED						

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE _____ in H_2O VACUUM _____ in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GATX TST OPERATOR GATX

LOCATION CARSON TANK IDENTIFICATION OR NUMBER 80012

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1923 MANUFACTURER WESTERN PIPE AND STEEL

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 41 ft. 10 in. DIAMETER 117 ft. 2 in. CONSTRUCTION TYPE RIVETED

CAPACITY 76,800 bbls. ROOF SLOPE .75 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME BEKATAI OIL FIELD FOREIGN

RVP 3.0 psia API GRAVITY 40.0 °

STOCK COMPOSITION (Mole Percent): CO_2 .01 N_2 .05

CH_4 .03 C_2H_6 .10 C_3H_8 .78 iC_4 .64 nC_4 1.43 iC_5 1.48 nC_5 1.43

C_6 2.09 C_7 PLUS 91.96 DENSITY OF C_7 PLUS .8306 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 171 lb/lb-mole API GRAVITY OF C_7 PLUS 38.7 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

A leak was detected in the manifold adapter during the morning of February 15 with the resulting flow data considered suspect and therefore not included in the emission summary. The OVA strip chart malfunctioned and only the bag samples, which were averaged, were used to estimate the emissions on February 16. All flow data were corrected to standard temperature.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION GATX 80012

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/15	0900	1.598	2.238	6.138	6.522	3.293	1.593	1.886	1.359	0.201	.020	.0	0	0	24.854	49.73
2/16	1200	1.327	1.311	1.950	6.010	3.453	1.458	2.358	1.778	0.492	.249	.048	0	0	20.473	53.31
2/16	1300	1.662	2.238	4.156	8.632	3.549	2.062	2.430	1.854	0.607	.384	.128	.020	0	27.721	51.08

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/16	0000	2400	0	0	2.92	93	53	65	N/A	1800	380	250	100	2.8	44

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GATX OPERATOR GATX

LOCATION CARSON TANK IDENTIFICATION OR NUMBER 178013 TEST NO. 1

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1923 MANUFACTURER WESTERN PIPE AND STEEL

COLOR OF WALL WHITE COLOR OF ROOF GRAY PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 41 ft. 6 in. DIAMETER 175 ft. 9 in. CONSTRUCTION TYPE RIVETED

CAPACITY 170,880 bbls. ROOF SLOPE 0 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME ESCRAVOS OIL FIELD FOREIGN

RVP 5.2 psia API GRAVITY 43.1 °

STOCK COMPOSITION (Mole Percent): CO_2 NIL N_2 NIL

CH_4 NIL C_2H_6 .08 C_3H_8 .90 iC_4 1.07 nC_4 2.67 iC_5 3.05 nC_5 2.86

C_6 4.06 C_7 PLUS 85.31 DENSITY OF C_7 PLUS .8265 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 167 lb/lb-mole API GRAVITY OF C_7 PLUS 39.5 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

All vapor flow data corrected to standard temperature. Grab samples exhibiting the highest total hydrocarbon concentrations were used to calculate hydrocarbon emissions. Liquid sample may not be representative of stock in tank at time of testing; therefore, this tank tested again May 18-20, 1977.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION GATX 178013 TEST 1

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/12	1200	.259	.207	3.981	9.157	12.381	5.812	4.618	2.409	.438	.080	0	0	0	39.342	67.71
2/12	1500	.020	.247	.836	1.194	.657	.394	.533	.617	.189	.040	0	0	0	4.728	62.94
2/13	0900	.259	1.792	9.395	13.377	7.743	3.265	2.393	1.194	.139	0	0	0	0	39.557	56.55
2/13	1200	.024	.318	1.139	3.503	2.946	1.768	1.943	1.274	.239	.032	0	0	0	13.186	68.62
2/13	1500	.020	.080	.677	1.433	1.123	.701	.573	.358	.104	.050	0	0	0	5.118	65.95
2/14	0900	.179	.478	8.758	15.288	10.271	4.399	3.862	1.891	.159	.040	0	0	0	45.265	61.33

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/11	0000	2400	0	0	2.3	90	47	60.5 56	276	4029	1180	1500	450	1.2	177
2/12	0000	2400	0	0	2.3	91	49	70 56	267	5857	1240	2340	900	1.7	256
2/13	0000	2400	0	0	2.3	79	49	64 56		5454	1260	2440	900	2.6	241

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GATX OPERATOR GATX

LOCATION CARSON TANK IDENTIFICATION OR NUMBER 178013 TEST NO. 2

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1923 MANUFACTURER WESTERN PIPE AND STEEL

COLOR OF WALL WHITE COLOR OF ROOF GRAY PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 41 ft. 6 in. DIAMETER 175 ft. 9 in. CONSTRUCTION TYPE RIVETED

CAPACITY 170,880 bbls. ROOF SLOPE 0 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME ESCRAVOS OIL FIELD FOREIGN

RVP 5.5 psia API GRAVITY 34.9 °

STOCK COMPOSITION (Mole Percent): CO_2 .02 N_2 .14

CH_4 .03 C_2H_6 .15 C_3H_8 1.58 iC_4 1.28 nC_4 2.50 iC_5 2.04 nC_5 2.00

C_6 4.16 C_7 PLUS 86.10 DENSITY OF C_7 PLUS .8528 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 179 lb/lb-mole API GRAVITY OF C_7 PLUS 34.3 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

All vapor flow data corrected to standard temperature. Grab samples exhibiting the highest total hydrocarbon concentrations were used to calculate hydrocarbon emissions. Vapor flow data collected on May 17 had to be voided due to the tank's roof vents opening during the test. Data for May 18 and 19, 1977 were deemed valid.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION GATX 178013 TEST 2

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
5/17	1000	.480	2.059	10.632	11.981	3.266	1.302	1.486	1.096	.217	.092	0	0	0	32.611	51.54
5/17	1200	.353	1.589	9.640	10.742	3.119	1.199	1.368	.993	.199	.096	0	0	0	29.297	52.32
5/18	0810	.436	1.736	10.191	11.293	3.060	1.243	1.302	.908	.143	.055	0	0	0	30.367	51.51
5/18	0900	.471	2.118	11.485	14.185	3.795	1.567	1.662	1.166	.210	.092	0	0	0	36.751	52.19
5/18	1005	.553	1.718	11.447	14.717	3.872	1.616	2.172	1.336	.277	.160	0	0	0	37.867	53.08
5/18	1200	.367	1.921	10.629	13.627	3.639	1.528	1.639	1.245	.251	.116	0	0	0	34.954	52.93
5/18	1330	.408	1.805	10.357	13.354	3.435	1.456	1.365	1.215	.273	.138	.055	0	0	33.860	52.72
5/19	0945	.524	1.863	11.583	14.717	3.901	1.616	1.696	1.201	.200	.087	0	0	0	37.388	52.44
5/19	1103	.273	1.659	10.765	11.719	3.086	1.310	1.463	1.077	.204	.087	.029	0	0	31.673	52.58

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
5/18	0000	2400	0	0	6.9	75	56	65	555	17058	3410	7828	550	7.5	574
5/19	0000	2400	0	0	6.9	79	58	65	503	16059	2900	6883	400	6.7	576

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GATX OPERATOR GATX

LOCATION CARSON TANK IDENTIFICATION OR NUMBER 178015

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1923 MANUFACTURER WESTERN PIPE AND STEEL

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 41 ft. 6 in. DIAMETER 175 ft. 9 in. CONSTRUCTION TYPE RIVETED

CAPACITY 170,880 bbls. ROOF SLOPE 0 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME ATTAKA OIL FIELD FOREIGN

RVP 0.4 psia API GRAVITY 24.1 °

STOCK COMPOSITION (Mole Percent): CO_2 .09 N_2 .07

CH_4 .27 C_2H_6 NIL C_3H_8 .01 iC_4 Trace nC_4 .01 iC_5 .01 nC_5 .01

C_6 .09 C_7 PLUS 99.44 DENSITY OF C_7 PLUS .9079 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 342 lb/lb-mole API GRAVITY OF C_7 PLUS 24.2 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION GATX 178015

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/8	1500	.424	0	.024	.028	.032	.029	.056	.065	.043	.043	.046	.033	0	.822	28.9
3/9	1200	1.982	0	.062	.059	.047	.020	.032	.024	.024	.021	.021	.025	.017	2.355	19.5
3/9	1500	1.247	0	.128	.026	.036	.016	.033	.034	.020	.022	.030	.027	0	1.619	23.1
3/10	0900	1.279	0	.056	.216	.052	.024	.034	.034	.023	.023	.038	.028	0	1.807	24.4

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/8	0000	2400	0	0	1.8	80	50	67	N/A	0	0	0	0	0	0
3/9	0000	2400	0	0	1.8	68	49	67	N/A	0	0	0	0	0	0
3/10	0000	1000	0	0	1.8	72	52	67	N/A	0	0	0	0	0	0

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GATX OPERATOR GATX

LOCATION CARSON TANK IDENTIFICATION OR NUMBER 178018

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1924 MANUFACTURER WESTERN PIPE AND STEEL

COLOR OF WALL WHITE COLOR OF ROOF BLACK PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING DEMONTIO

STRAIGHT WALL HEIGHT 41 ft. 6 in. DIAMETER 175 ft. 9 in. CONSTRUCTION TYPE RIVETED

CAPACITY 170,880 bbls. ROOF SLOPE 0 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME BEKATAI OIL FIELD FOREIGN

RVP 2.0 psia API GRAVITY 40.5 °

STOCK COMPOSITION (Mole Percent): CO_2 0.06 N_2 0.07

CH_4 .03 C_2H_6 .08 C_3H_8 .60 iC_4 .49 nC_4 1.06 iC_5 1.12 nC_5 1.12

C_6 3.35 C_7 PLUS 92.07 DENSITY OF C_7 PLUS .8291 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 170 lb/lb-mole API GRAVITY OF C_7 PLUS 39.0 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Bag samples taken at 1200 and 1500 on February 15 were used to estimate the emission rate. Flow out of the tank occurred during the period 1000 to 1400 on this day. Flow-out on February 16 occurred from 0900 to 1100 with the grab sample taken at 1200 used to estimate the emission since it was most representative of the period of positive flow.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION GATX 178018

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/15	0100	1.055	1.100	2.622	4.923	2.494	1.231	1.407	.988	1.854	.024	0	0	0	17.697	53.20
2/15	1200	1.369	1.825	5.703	6.843	3.821	2.110	2.367	1.711	.385	.143	.014	0	0	26.289	51.23
2/15	1500	1.711	2.167	6.957	9.010	5.703	3.251	3.279	2.270	.428	.066	0	0	0	34.840	51.53
2/16	0900	1.026	1.597	2.395	4.790	2.566	1.440	1.668	1.283	.264	.143	.034	0	0	17.206	51.02
2/16	1200	1.023	1.598	2.494	6.937	4.284	2.318	2.791	1.886	.480	.121	.016	0	0	23.948	55.93
2/16	1300	.342	.684	3.079	3.650	2.766	1.457	1.768	.356	.274	.086	.004	0	0	14.466	56.62
2/16	1400	1.026	1.711	5.703	7.185	4.306	2.481	2.538	1.825	.356	.057	0	0	0	27.188	53.65

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/15	0000	2400	0	0	2.5	91	47	63	N/A	284	132	0	0	0.4	8.7
2/16	0000	2400	0	0	2.5	93	53	63	N/A	173	91	0	0	0.2	4.1

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GETTY OIL CO. OPERATOR GETTY OIL CO.

LOCATION SEAL BEACH TANK IDENTIFICATION OR NUMBER 1SB3

TANK OPERATION CONTINUOUS MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION BEFORE 1965 MANUFACTURER NONE AVAILABLE

COLOR OF WALL TAN COLOR OF ROOF TAN PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING COAL TAR EPOXY ROOF COATING NONE

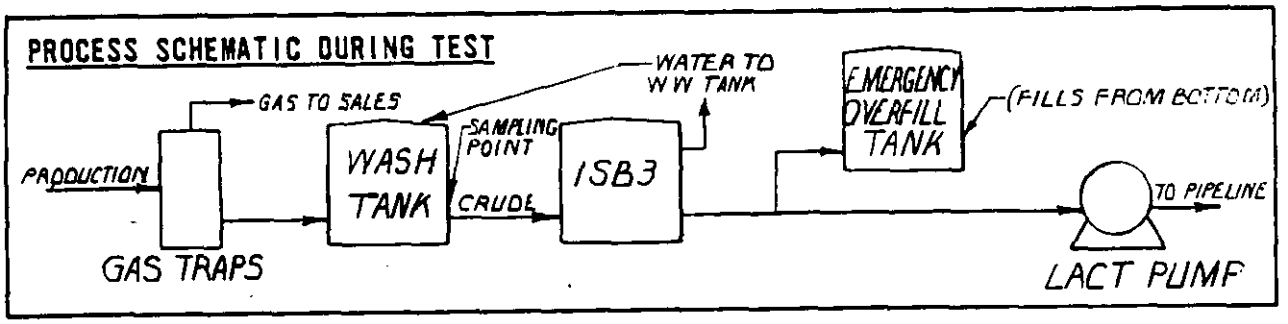
STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 22 ft. 0 in. CONSTRUCTION TYPE WELDED/BOLTED

CAPACITY 1000 bbls. ROOF SLOPE 1"/1' in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME N/A OIL FIELD N/A

RVP 3.0 psia API GRAVITY 26.1°

STOCK COMPOSITION (Mole Percent): CO_2 .04 N_2 .04

CH_4 .34 C_2H_6 .21 C_3H_8 .68 iC_4 .25 nC_4 .78 iC_5 .44 nC_5 .52

C_6 .86 C_7 PLUS 95.84 DENSITY OF C_7 PLUS .9010 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 276 lb/lb-mole API GRAVITY OF C_7 PLUS 25.4 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This tank normally varies in stock depth between 5 and 7 feet. This tank is connected to a vapor recovery system but it was disconnected at least 24 hours prior to the test. Vapor flows were corrected to standard temperature. Calculated hydrocarbon emissions for May 8 were determined from the bag sample taken at 0947 PST. No valid emission information was obtained prior to May 8 due to a crack in the manifold PVC piping resulting in a loss of pressure and a power outage at the lease.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION GETTY 15B3

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
5/7	1200	5.554	1.814	3.184	4.643	3.401	2.409	2.791	1.913	.964	.446	.397	.184	0	27.698	39.99
5/7	1800	.590	.850	3.979	3.184	1.367	.631	1.013	.836	.460	.227	.128	0	0	13.265	51.07
5/8	1531	.349	.340	1.207	1.205	.531	.272	.460	.390	.131	.131	.092	0	0	5.109	49.98
5/8	0947	1.360	1.360	5.107	3.913	1.365	.620	.930	.684	.315	.131	0	0	0	15.785	44.10
5/9	0800	1.031	.973	3.752	1.968	1.169	.565	.909	1.067	.326	.150	.075	0	0	11.986	45.95

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
5/8	0000	2400	320	320	10.4	68	52	87	N/A	224	56	0	0	0.3	3.6

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GETTY OIL COMPANY OPERATOR GETTY

LOCATION LLOYD LEASE TANK IDENTIFICATION OR NUMBER 5729

TANK OPERATION LACT MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION BEFORE 1965 MANUFACTURER UNKNOWN

COLOR OF WALL BEIGE COLOR OF ROOF BEIGE PAINT CONDITION GOOD

INSULATION NO THICKNESS ___ in. WALL COATING RUBBER LINER ROOF COATING NONE

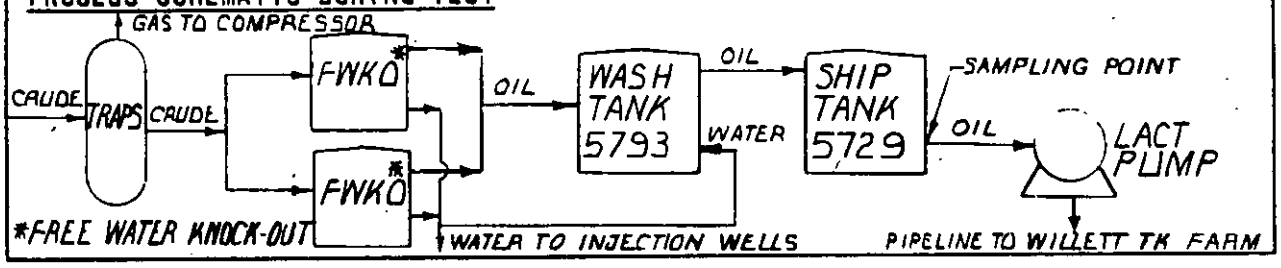
STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 47 ft. 0 in. CONSTRUCTION TYPE BOLTED

CAPACITY 5000 bbls. ROOF SLOPE 1 in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME VENTURA OIL FIELD VENTURA AVE.

RVP 5.5 psia API GRAVITY 30.1 °

STOCK COMPOSITION (Mole Percent): CO_2 0.02 N_2 0.01

CH_4 0.09 C_2H_6 0.16 C_3H_8 1.57 iC_4 0.91 nC_4 3.18 iC_5 2.25 nC_5 2.61

C_6 4.42 C_7 PLUS 84.78 DENSITY OF C_7 PLUS 0.8768 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 250 lb/lb-mole API GRAVITY OF C_7 PLUS -- °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This tank normally filled continuously with the level varying between 3 feet and 6 feet. This tank was usually on vapor recovery but was disconnected 72 hours prior to the test. Vapor flows were corrected to standard temperature and also for condensate. The amount of condensate was determined using the vapor condensate system and a refrigeration unit with a total of 136 lbs of condensate measured during the test. Calculated total hydrocarbon and methane emissions were determined from the following bag samples: 4/5 (0730 bag); 4/6 (1200 bag); and 4/7 (1130 bag).

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION GETTY 5729

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/5	0000	2.622	2.107	15.287	19.507	8.692	3.519	2.985	.622	.022	0	0	0	0	55.364	49.76
4/5	0730	4.069	3.189	19.305	24.968	11.328	4.296	5.513	2.509	.687	.220	0	0	0	76.084	50.13
4/5	0830	2.749	2.310	14.800	19.562	8.767	3.416	3.588	.967	.041	0	0	0	0	56.201	49.91
4/5	1415	3.189	2.221	15.187	22.780	9.128	4.200	5.004	2.770	1.114	.439	.119	0	0	66.150	52.05
4/5	1500	2.662	2.090	14.157	18.533	8.413	2.990	3.932	.581	.261	.036	0	0	0	54.655	50.51
4/5	1800	2.615	1.699	14.380	18.358	8.367	3.497	3.824	1.177	.033	0	0	0	0	53.949	50.58
4/5	2300	2.876	1.830	15.910	20.500	9.347	3.268	3.138	.778	.065	0	0	0	0	57.713	49.76
4/5	2400	2.876	1.961	15.193	19.153	7.975	2.762	2.647	.482	0	0	0	0	0	53.048	48.59
4/6	0900	2.876	2.301	15.604	20.806	9.020	3.121	3.628	.940	.139	0	0	0	0	58.435	49.76
4/6	1200	1.930	3.688	18.318	34.251	13.616	5.093	6.272	3.056	1.273	.496	.147	0	0	88.140	55.12
4/7	1130	4.789	4.205	21.380	33.945	13.998	5.481	6.591	3.275	1.166	.520	.204	0	0	95.555	51.01
4/7	1400	4.947	4.272	13.947	30.524	15.741	5.903	6.746	3.078	.942	.295	.091	0	0	86.486	51.39
4/7	1730	4.835	4.385	13.552	30.656	15.741	5.622	6.367	2.811	.829	.084	0	0	0	84.881	51.12

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/5	0000	2400	6400	6400	11.5	64	45	110	419	13717	1695	2260	570	56	1043
4/6	0000	2400	6400	6400	11.5	62	50	110	433	16760	2635	2040	877	32	1477
4/7	0000	2400	6400	6400	11.5	61	52	110	464	14088	2330	2888	589	67	1346

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GETTY OIL CO. OPERATOR GETTY

LOCATION LLOYD LEASE TANK IDENTIFICATION OR NUMBER 5793

TANK OPERATION WASH MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION BEFORE 1965 MANUFACTURER UNKNOWN

COLOR OF WALL LT. GRAY COLOR OF ROOF LT. GRAY PAINT CONDITION GOOD

INSULATION YES THICKNESS 2 in. WALL COATING COAL TAR EPOXY ROOF COATING NONE

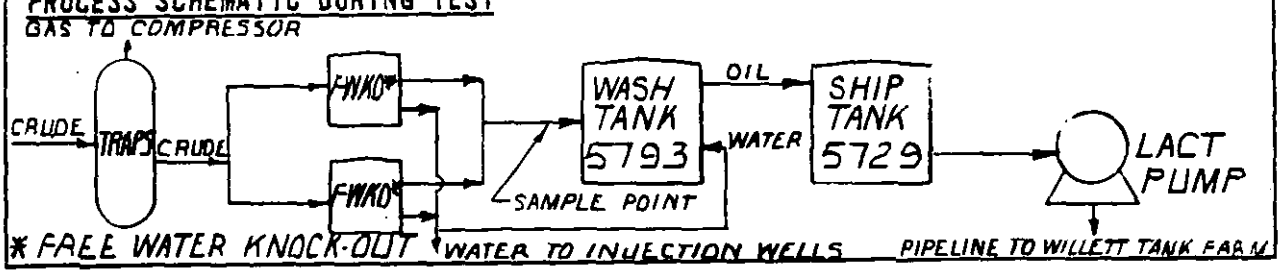
STRAIGHT WALL HEIGHT 24 ft. 0 in. DIAMETER 38 ft. 7 in. CONSTRUCTION TYPE BOLTED

CAPACITY 5,000 bbls. ROOF SLOPE 1 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME VENTURA AVE CRUDE OIL FIELD VENTURA AVE

RVP 5.9 psia API GRAVITY 30.0 °

STOCK COMPOSITION (Mole Percent): CO_2 0.02 N_2 0.06

CH_4 0.19 C_2H_6 0.17 C_3H_8 1.61 iC_4 0.91 nC_4 3.14 iC_5 2.12 nC_5 2.46

C_6 3.60 C_7 PLUS 85.72 DENSITY OF C_7 PLUS 0.8859 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 252 lb/lb-mole API GRAVITY OF C_7 PLUS 28.1 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

The tank was equipped with a vapor recovery system which was disconnected 72 hours prior to testing. Due to low flow conditions, the condensate traps were removed the following day on April 9. The test proceeded until April 11 at 1300 hours at which time it was terminated. All vapor flows were corrected to standard temperature.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION GETTY 5793

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/9	1008	4.476	4.590	22.293	38.543	18.477	6.441	6.980	2.711	.595	.136	0	0	0	105.248	51.84
4/9	1041	4.361	4.820	22.024	37.065	15.894	5.752	5.953	3.213	.975	.330	.050	0	0	100.440	51.40
4/10	1130	.758	1.148	8.863	12.703	4.935	2.396	3.271	1.779	.545	.153	0	0	0	36.550	55.83

TEST SUMMARY ONE WAY VALVE SETTING:- PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/9	0000	2400	6400	6400	1	63	49	106	N/A	166	66	0	0	0.7	17
4/10	0000	2400	6400	6400	1	62	43	106	N/A	154	44	182	77	0.7	16

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GETTY OIL CO. OPERATOR GETTY

LOCATION WILLIAMS HOLDING TANK IDENTIFICATION OR NUMBER 9682

TANK OPERATION WASH MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1975 MANUFACTURER NUNN CONSTRUCTION

COLOR OF WALL YELLOW COLOR OF ROOF YELLOW PAINT CONDITION GOOD

INSULATION NO THICKNESS ___ in. WALL COATING COAL TAR ~~EPOXY~~ ROOF COATING NONE

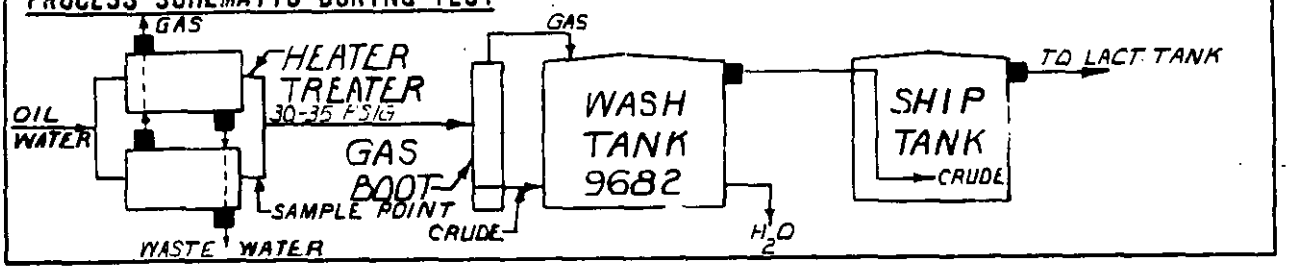
STRAIGHT WALL HEIGHT 24 ft. 0 in. DIAMETER 30 ft. 0 in. CONSTRUCTION TYPE BOLTED

CAPACITY 3000 bbls. ROOF SLOPE 1 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NOT APPLICABLE

PRESSURE ROOF VENT NORMAL SETTING NONE in. H_2O VACUUM ROOF VENT NORMAL SETTING NONE in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME CAT CANYON OIL FIELD CAT CANYON

RVP 0.4 psia API GRAVITY 12.0 °

STOCK COMPOSITION (Mole Percent): CO_2 0.19 N_2 0.04

CH_4 0.73 C_2H_6 0.02 C_3H_8 0.06 iC_4 0.07 nC_4 0.26 iC_5 0.25 nC_5 0.20

C_6 0.14 C_7 PLUS 98.04 DENSITY OF C_7 PLUS 0.9892 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 487 lb/lb-mole API GRAVITY OF C_7 PLUS 11.4 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Due to space restrictions, only the vapor metering system was connected during the test. Therefore, no air-in data were obtained during this test. All the hours of data (66) gathered during testing was utilized in the calculation of emissions. A total of 59 lbs of condensate was collected in the vapor traps. This mass of condensate was converted to SCF and proportioned between the four test dates. All vapor flows were corrected to standard temperature.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION GETTY 9682

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/29	1630	8.251	0.465	2.556	10.82	8.890	4.793	5.011	3.791	1.365	0.494	0.218	0	0	46.658	44.37
4/30	0915	8.367	0.813	2.584	10.74	8.570	5.084	7.059	4.424	1.670	0.450	0.073	0	0	49.887	45.52
4/30	1548	6.856	0.395	1.849	8.83	6.925	4.430	6.363	4.016	1.511	0.508	.080	0	0	41.771	46.60
5/1	1142	7.421	0.584	2.870	7.63	6.676	4.539	5.931	5.931	2.755	1.040	.394	.253	0	46.024	47.57
5/1	1500	7.533	0.495	1.842	7.68	6.591	3.752	4.638	2.586	.899	.394	.197	.126	0	36.737	41.96
5/1	1312	7.645	0.629	1.974	7.69	6.662	4.034	5.664	3.849	1.560	.646	.379	.169	0	40.902	44.26
5/2	0955	8.770	0.787	2.434	9.40	8.517	5.369	7.870	5.678	2.839	1.630	1.293	.899	.956	56.449	49.05

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/29	1700	2400	700	700	3	71	43	185		2219	587	NA	NA	63	355
4/30	0000	2400	2400	2400	3	70	54	185		4605	386	NA	NA	39	230
5/1	0000	2400	2400	2400	3	69	50	185		7539	360	NA	NA	56	347
5/2	0000	1000	1000	1000	3	71	44	185		2510	555	NA	NA	45	277

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GETTY OIL CO. OPERATOR GETTY OIL CO.

LOCATION VENTURA MARINE TERM. TANK IDENTIFICATION OR NUMBER 55709

TANK OPERATION BATCH MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION BEFORE 1965 MANUFACTURER UNKNOWN

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NO THICKNESS - in. WALL COATING N/A ROOF COATING TAR

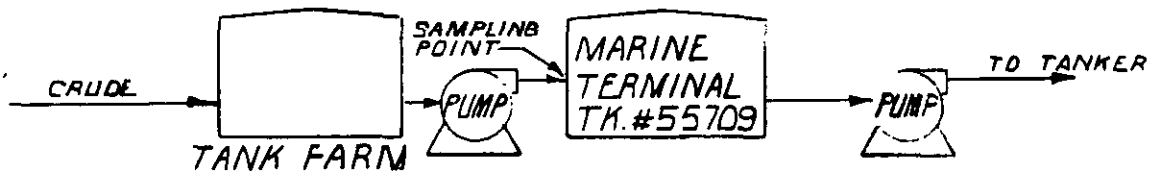
STRAIGHT WALL HEIGHT 32 ft. 0 in. DIAMETER 120 ft. 0 in. CONSTRUCTION TYPE RIVETED

CAPACITY 55,000 bbls. ROOF SLOPE 0 in./ft. INTERNAL HEATER TYPE NO

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NO

PRESSURE ROOF VENT NORMAL SETTING 0.86 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0.86 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME VENTURA AVE. CRUDE OIL FIELD VENTURA AVE.

RVP 5.0 psia API GRAVITY 30 °

STOCK COMPOSITION (Mole Percent): CO_2 .07 N_2 .05

CH_4 .24 C_2H_6 .12 C_3H_8 1.35 iC_4 .75 nC_4 3.25 iC_5 1.70 nC_5 2.29

C_6 3.37 C_7 PLUS 86.81 DENSITY OF C_7 PLUS 0.8886 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 272 lb/lb-mole API GRAVITY OF C_7 PLUS 27.6 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

On 4/12/77 and 4/13/77, vapor volumes of 59,600 and 54,955 scf were metered. Problems were experienced in maintaining tank pressure below the 2.20 inch H_2O gauge setting of the relief valve. The volume of vapors which were physically displaced were computed from the liquid flow rates into the tank. These volumes were 101,000 and 63,000 scf, respectively. Relief valves were opening.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION GETTY 55709

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3-gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/11	1715	.057	.344	5.394	10.902	4.619	1.664	1.130	0.975	0.153	0.061	0	0	0	25.300	58.88
4/12	1204	.149	.459	6.656	14.001	5.222	1.764	2.381	1.076	0.273	0.007	0	0	0	31.988	58.74
4/12	1315	.321	.746	5.623	13.771	8.647	2.051	2.654	1.148	0.258	0.086	0	0	0	35.305	59.63
4/12	1555	.160	.527	6.656	14.001	5.222	1.786	2.417	1.176	0.301	0.082	0	0	0	32.279	58.76
4/13	0955	.252	.918	7.345	16.296	5.968	2.015	2.223	1.248	0.373	0.143	0	0	0	36.782	57.81
4/13	0100	.218	.631	5.681	17.792	5.164	1.707	2.152	0.861	0.163	0.007	0	0	0	24.560	58.15
4/13	1135	.137	.689	6.886	13.771	4.476	1.585	1.987	0.789	0.158	0	0	0	0	30.377	57.12

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/12	0000	2400	18000	0	22	82	50	72	N/A	101000*	N/A	0	0	20	3263
4/13	0000	2400	11250	0	13	84	46	85	349	63000*	N/A	0	0	12	

* Calculated based on liquid flow rate

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GETTY OIL COMPANY OPERATOR GETTY OIL

LOCATION WILLETT TANK FARM TANK IDENTIFICATION OR NUMBER 80712

TANK OPERATION BATCH MODE DURING TEST WORKING (FILLING)

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION PRIOR TO 1965 MANUFACTURER NA

COLOR OF WALL BEIGE COLOR OF ROOF BEIGE PAINT CONDITION GOOD

INSULATION NONE THICKNESS ____ in. WALL COATING NONE ROOF COATING NONE

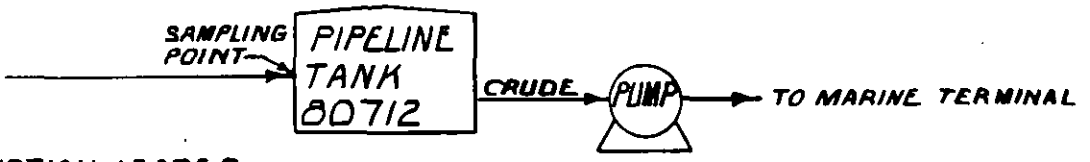
STRAIGHT WALL HEIGHT 40 ft. ____ in. DIAMETER 120 ft. 0 in. CONSTRUCTION TYPE RIVETED

CAPACITY 80,000 bbls. ROOF SLOPE 0 in./ft. INTERNAL HEATER TYPE NO

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 1 in. H_2O

PROCESS SCHEMATIC DURING TEST



PRODUCTION LEASES

STOCK PARAMETERS

TYPE CRUDE COMMON NAME VENTURA AVE. CRUDE OIL FIELD VENTURA AVE.

RVP 5.7 psia API GRAVITY 30 °

STOCK COMPOSITION (Mole Percent): CO_2 .11 N_2 .01

CH_4 .14 C_2H_6 .11 C_3H_8 1.48 iC_4 .71 nC_4 3.30 iC_5 1.23 nC_5 1.78

C_6 1.82 C_7 PLUS 89.31 DENSITY OF C_7 PLUS .8924 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 26.9 lb/lb-mole API GRAVITY OF C_7 PLUS 26.9 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

The vapor recovery system on the tank was blinded off during the test. A pressure relief valve, which was between the tank and the blind, was not weighted and was observed to have opened on 4/15/77. It was then sealed off to prevent the loss of hydrocarbon vapors. Problems were experienced during the test with the turbine meter and the metered volumes of vapor were significantly below the 13,500 bbl/day liquid filling rate. THC and CH_4 emission rates, then, were computed from the calculated flow rates (based on liquid flow) rather than on the metered volumes. Relief valves were opening.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION GETTY 80712

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/15	1100	2.833	0.931	8.713	15.586	3.764	1.370	1.920	0.918	.265	.100	0	0	0	36.401	47.19
4/15	1120	2.482	1.034	8.471	15.490	3.671	1.377	1.920	.918	.271	.103	0	0	0	35.737	48.00
4/16	0830	2.482	1.034	8.592	16.095	3.826	1.341	1.797	.776	.194	.065	0	0	0	34.586	46.74
4/16	1305	2.379	.993	8.617	16.071	3.986	1.348	1.855	.840	.223	.078	0	0	0	36.388	48.38
4/16	1600	2.068	.724	7.866	14.764	3.387	1.260	1.745	.750	.162	.016	0	0	0	32.742	48.70
4/17	0938	3.960	.960	9.831	14.834	3.375	1.235	1.650	.661	.109	0	0	0	0	36.615	43.53
4/17	1230	4.020	.900	9.480	14.307	2.700	1.014	1.421	.546	.056	0	0	0	0	34.444	42.51
4/17	1510	4.550	.975	9.918	15.185	3.488	1.205	1.461	.642	.143	.030	0	0	0	43.664	46.18
4/18	0748	4.170	.900	10.557	15.448	3.351	1.069	1.570	.609	.211	.047	0	0	0	37.733	43.25

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT*		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/15	0000	2400	13500	0	29.0	65	46	75	413	75600	NA	0	0	214	2752
4/16	0000	2400	13500	0	23.4	65	54	74	0	75600	NA	0	0	180	2751
4/17	0000	2400	13500	0	17.4	65	56	66	0	75600	NA	0	0	299	2768

* Calculated from liquid flow rate

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER GETTY OIL OPERATOR GETTY OIL

LOCATION RECRUIT FEE TANK IDENTIFICATION OR NUMBER KD-42-25

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION BEFORE 1965 MANUFACTURER NA

COLOR OF WALL GREEN COLOR OF ROOF GREEN PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 12 ft. 0 in. DIAMETER 10 ft. 1 in. CONSTRUCTION TYPE WELDED

CAPACITY 170 bbls. ROOF SLOPE 2 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 0 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE CRUDE COMMON NAME VENTURA AVE. CRUDE OIL FIELD VENTURA AVE.

RVP 4.1 psia API GRAVITY 29.9 °

STOCK COMPOSITION (Mole Percent): CO_2 0.01 N_2 0.08

CH_4 0.03 C_2H_6 0.05 C_3H_8 0.85 iC_4 0.63 nC_4 2.38 iC_5 1.90 nC_5 2.30

C_6 4.04 C_7 PLUS 87.73 DENSITY OF C_7 PLUS 0.8812 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 249 lb/lb-mole API GRAVITY OF C_7 PLUS 28.9 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

It was the smallest tank (170 bbsl) in the study and was the best constructed. The tank had been previously used as a pressure vessel and, therefore, any possible leaks would have occurred in the test equipment.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION GETTY KD-42-25

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/30	1312	0	.225	3.881	6.052	1.560	.801	1.019	.717	.379	0	0	0	0	14.635	58.6
4/30	1515	.042	.258	5.157	8.355	3.893	3.605	4.048	1.939	.506	.141	0	0	0	27.944	65.0
5/1	1338	.058	.351	6.359	10.373	4.605	1.899	2.108	.935	.230	0	0	0	0	26.918	59.2

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/30	0000	2400	0	0	4	67	54	74	220	0	0	0	0	0	0
5/1	0000	2400	0	0	4	68	44	74	292	0	0	0	0	0	0

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER MOBIL OIL CORP. OPERATOR MOBIL

LOCATION SANTA FE SPRINGS TANK IDENTIFICATION OR NUMBER 20X1160

TANK OPERATION LACT MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION NA MANUFACTURER NA

COLOR OF WALL ALUMINUM ~~(DIFFUSE)~~ COLOR OF ROOF BLACK PAINT CONDITION GOOD

INSULATION NO THICKNESS ___ in. WALL COATING N/A ROOF COATING N/A

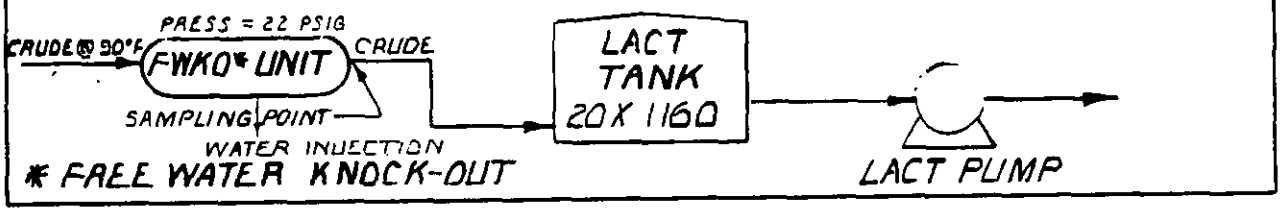
STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 29 ft. 8 in. CONSTRUCTION TYPE BOLTED

CAPACITY 2000 bbls. ROOF SLOPE 1 in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING 0.5 in. H_2O VACUUM ROOF VENT NORMAL SETTING N/A in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME SANTA FE SPRINGS OIL FIELD SANTA FE SPRINGS

RVP 3.5 psia API GRAVITY 30.0 °

STOCK COMPOSITION (Mole Percent): CO_2 0.05 N_2 0.03

CH_4 0.20 C_2H_6 0.23 C_3H_8 0.69 iC_4 0.47 nC_4 1.09 iC_5 1.13 nC_5 1.07

C_6 2.85 C_7 PLUS 92.19 DENSITY OF C_7 PLUS 0.8716 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 228 lb/lb-mole API GRAVITY OF C_7 PLUS 30.7 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This tank normally was on vapor recovery but was taken off 72 hours prior to testing. Vapor flows are corrected to standard temperature. Hydrocarbon emissions for each day were calculated from the following bag samples: 3/18 (1000 bag); 3/19 (1020 bag); and 3/20 (1020 bag on 3/19).

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION MOBIL 20X 1160

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/17	1552	3.858	3.428	4.436	4.484	2.814	1.574	2.087	1.360	.471	.151	.016	0	0	24.679	39.36
3/18	1000	1.646	4.832	6.218	8.202	4.074	1.818	1.937	1.682	.583	.248	.101	.013	0	31.353	47.22
3/19	1020	2.730	3.518	5.914	6.808	4.126	1.745	2.802	1.891	.671	.172	0	0	0	30.379	45.56
3/21	0805	1.340	2.346	4.153	4.841	3.095	1.552	2.183	1.444	.430	.043	0	0	0	21.427	48.92

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/18	0000	2400	1650	1650	11.5	74	52	90	N/A	340	142	0	0	0.6	11
3/19	0000	2400	1650	1650	11.5	76	53	90	N/A	255	211	310	101	0.7	8
3/20	0000	2400	1650	1650	11.5	77	54	90	N/A	182	102	0	0	0.5	6

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER MOBIL OIL CORP. OPERATOR MOBIL

LOCATION SANTA FE SPRINGS TANK IDENTIFICATION OR NUMBER 30X55

TANK OPERATION WASH MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION UNKNOWN MANUFACTURER UNKNOWN

COLOR OF WALL ALUMINUM (DIFFUSE) COLOR OF ROOF BLACK PAINT CONDITION GOOD

INSULATION NO THICKNESS ___ in. WALL COATING N/A ROOF COATING N/A

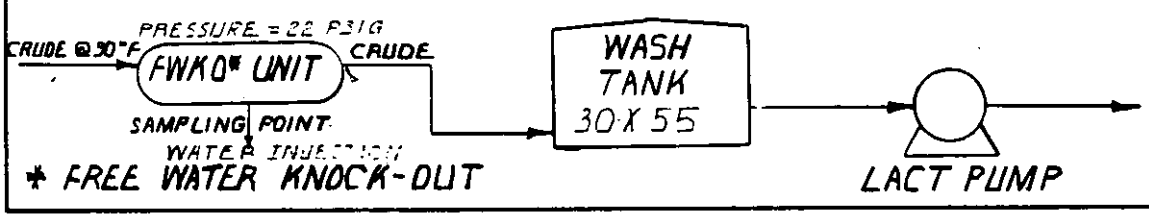
STRAIGHT WALL HEIGHT 24 ft. 0 in. DIAMETER 29 ft. 8 in. CONSTRUCTION TYPE BOLTED

CAPACITY 3000 bbls. ROOF SLOPE 1 in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING 2 in. H_2O VACUUM ROOF VENT NORMAL SETTING ___ in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME SANTA FE SPRINGS OIL FIELD SANTA FE SPRINGS

RVP 4.3 psia API GRAVITY 31.6 °

STOCK COMPOSITION (Mole Percent): CO_2 .10 N_2 .06

CH_4 .66 C_2H_6 .36 C_3H_8 .84 iC_4 .49 nC_4 1.20 iC_5 1.08 nC_5 1.10

C_6 2.69 C_7 PLUS 91.42 DENSITY OF C_7 PLUS .8740 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 226 lb/lb-mole API GRAVITY OF C_7 PLUS 30.2 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This tank, normally on vapor recovery, was taken off 72 hours prior to testing. The vapor condensate system and refrigeration unit were activated since the stock was kept at 110°F. No condensate was measured in the vapor traps at the end of testing, however. Data on May 6 were invalidated because the power to the trailer was inadvertently disconnected.

Vapor flows were corrected to standard temperatures.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION: MOBIL 30X55

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
5/3	1707	6.719	2.911	3.145	3.407	2.100	1.176	1.624	.917	.392	.238	.203	0	0	22.831	31.77
5/4	0819	6.907	4.835	7.867	7.140	3.166	1.590	2.346	1.403	.345	.022	0	0	0	35.620	35.86
5/4	1745	8.058	6.792	10.77	12.31	5.169	2.691	3.425	1.935	.432	.094	0	0	0	51.686	38.50
5/5	1000	4.718	3.602	6.731	6.595	3.312	2.005	2.469	1.663	.683	.065	0	0	0	31.844	40.10
5/5	1330	6.740	4.300	7.615	8.703	4.358	1.961	2.106	1.191	.156	0	0	0	0	37.130	37.08
5/5	1500	8.901	4.881	11.69	14.27	6.885	3.791	4.975	3.435	1.351	.291	0	0	0	60.483	41.43
5/5	1541	8.599	7.670	11.96	15.50	6.682	3.675	4.552	3.014	1.162	.639	0	0	0	63.461	40.95

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
5/4	0000	2400	360	360	2.5	80	59	110	N/A	45	18	0	0	0.4	2.3
5/5	0000	2400	360	360	2.5	77	47	110	N/A	79	15	0	0	0.7	5.0

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER MOBIL OIL CORP. OPERATOR MOBIL OIL CORP.

LOCATION TORRANCE, CA. TANK IDENTIFICATION OR NUMBER 800X127

TANK OPERATION CONTINUOUS MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION UNKNOWN MANUFACTURER UNKNOWN

COLOR OF WALL BEIGE COLOR OF ROOF BEIGE PAINT CONDITION N/A

INSULATION NONE THICKNESS – in. WALL COATING NONE ROOF COATING NONE

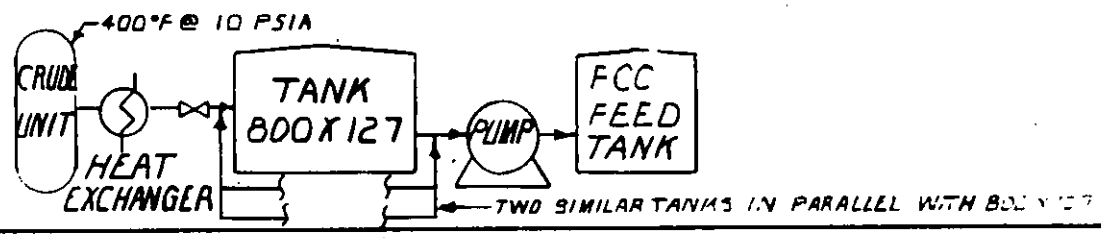
STRAIGHT WALL HEIGHT 39 ft. 9.5 in. DIAMETER 117 ft. 3 in. CONSTRUCTION TYPE N/A

CAPACITY 80,000 bbls. ROOF SLOPE N/A in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION N/A

PRESSURE ROOF VENT NORMAL SETTING N/A in. H_2O VACUUM ROOF VENT NORMAL SETTING N/A in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE DISTILLATE COMMON NAME VACUUM GAS OIL FLASH POINT N/A °F

REFLUX METHOD

PRESSURE, mmHg	TEMP. °C

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

The positive displacement meter on the vapor side seized during the test and no vapor flow was metered. Vapor output was estimated based on gaugings. The bag samples collected during the test exhibited a uniform, low THC concentration. As only one of these samples was taken during a period when the tank was under positive pressure, and the OVA unit was off-line for servicing, mass hydrocarbon emissions for the tank could not be calculated with any level of confidence.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION: MOBIL OIL 800X127

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/4	1800	.044	.019	.018	.018	.028	.053	.096	.108	.066	.043	.014	0	0	0.508	64.22
3/4	2100	.078	.057	.053	.064	.072	.090	.133	.126	.070	.040	.015	0	0	0.799	55.32
3/5	1500	.010	.003	.010	.020	.036	.044	.080	.089	.058	.038	.013	0	0	0.402	85.34
3/5	1800	.003	.001	.008	.017	.030	.022	.053	.050	.043	.034	.007	0	0	0.266	91.73
						VOIDED TEST										

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/5	0000	2400	8397	3117	6.4	70	45	140	240	8397		17500		Void	Void
3/6	0000	2400	2712	4738	9.6	70	47	140	348	15223		26600		Void	Void

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER MOBIL OIL CORP. OPERATOR MOBIL

LOCATION TORRANCE REFINERY TANK IDENTIFICATION OR NUMBER 900X2

TANK OPERATION CONTINUOUS MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION UNKNOWN MANUFACTURER UNKNOWN

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION N/A

INSULATION NONE THICKNESS - in. WALL COATING NONE ROOF COATING NONE

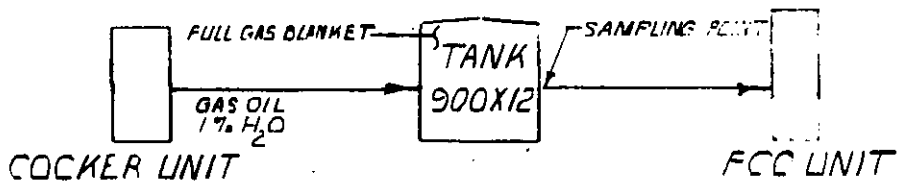
STRAIGHT WALL HEIGHT 43 ft. 10 in. DIAMETER 120 ft. 0 in. CONSTRUCTION TYPE N/A

CAPACITY 90,000 bbls. ROOF SLOPE 3/4 in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION N/A

PRESSURE ROOF VENT NORMAL SETTING N/A in. H_2O VACUUM ROOF VENT NORMAL SETTING N/A in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE DISTILLATE COMMON NAME GAS OIL FLASH POINT N/A °F

REFLUX METHOD

PRESSURE, mmHg	TEMP. °C

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

The vapor recovery system on the tank had not been disconnected for a sufficient amount of time prior to the test. Consequently, hydrocarbon concentrations measured during the testing program were not representative of tank vapor losses. Valid flow data was received for each of the days the metering system was on-line. However, emission rates could not be calculated due to the inadequate preparation of the tank. The test data were voided for this tank.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION MOBIL 900X2

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
–	VOID															
						VOIDED TEST										

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE ____ in H_2O VACUUM ____ in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/3	0000	0000	10870	0	22.4	69	44	78	294	23859		0		VOID	VOID

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER SHELL OIL CO. OPERATOR SHELL OIL CO. TEST #1

LOCATION BREA, CA. TANK IDENTIFICATION OR NUMBER 550S4

TANK OPERATION CONTINUOUS MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1954 MANUFACTURER HORTON TANK

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NONE THICKNESS -- in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 40 ft. 0 in. DIAMETER 100 ft. 0 in. CONSTRUCTION TYPE WELDED

CAPACITY 55,000 bbls. ROOF SLOPE 1 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NOT IN USE

PRESSURE ROOF VENT NORMAL SETTING .86 in. H_2O VACUUM ROOF VENT NORMAL SETTING .86 in. H_2O

PROCESS SCHEMATIC DURING TEST

SEE TEST #2

STOCK PARAMETERS

TYPE CRUDE COMMON NAME BREA CRUDE OIL FIELD BREA OLINDA

RVP 0.1 psia API GRAVITY 16.4 °

STOCK COMPOSITION (Mole Percent): CO_2 0.09 N_2 0.17

CH_4 0.19 C_2H_6 0.05 C_3H_8 0.24 iC_4 0.12 nC_4 0.46 iC_5 0.35 nC_5 0.39

C_6 0.56 C_7 PLUS 97.38 DENSITY OF C_7 PLUS 0.9559 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 389. lb/lb-mole API GRAVITY OF C_7 PLUS 16.5 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

All flows corrected to standard temperature. Liquid sample may not be representative of testing period. This tank retested May 20-23, 1977.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION SHELL 55054

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
2/23	1300	.015	0	.226	.787	.283	.119	.343	.131	.112	.037	.015	0	0	2.068	67.36
	1400	.134	.194	.909	2.921	2.235	1.079	1.305	.417	.268	.067	.007	0	0	9.537	64.24

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE 2.2 in H_2O VACUUM 1.5 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
2/23	0100	2400	10807	12407	23	54	48	126	N/A	5776	N/A	3230	N/A	0.8	55.1

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER SHELL OIL CO. OPERATOR SHELL OIL CO. TEST #2

LOCATION BREA, CA. TANK IDENTIFICATION OR NUMBER 550S4

TANK OPERATION CONTINUOUS MODE DURING TEST CONTINUOUS WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1954 MANUFACTURER HORTON TANK

COLOR OF WALL WHITE COLOR OF ROOF WHITE PAINT CONDITION GOOD

INSULATION NONE THICKNESS – in. WALL COATING NONE ROOF COATING NONE

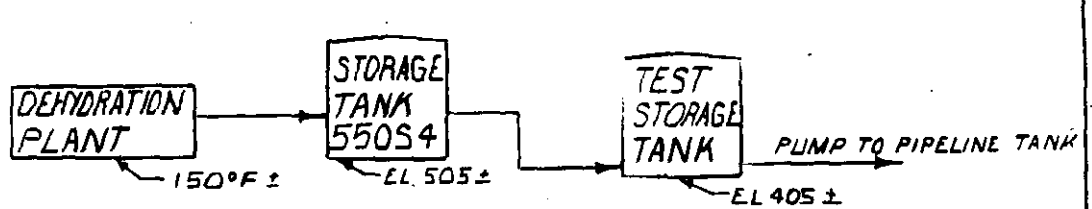
STRAIGHT WALL HEIGHT 40 ft. 0 in. DIAMETER 100 ft. 0 in. CONSTRUCTION TYPE WELDED

CAPACITY 55,000 bbls. ROOF SLOPE 1"/1' in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NOT IN USE

PRESSURE ROOF VENT NORMAL SETTING .86 in. H_2O VACUUM ROOF VENT NORMAL SETTING .86 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME BREA CRUDE OIL FIELD BREA-OLINDA

RVP 0.8 psia API GRAVITY 17.0 °

STOCK COMPOSITION (Mole Percent): CO_2 .07 N_2 NIL

CH_4 .12 C_2H_6 .06 C_3H_8 .52 iC_4 .31 nC_4 1.27 iC_5 .95 nC_5 1.05

C_6 1.46 C_7 PLUS 376 DENSITY OF C_7 PLUS .9546 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 376 lb/lb-mole API GRAVITY OF C_7 PLUS 16.6 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

On 5/21/77, the relief valves on the tank opened due to an excessive pressure drop across the meters thereby voiding test data for this day. Vapor flow rates on 5/22/77 were corrected to standard temperature. The bag samples with the highest THC concentration were used to compute daily hydrocarbon concentrations.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** SHELL OIL #550 S4

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
5/20	1447	.192	.256	2.658	5.981	3.777	1.832	2.328	.980	.234	.046	0	0	0	18.284	62.79
5/21	1015	.227	.284	3.323	7.443	4.458	2.272	2.875	1.342	.351	.128	0	0	0	22.704	63.20
5/21	1103	.217	.277	3.190	7.311	4.458	2.222	2.804	1.214	.323	.110	0	0	0	22.126	63.15
5/21	1403	.220	.274	3.190	7.178	4.373	2.172	2.754	1.246	.305	.096	0	0	0	21.809	63.04
5/23	1125	.255	.311	3.472	7.297	4.437	2.165	2.584	1.104	.328	.262	.078	0	0	22.294	62.36
5/23	1044	.238	.309	3.432	7.500	4.475	2.079	2.483	1.061	.256	.065	0	0	0	21.897	61.75

TEST SUMMARY **ONE WAY VALVE SETTING: PRESSURE** 0.86 in H_2O **VACUUM** 0.86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
5/22	0000	2400	1244*	634	26.5	83	62	132	417	8405	1530	504	NA	1.9	195

* ESTIMATED FROM GAUGINGS AND OUTFLOW RECORDS

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER TEXACO OPERATOR TEXACO

LOCATION SANTA PAULA CANYON TANK IDENTIFICATION OR NUMBER 2583

TANK OPERATION LACT MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION BEFORE 1958 MANUFACTURER SUPERIOR

COLOR OF WALL ALUMINUM (DIFFUSE) COLOR OF ROOF AL(DIFFUSE) PAINT CONDITION GOOD

INSULATION NO THICKNESS ___ in. WALL COATING N/A ROOF COATING N/A

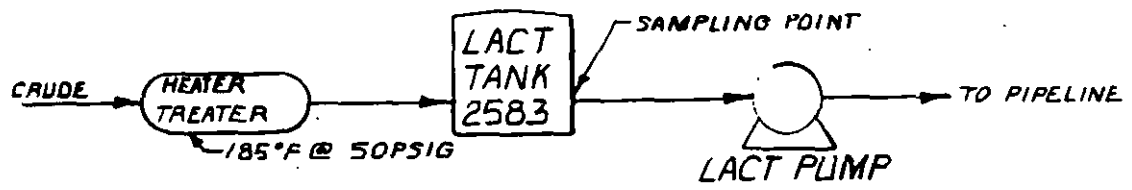
STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 21 ft. 6 in. CONSTRUCTION TYPE BOLTED

CAPACITY 1000 bbls. ROOF SLOPE 1 in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING .86 in. H_2O VACUUM ROOF VENT NORMAL SETTING .86 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME SOUTH MOUNTAIN OIL FIELD SOUTH MOUNTAIN

RVP 3.2 psia API GRAVITY 22.3 °

STOCK COMPOSITION (Mole Percent): CO_2 Trace N_2 .04

CH_4 .20 C_2H_6 .27 C_3H_8 1.02 iC_4 .42 nC_4 1.34 iC_5 .94 nC_5 1.14

C_6 2.17 C_7 PLUS 92.46 DENSITY OF C_7 PLUS .9077 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 294 lb/lb-mole API GRAVITY OF C_7 PLUS 24.2 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This tank normally filled continuously with the level varying from 4 feet to 7 feet as the LACT unit pump cycled on and off. The vapor recovery system was shut off 72 hours prior to the test. Vapor flows are corrected to standard temperature. Hydrocarbon emissions for each day were calculated from the following bag samples: 4/19 (1310 bag); and 4/20 (0900 bag). The entire test was conducted with the vapor condensate system and refrigeration unit in operation with a total of 67 lbs of condensate collected throughout the test.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION TEXACO 2583

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/19	1000	9.001	6.990	13.693	16.326	6.683	4.041	4.922	3.038	1.247	.094	0	0	0	66.034	41.00
4/19	0830	7.801	5.850	14.746	16.361	5.970	3.610	4.491	2.569	.731	.066	0	0	0	62.194	41.61
4/19	1310	5.374	6.269	17.235	17.934	7.115	3.943	5.063	3.147	1.244	.336	.168	0	0	67.828	45.88
4/19	1600	8.551	7.351	13.833	17.239	6.732	3.816	4.805	2.752	.966	.291	.038	0	0	66.371	41.30
4/19	1700	8.160	6.901	13.622	14.816	6.376	3.540	4.345	2.499	.891	.323	.042	0	0	61.514	40.84
4/19	2100	11.384	7.342	13.402	16.839	6.424	3.074	2.203	1.968	.505	.284	0	0	0	62.926	36.74
4/20	0900	8.223	7.782	14.777	17.183	6.901	3.836	2.799	2.438	.872	.505	0	0	0	65.315	40.77
4/20	1600	6.408	5.696	11.748	14.081	5.874	3.222	4.072	2.421	.899	.276	0	0	0	54.697	42.50

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/19	0900	2400	480	480	10.5	74	50	120	N/A	4037	1296	304	304	35	442
4/20	0000	2400	464	464	10.5	67	42	120	N/A	8128	1467	372	175	68	542

NOTE: PARTIAL DAY OF TEST FOR 4/19

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER TEXACO, INC. OPERATOR TEXACO, INC.

LOCATION CARSON TANK IDENTIFICATION OR NUMBER 80034

TANK OPERATION BATCH MODE DURING TEST STANDING STORAGE

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1926 MANUFACTURER WESTERN PIPE AND STEEL

COLOR OF WALL BLACK COLOR OF ROOF BLACK PAINT CONDITION GOOD

INSULATION NONE THICKNESS 0 in. WALL COATING NONE ROOF COATING NONE

STRAIGHT WALL HEIGHT 40 ft. 9 in. DIAMETER 117 ft. 2 in. CONSTRUCTION TYPE RIVETED

CAPACITY 79,840 bbls. ROOF SLOPE 1.5 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING .87 in. H_2O VACUUM ROOF VENT NORMAL SETTING .87 in. H_2O

PROCESS SCHEMATIC DURING TEST

N/A

STOCK PARAMETERS

TYPE DISTILLATE COMMON NAME DIESEL FLASH POINT 165 °F

REFLUX METHOD

PRESSURE, mmHg	TEMP. °C
200	156
300	172
400	184
500	194
600	202
758	214

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Texaco would allow only 0.5" (W.C.) pressure and 0.5" (W.C.) vacuum to be placed on the tank. For this reason, the test had to be conducted manually without the use of one-way valves. The pressure relief valve opened during the test on March 4 and as a result, that day's data were voided. Successful tests were obtained on March 5 and 6. Positive flows were corrected to standard temperature.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION TEXACO 80034

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
3/4	1500	1.348	0	0	0	0	0	0	.017	.062	.113	.025	0	0	1.566	18.2
3/5	0900	0	0	0	0	0	0	.021	.046	.047	.054	.042	.015	0	.224	135.0
3/6	0700	.087	.033	.005	.003	.002	.013	.031	.029	.018	.016	.005	0	0	.242	31.5
3/6	1200	.082	.029	.006	.003	.003	.003	.021	.062	.064	.074	.043	.010	0	.401	71.1
3/7	0700	.165	.033	.014	.022	.015	.004	.033	.047	.041	.051	.031	.004	0	.461	37.6

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE 0 in H_2O VACUUM 0 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
3/5	0000	2400	0	0	21.7	73	39	66	239	27210	7200	18900	3500	2.5	12.0
3/6	0000	2400	0	0	21.7	76	39	66	386	25680	6600	18900	3700	2.3	11.3

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER TEXACO OPERATOR TEXACO

LOCATION SANTA MARIA/BRADLEY TANK IDENTIFICATION OR NUMBER TX 2-5024

TANK OPERATION LACT MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1972 MANUFACTURER TRICO SUPERIOR

COLOR OF WALL ALUMINUM (DIFF) COLOR OF ROOF BLACK PAINT CONDITION N/A

INSULATION URETHANE ALUMINUM JACKET THICKNESS 1 in. WALL COATING N/A ROOF COATING N/A

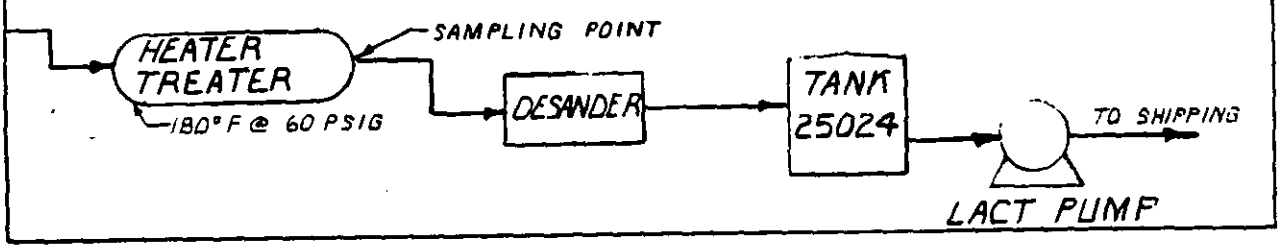
STRAIGHT WALL HEIGHT 16 ft. 1 in. DIAMETER 21 ft. 6 1/2 in. CONSTRUCTION TYPE BOLTED

CAPACITY 1000 bbls. ROOF SLOPE 0.51 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 0.86 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0.86 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME SANTA MARIA CRUDE OIL FIELD SANTA MARIA

RVP 1.3 psia API GRAVITY 11.9 °

STOCK COMPOSITION (Mole Percent): CO_2 .03 N_2 .17

CH_4 1.5 C_2H_6 .19 C_3H_8 .56 iC_4 .26 nC_4 .77 iC_5 .68 nC_5 .59

C_6 .60 C_7 PLUS 94.65 DENSITY OF C_7 PLUS .9856 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 460 lb/lb-mole API GRAVITY OF C_7 PLUS 12.5 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This tank normally filled continuously with the level varying between a high of 4'5" (LACT pump on), and a low of 3'11". This tank was not connected into a vapor recovery system. Vapor flows are corrected to standard temperature. Total hydrocarbon and methane mass emission rates were calculated using corrected flow rates and the highest daily concentration from the bags. The entire test was conducted with the vapor condensate system and refrigeration unit in operation with a total of 264 lbs of condensate collected throughout the test.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION TX 2-5024

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/21	1710	7.69	2.136	7.499	13.914	8.544	6.212	5.02	2.563	1.104	.365	.098	0	0	55.144	44.66
4/22	1100	9.547	2.779	9.088	17.925	14.249	8.091	6.644	4.114	1.550	.603	.166	0	0	74.756	46.34
4/22	1225	10.972	1.425	4.002	5.002	4.097	3.260	4.043	7.926	8.941	1.763	.011	0	0	51.442	43.06
4/22	1635	9.832	1.852	5.903	10.005	7.516	5.112	4.667	2.405	1.371	.686	.312	0	0	49.660	40.41
4/22	1605	8.265	1.852	5.419	9.004	6.662	4.649	4.444	2.485	1.256	.517	.169	0	0	44.721	41.35
4/23	1030	8.094	2.707	8.504	16.841	13.608	7.267	5.201	2.262	.855	.214	.078	0	0	65.632	45.88
4/23	1445	6.783	2.351	7.920	16.341	14.178	7.748	6.259	2.877	.962	.062	0	0	0	65.481	48.73
4/24	1200	8.265	1.852	6.170	11.506	9.903	.659	4.987	1.639	.579	0	0	0	0	45.559	40.38
4/24	1606	7.267	1.781	6.420	12.256	11.257	7.873	7.214	3.598	1.443	.125	0	0	0	59.233	48.09
4/24	0936	9.482	1.813	6.136	11.341	9.552	6.554	5.726	2.893	1.348	.436	.147	.017	0	55.445	42.94
4/24	1440	8.367	2.287	7.098	13.756	11.853	6.826	4.698	1.307	.174	0	0	0	0	56.364	43.41
4/25	0915	10.415	1.926	4.091	4.758	3.873	1.980	3.161	1.507	.856	.535	.446	0	0	33.549	32.81

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/22	0100	2400	380	380	12	71	42	128	N/A	14807	4723	90		146	1140
4/23	0100	2400	406	406	12	80	36	125	N/A	19984	4707	205		165	1337
4/24	0100	2400	415	415	12	73	36	120	N/A	7824	564	185		57	472

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER TEXACO OPERATOR TEXACO

LOCATION Dodge-Ardantz/Santa Maria TANK IDENTIFICATION OR NUMBER TX2-5267

TANK OPERATION LACT MODE DURING TEST Working

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1974 MANUFACTURER TRICO SUPERIOR

COLOR OF WALL ALUMINUM (DIFF COLOR OF ROOF RED PAINT CONDITION POOR

INSULATION URETHANE THICKNESS 1 in. WALL COATING EPOXY ROOF COATING NONE
ALUMINUM JACKET

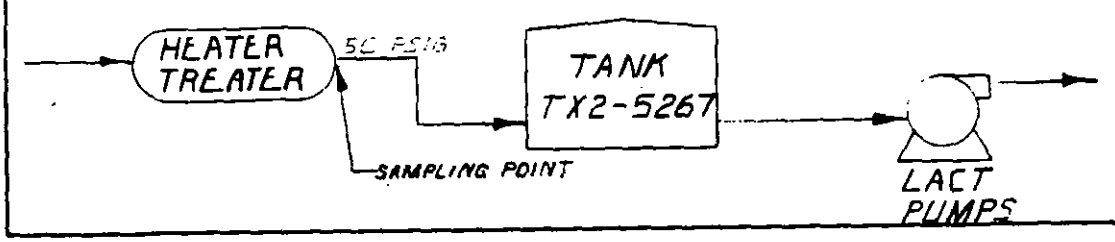
STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 21 ft. 6-1/2 in. CONSTRUCTION TYPE BOLTED

CAPACITY 1000 bbls. ROOF SLOPE 0.51 in./ft. INTERNAL HEATER TYPE STEAM

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NO

PRESSURE ROOF VENT NORMAL SETTING 0.86 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0.86 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME SANTA MARIA CRUDE OIL FIELD SANTA MARIA

RVP 0.7 psia API GRAVITY 9.90 °

STOCK COMPOSITION (Mole Percent): CO_2 .39 N_2 .14

CH_4 .49 C_2H_6 .03 C_3H_8 .07 iC_4 .25 nC_4 .22 iC_5 .67 nC_5 .14

C_6 .19 C_7 PLUS 97.41 DENSITY OF C_7 PLUS .9924 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 494 lb/lb-mole API GRAVITY OF C_7 PLUS 10.90

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This tank normally filled continuously with the level varying between a high of 6.45 feet and a low of 6.25 feet. This tank is not connected into a vapor recovery system. Vapor flows were corrected to standard temperature and also for condensate. The amount of condensate was determined using the vapor condensate system and refrigeration unit since the tank was heated. Calculated total hydrocarbon and methane emissions were determined from the following bag samples: 4/26 (1000 bag); and 4/26 (1720 bag). Data obtained on 4/27 were deemed void due to loss of pressure in the system by a faulty P/V valve.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** TX 2-5267

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/26	1000	.891	.160	.643	5.715	9.411	7.806	8.199	17.034	23.847	15.43	6.773	2.852	.962	99.732	101.20
4/26	1430	0	0	0	.236	.535	1.372	2.656	2.763	2.941	1.167	.463	.062	0	12.195	108.36
4/27	1720	1.566	.241	1.071	8.113	12.222	9.743	6.782	5.886	4.476	2.668	2.109	1.377	.947	58.202	76.55
4/27	1620	.258	.086	.306	1.178	1.541	1.610	2.685	3.081	3.030	2.048	1.205	.456	.181	17.666	93.29
4/27	1740	0	.027	.032	.325	.508	.488	.497	.602	.405	.271	.323	.284	0	3.762	96.57

TEST SUMMARY **ONE WAY VALVE SETTING:** PRESSURE _____ in H_2O VACUUM _____ in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/26	0000	2400	503	503	10.2	68	47	195	413	4413	538	2908	N/A	4.0	444
4/28	0100	2400	375	375	10.2	64	43	193	N/A	562	54	2813	N/A	0.9	33

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER UNION OIL CO. OPERATOR UNION

LOCATION WELDON CANYON TANK IDENTIFICATION OR NUMBER 6761

TANK OPERATION BATCH MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1951 MANUFACTURER SUPERIOR TANK

COLOR OF WALL ALUMINUM(SPECULAR) COLOR OF ROOF ALUMINUM(SPECULAR) PAINT CONDITION FAIR

INSULATION NONE THICKNESS - in. WALL COATING NONE ROOF COATING NONE

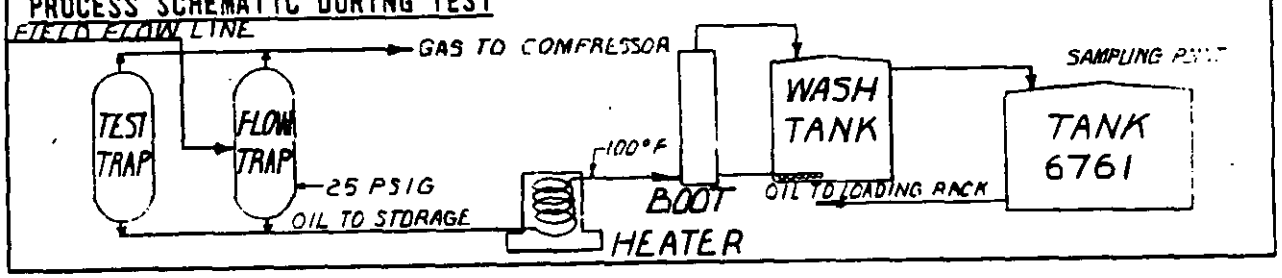
STRAIGHT WALL HEIGHT 16 ft. 0 in. DIAMETER 22 ft. 0 in. CONSTRUCTION TYPE BOLTED

CAPACITY 1000 bbls. ROOF SLOPE 1.58 in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION N/A

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0.5 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME VENTURA LIGHT CRUDE OIL FIELD OJAI FIELD-WELDON CANYON

RVP 4.6 psia API GRAVITY 29.2 °

STOCK COMPOSITION (Mole Percent): CO_2 0.05 N_2 0.05

CH_4 0.05 C_2H_6 0.08 C_3H_8 1.24 iC_4 0.61 nC_4 3.27 iC_5 2.38 nC_5 2.45

C_6 5.11 C_7 PLUS 84.71 DENSITY OF C_7 PLUS 0.8975 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 248 lb/lb-mole API GRAVITY OF C_7 PLUS 26.0 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

During the test, tank gaugings indicated a steady 80 bbl/day flow into the tank. Hydrocarbon losses from the tank were therefore computed based on the liquid flow into the tank. No leaks could be found; however, there were obviously leaks in the system since very low flows were metered.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** UNION 6761

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/12	1505	.450	1.124	11.47	20.39	8.714	3.499	3.248	1.701	.562	.267	0	0	0	51.431	57.70
4/12	1505	.424	1.148	11.22	20.38	7.981	3.156	2.912	1.478	.380	.108	0	0	0	49.198	57.02
4/12	1505	.259	.806	9.68	16.70	6.515	2.482	2.282	1.138	.336	.116	0	0	0	40.315	57.18
4/16	1210	3.051	4.550	11.73	22.21	8.118	2.547	2.120	1.047	.278	.116	0	0	0	55.784	47.87
4/17	1355	7.801	4.050	16.67	20.97	7.051	2.377	1.960	.846	.122	0	0	0	0	61.861	40.88
4/13	1237	.308	1.034	13.51	18.01	5.939	2.151	1.883	.880	.192	.082	0	0	0	44.001	54.60
4/13	1349	.220	.990	13.12	18.58	6.379	2.179	1.925	.917	.206	.041	0	0	0	44.565	55.23
4/14	1215	3.959	3.189	13.22	19.82	7.039	2.433	2.076	.907	.186	.014	0	0	0	52.847	45.96

TEST SUMMARY **ONE WAY VALVE SETTING: PRESSURE** 0.86 in H_2O **VACUUM** 0.86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT*		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/12	0000	2400	80	0	135	82	50	63	N/A	450	0	0	0	0.2	23*
4/13	0000	2400	80	0	125	84	46	62	349	450	0	0	0	0.1	20*

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER UNION OIL CO. OPERATOR UNION

LOCATION SNYDER LEASE TANK IDENTIFICATION OR NUMBER 8826

TANK OPERATION LACT MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1965 MANUFACTURER SUPERIOR

COLOR OF WALL AL (DIFFUSE) COLOR OF ROOF AL (DIFFUSE) PAINT CONDITION FAIR

INSULATION NO THICKNESS ___ in. WALL COATING NONE ROOF COATING NONE

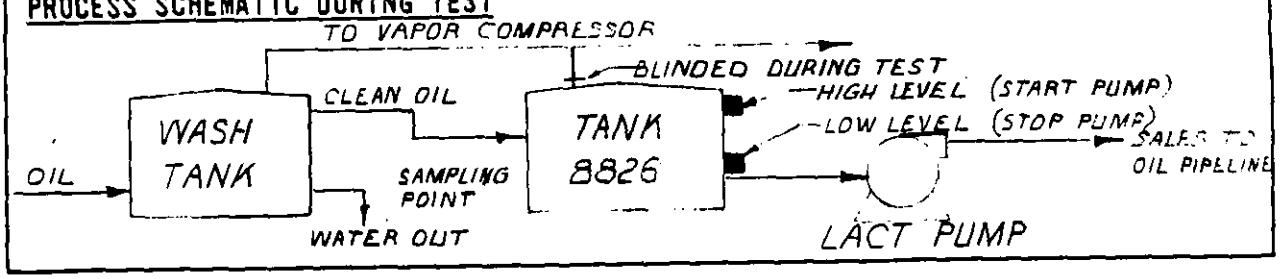
STRAIGHT WALL HEIGHT 8 ft. 0 in. DIAMETER 15 ft. 5 in. CONSTRUCTION TYPE BOLTED

CAPACITY 250 bbls. ROOF SLOPE 1.6 in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION HYDROCARBONS

PRESSURE ROOF VENT NORMAL SETTING 1 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0.5 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME VENTURA LIGHT OIL FIELD SOUTH MOUNTAIN

RVP 4.4 psia API GRAVITY 28.2 °

STOCK COMPOSITION (Mole Percent): CO_2 0.01 N_2 N.D.

CH_4 0.25 C_2H_6 0.23 C_3H_8 1.05 iC_4 0.59 nC_4 2.01 iC_5 1.59 nC_5 2.05

C_6 4.16 C_7 PLUS 88.06 DENSITY OF C_7 PLUS 0.8837 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 281 lb/lb-mole API GRAVITY OF C_7 PLUS 28.5 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

This tank normally filled continuously during the day and then the oil was shipped during one hour at night. The tank level varied from approximately 2 feet to 5 feet. The vapor recovery unit was disconnected at least 24 hours prior to conducting the test. Vapor flows are corrected to standard temperature. Hydrocarbon emissions for the period 4/6 through 4/11 were calculated from bags taken throughout this period. It was assumed that the same volume of vapor was escaping as the amount of oil turned over in a day.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS — TANK IDENTIFICATION UNION 8826

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/7	0400	.224	1.513	4.853	7.214	2.886	1.282	1.268	.462	.035	0	0	0	0	19.739	53.30
4/6	2000	.112	.729	4.617	5.837	1.366	.953	1.289	.539	.077	0	0	0	0	15.519	54.55
4/7	0935	.403	2.130	8.552	10.625	3.811	1.478	1.667	.743	.130	0	0	0	0	29.538	52.11
4/7	1345	.246	1.457	7.608	8.526	3.447	1.506	1.604	.652	.095	0	0	0	0	25.141	53.41
4/8	2245	.560	1.906	9.444	10.887	4.063	.904	1.709	.771	.105	0	0	0	0	30.349	51.33
4/9	1445	.673	2.242	9.444	10.887	4.231	1.871	1.934	.785	.112	0	0	0	0	32.178	51.46
4/10	1455	.476	1.962	8.657	10.297	4.288	.963	2.018	.855	.154	0	0	0	0	29.670	52.25
4/10	1555	.729	2.460	10.100	11.937	4.876	1.310	2.256	.953	.203	.007	0	0	0	34.836	51.45
4/11	0845	.701	1.962	8.920	10.166	4.091	1.850	1.948	.869	.189	.005	0	0	0	30.699	51.79

TEST SUMMARY — ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
4/6-4/1	0000	2400	106	106	4.5	80	50	65	N/A	595	25	466	300	0.4	21

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER UNION OIL COMPANY OPERATOR UNION OIL COMPANY

LOCATION PLACENTIA TANK IDENTIFICATION OR NUMBER 10001

TANK OPERATION CONTINUOUS MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1928 MANUFACTURER UNKNOWN

COLOR OF WALL ALUMINUM (DIFFUSE) COLOR OF ROOF ALUMINUM (DIFFUSE) PAINT CONDITION N/A

INSULATION NONE THICKNESS N/A in. WALL COATING N/A ROOF COATING N/A

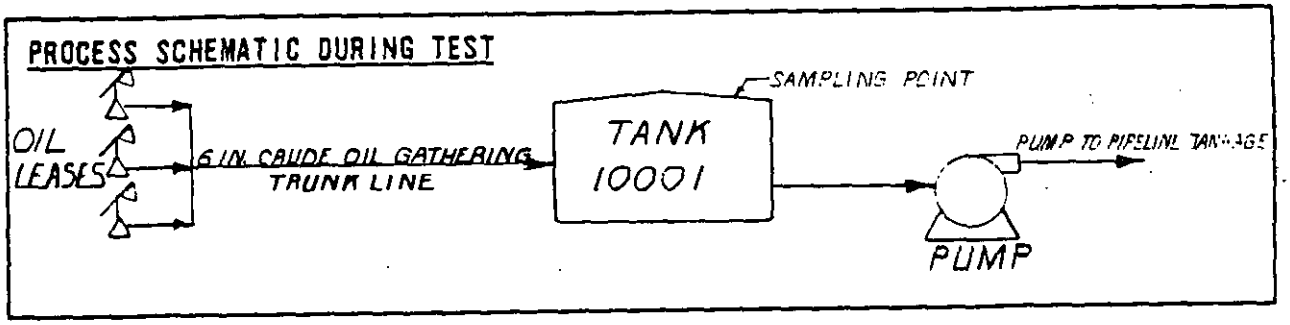
STRAIGHT WALL HEIGHT 29 ft. 6 in. DIAMETER 48 ft. 0 in. CONSTRUCTION TYPE N/A

CAPACITY 9500 bbls. ROOF SLOPE 0.5 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 0.86 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0.86 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME UNKNOWN OIL FIELD RICHFIELD

RVP 0.8 psia API GRAVITY 21 °

STOCK COMPOSITION (Mole Percent): CO_2 .01 N_2 14

CH_4 - C_2H_6 .02 C_3H_8 .28 iC_4 .29 nC_4 .21 iC_5 .83 nC_5 .42

C_6 1.00 C_7 PLUS .9630 DENSITY OF C_7 PLUS .9264 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 320 lb/lb-mole API GRAVITY OF C_7 PLUS 21.1 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

The mass rates of total hydrocarbons and methane emissions were computed from metered volumes corrected for temperature and hydrocarbon concentrations.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** UNION OIL 10001

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
1/21		.142	.254	1.612	3.799	.051	.700	1.990	1.023	1.117	3.000	0	0	0	13.669	
1/21		.156	.280	1.433	.069	2.579	.856	2.568	.186	.990	.173	0	0	0	6.611	
1/21		.072	.195	.718	1.231	0.941	.312	.865	.204	.213	.081	0	0	0	4.832	
1/21		.146	.235	1.349	3.604	1.960	3.604	0.604	1.687	.835	.586	.306	0	0	11.312	
1/21		.137	.164	1.220	2.916	1.923	.604	1.687	.864	.459	1.969	0	0	0	11.943	
1/21		.188	.308	.172	3.546	2.583	.792	2.323	1.746	1.075	.578	.341	0	0	13.652	

TEST SUMMARY **ONE WAY VALVE SETTING: PRESSURE** 0.0 in H_2O **VACUUM** 0.0 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
1/21	0000	2400	2460	2000	16	72	54	85	N/A	7783	N/A	4600	N/A	1.1	106

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER UNION OIL CO. OPERATOR UNION OIL

LOCATION ORCUTT PUMP STATION TANK IDENTIFICATION OR NUMBER 37402

TANK OPERATION CONTINUOUS MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION 1910 MANUFACTURER UNKNOWN

COLOR OF WALL TAN COLOR OF ROOF TAN PAINT CONDITION GOOD

INSULATION NONE THICKNESS ___ in. WALL COATING NONE ROOF COATING NONE

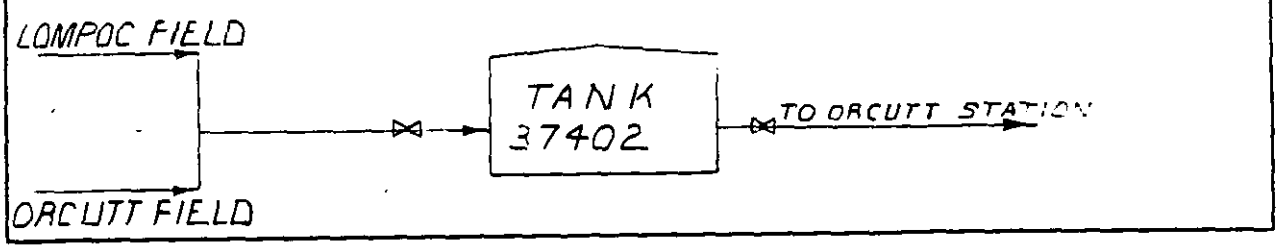
STRAIGHT WALL HEIGHT 30 ft. 0 in. DIAMETER 95 ft. 0 in. CONSTRUCTION TYPE RIVETED

CAPACITY 38354 bbls. ROOF SLOPE 5/8 in./ft. INTERNAL HEATER TYPE NONE

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION NONE

PRESSURE ROOF VENT NORMAL SETTING 0.86 in. H_2O VACUUM ROOF VENT NORMAL SETTING 0.86 in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME ORCUTT LOMPOC MIX OIL FIELD ORCUTT/LOMPOC

RVP 2.3 psia API GRAVITY 23.9 °

STOCK COMPOSITION (Mole Percent): CO_2 0.02 N_2 0.08

CH_4 0.02 C_2H_6 0.03 C_3H_8 0.29 iC_4 0.18 nC_4 0.83 iC_5 0.67 nC_5 1.58

C_6 2.67 C_7 PLUS 93.63 DENSITY OF C_7 PLUS .9156 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 272 lb/lb-mole API GRAVITY OF C_7 PLUS 22.9 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Flow data for Jan. 26 and Jan. 28 corrected to standard temperature. Data for Jan 27 voided due to P/V relief valve releasing pressure during day. During the testing, the level in the tank did not vary by more than one foot as the input stream from the oil leases was approximately equal to the output stream to the Orcutt pump station.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS **TANK IDENTIFICATION** UNION 37402

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
1/26		.001	.002	.116	.234	3.902	.039	.152	.180	.223	.049	0	0	0	4.898	77.625
1/26	0200	.198	.239	1.623	3.204	4.458	.825	2.302	1.595	.453	.109	0	0	0	15.002	79.809
1/26	0500	.178	.137	1.153	2.700	3.550	.957	2.122	1.329	.651	.104	0	0	0	12.881	70.733
1/28	1200	.209	.235	1.747	3.052	4.177	.821	2.303	1.673	.485	.116	0	0	0	14.818	89.626
1/28	0915	.407	.313	1.579	3.409	4.658	.954	2.470	1.587	.407	.034	0	0	0	15.818	79.618
1/26	1500	.001	.024	.315	.350	.205	.091	.216	.121	0	.069	0	0	0	1.391	80.106

TEST SUMMARY **ONE WAY VALVE SETTING:** PRESSURE 0.86 in H_2O VACUUM 0.86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
1/26	0000	2400	4200	2600	24	64	44	60	234	16155	3277	5		3.2	242
1/28	0000	2400	4200	4300	23	61	50	60	174	6733	1561	5630		2.7	107

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

GENERAL

OWNER UNION OIL CO. OPERATOR UNION

LOCATION WELDON CANYON TANK IDENTIFICATION OR NUMBER NONE

TANK OPERATION WASH MODE DURING TEST WORKING

TANK PHYSICAL PARAMETERS

YEAR OF CONSTRUCTION UNKNOWN MANUFACTURER UNKNOWN

COLOR OF WALL BEIGE COLOR OF ROOF BEIGE PAINT CONDITION N/A

INSULATION NONE THICKNESS – in. WALL COATING N/A ROOF COATING N/A

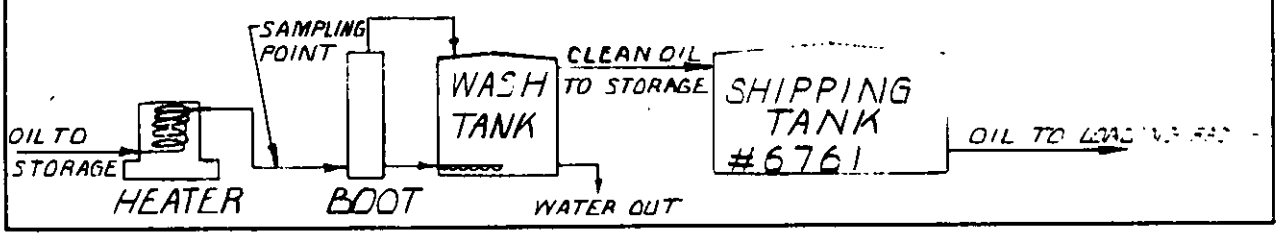
STRAIGHT WALL HEIGHT 12 ft. 0 in. DIAMETER 10 ft. 0 in. CONSTRUCTION TYPE N/A

CAPACITY 1000 bbls. ROOF SLOPE N/A in./ft. INTERNAL HEATER TYPE N/A

VAPOR RECOVERY SYSTEM MAKE UP GAS COMPOSITION N/A

PRESSURE ROOF VENT NORMAL SETTING N/A in. H_2O VACUUM ROOF VENT NORMAL SETTING N/A in. H_2O

PROCESS SCHEMATIC DURING TEST



STOCK PARAMETERS

TYPE CRUDE COMMON NAME VENTURA LIGHT CRUDE OIL FIELD WELDON CANYON

RVP 8.4 psia API GRAVITY 22.3 °

STOCK COMPOSITION (Mole Percent): CO_2 0.28 N_2 0.03

CH_4 0.84 C_2H_6 0.27 C_3H_8 1.94 iC_4 0.69 nC_4 3.30 iC_5 2.13 nC_5 2.21

C_6 3.40 C_7 PLUS 84.91 DENSITY OF C_7 PLUS 0.8937 g/cc.

MOLECULAR WEIGHT OF C_7 PLUS 250 lb/lb-mole API GRAVITY OF C_7 PLUS 26.7 °

GENERAL COMMENTS RELATED TO EMISSIONS DURING TEST

Due to leaks in the tank, no vapor outflow was measured. It was not possible to seal the leaks in the tank. This test was voided due to inability to measure any flow out of the tank.

WOGA FIXED-ROOF TANK EMISSION TEST SUMMARY

TANK VAPOR GRAB SAMPLE ANALYSIS TANK IDENTIFICATION UNION OIL CO

DATE	TIME	HYDROCARBON SPECIES CONCENTRATION (10^{-3} lb/ft^3 gas) @ 77°F														HYDROCARBON MOLECULAR WEIGHT lb/lb-mole
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}^+	TOTAL	
4/14	1330	4.344	4.949	15.984	25.997	8.688	3.361	2.956	1.361	.289	.041	0	0	0	67.971	46.93
4/15	1015	5.114	4.949	17.503	29.086	10.586	3.327	2.763	1.409	.392	.131	0	0	0	75.259	46.75
4/18	0817	7.651	4.275	16.852	20.714	7.426	2.260	1.753	.638	.061	0	0	0	0	61.630	40.81

TEST SUMMARY ONE WAY VALVE SETTING: PRESSURE .86 in H_2O VACUUM .86 in H_2O

DATE	TIME		LIQUID FLOW (bbls)		AVERAGE OUTAGE	AMBIENT TEMP. (°F)		STOCK TEMP.	TOTAL SOLAR INSOLATION, L	GAS FLOW, ft^3 @ 77°F				HYDROCARBON EMISSIONS (lbs/day)	
										OUT		IN			
	START	END	IN	OUT	(ft.)	MAX.	MIN.	°F		TOTAL	MAX.HR.	TOTAL	MAX.HR.	CH_4	TOTAL
	TEST VOIDED														