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SUMMARY OF SOURCE TEST RESULTS

COMPANY: **UNOCAL CORPORATION** APCD #: 304006030

TEST DATE: MAY 14, 1993 UNIT #: COALINGA PUMP STATION IC ENGINE

EMISSIONS	gr/scf	@ 12% CO2	ppm	ppm @ 3% O2	lb/hr		Permit Limits
NOx			2679	2379	17.2		
			2668	2371	17.1		
			2643	2352	17.0		
Mean:			2663	2367	17.1		19.0 lb/hr
CO			19050	5577	74.4		
			18762	5496	73.3		
			18825	5522	73.6		
Mean:			18879	5532	73.8		75.0 lb/hr
NMHC			109		0.24		
			111		0.25		
			113		0.25		
Mean:			111		0.25		0.35 lb/hr

Comments:

For San Joaquin Valley Unified APCD Use Only:

INTRODUCTION

On May 14, 1993, Petro Chem Environmental Services, Inc. (PCES) performed a series of emission tests for Unocal Corporation at their Coalinga Lease located in Coalinga, California. The unit tested was a 767 HP Delaval GSG8 IC engine. Concentrations and emissions of NOx, CO, O_2, and NMHC were determined using the following procedures:

Parameters	Method	# Test Runs
NOx	CARB Method 1-100; Chemiluminescent Thermo Electrode Model 10	3 - 40 minute
CO	CARB Method 1-100; Chemiluminescent Thermo Electrode Model 48	3 - 40 minute
O_2	CARB Method 1-100; Teledyne Fuel Cell 320 AX	3 - 40 minute
Fuel Gas	ASTM Method GC/TCD; O_2, CO_2, N_2, C_1-C_6+	1
NMHC	EPA Method 18; GC-FID	3
Volume Flow	EPA Method 19; F-Factor Analysis and Fuel Rates	3

All testing was performed by Bob Martin of Petro Chem Environmental Services, Inc. The fuel sample and hydrocarbons were analyzed by Terry Rowles of PCES. The operation of the test unit was supervised by Bill Sharrer of Unocal Corporation. Gary Martin was present to witness the testing for San Joaquin Valley Unified APCD.

COMPANY : UNOCAL CORPORATION
UNIT : COALINGA PUMP STATION – IC ENGINE
DATE : 5–14–93
PROJECT : 086–317

RUN #1

NOx/CO/O2 DATA

Stack Gas Measurement Data							
TIME INTERVAL			CONCENTRATIONS			% FULL SCALE	
BEGIN	–	END	O2:%	NOx:ppm	CO:ppm	O2%fs	NOx%fs	CO%fs
10:20 AM	–	10:30 AM	0.73	2689	18788	12.9	63.7	28.7
10:30 AM	–	10:40 AM	0.74	2679	18963	12.9	63.4	28.7
10:40 AM	–	10:50 AM	0.75	2674	19138	12.9	63.2	28.7
10:50 AM	–	11:00 AM	0.77	2674	19313	12.9	63.1	28.7
	Averages:		0.75	2679	19050	12.9	63.4	28.7

Calibration Data	O2	NOx	CO
INITIAL zero	10	10	10
INITIAL span	94	50	39.9
FINAL zero	9.8	9.8	9.9
FINAL span	94	49.8	39.3
ZERO DRIFT %/ppm	–0.05	–10.00	–100
CALIB. DRIFT %/ppm	0.00	–10.01	–600
ZERO DRIFT %fs	–0.20	–0.20	–0.10
CALIB.DRIFT %fs	0.00	–0.20	–0.60
CAL GAS value	20.9	2001	29900
FULL SCALE RANGE	25	5000	100000

DSCFM = 882 (METHOD 19)

	%O2	ppm	@ 3%O2	@15%O2	lb/hr
NOx values:	0.75	2679	2379	784	17.2

	%O2	ppm	@ 3%O2	@15%O2	lb/hr
CO values:	0.75	19050	16920	5577	74.4

COMPANY : UNOCAL CORPORATION
UNIT : COALINGA PUMP STATION - IC ENGINE
DATE : 5-14-93
PROJECT : 086-317

RUN #2

NOx/CO/O2 DATA

Stack Gas Measurement Data							
TIME INTERVAL			CONCENTRATIONS			% FULL SCALE	
BEGIN	-	END	O2:%	NOx:ppm	CO:ppm	O2%fs	NOx%fs	CO%fs
11:08 AM	-	11:18 AM	0.73	2693	18750	12.9	63.7	28.8
11:18 AM	-	11:28 AM	0.73	2668	18775	12.8	63.2	28.8
11:28 AM	-	11:38 AM	0.76	2663	18800	12.8	63.1	28.8
11:38 AM	-	11:48 AM	0.81	2648	18725	12.9	62.8	28.7
	Averages:		0.76	2668	18762	12.9	63.2	28.8

Calibration Data	O2	NOx	CO
INITIAL zero	10	10	10
INITIAL span	94	49.9	40
FINAL zero	9.8	9.9	10
FINAL span	93.8	50	39.9
ZERO DRIFT %/ppm	-0.05	-5.02	0.00
CALIB. DRIFT %/ppm	-0.05	5.02	-99.67
ZERO DRIFT %fs	-0.20	-0.10	0.00
CALIB.DRIFT %fs	-0.20	0.10	-0.10
CAL GAS value	20.9	2001	29900
FULL SCALE RANGE	25	5000	100000

DSCFM = 882 (METHOD 19)

	%O2	ppm	@ 3%O2	@15%O2	lb/hr
NOx values:	0.76	2668	2371	782	17.1

	%O2	ppm	@ 3%O2	@15%O2	lb/hr
CO values:	0.76	18762	16675	5496	73.3

COMPANY : UNOCAL CORPORATION
UNIT : COALINGA PUMP STATION - IC ENGINE
DATE : 5-14-93
PROJECT : 086-317

RUN #3

NOx/CO/O2 DATA

Stack Gas Measurement Data							
TIME INTERVAL			CONCENTRATIONS			% FULL SCALE	
BEGIN	-	END	O2:%	NOx:ppm	CO:ppm	O2%fs	NOx%fs	CO%fs
11:50 AM	-	12:00 PM	0.72	2648	18813	12.8	62.9	28.8
12:00 PM	-	12:10 PM	0.76	2637	18838	12.8	62.6	28.8
12:10 PM	-	12:20 PM	0.81	2646	18763	12.8	62.7	28.7
12:20 PM	-	12:30 PM	0.85	2639	18888	12.8	62.5	28.8
	Averages:		0.78	2643	18825	12.8	62.7	28.8

Calibration Data	O2	NOx	CO
INITIAL zero	10	10	10
INITIAL span	93.9	50	39.9
FINAL zero	9.9	9.9	10
FINAL span	93.3	49.8	39.8
ZERO DRIFT %/ppm	-0.02	-5.00	0.00
CALIB. DRIFT %/ppm	-0.15	-10.01	-100
ZERO DRIFT %fs	-0.10	-0.10	0.00
CALIB.DRIFT %fs	-0.60	-0.20	-0.10
CAL GAS value	20.9	2001	29900
FULL SCALE RANGE	25	5000	100000

DSCFM = 883 (METHOD 19)

	%O2	ppm	@ 3%O2	@15%O2	lb/hr
NOx values:	0.78	2643	2352	775	17.0

	%O2	ppm	@ 3%O2	@15%O2	lb/hr
CO values:	0.78	18825	16752	5522	73.6

COMPANY : UNOCAL CORPORATION
UNIT : COALINGA PUMP STATION - IC ENGINE
DATE : 5-14-93
PROJECT : 086-317

HYDROCARBON RESULTS

RUN No.: 1					
DSCFM: 882					
		ppm	lb/hr	ppm (as Methane)	lb/hr (as Methane)
Methane	(C1)	629	1.40	629	1.40
Ethane	(C2)	42	0.18	84	0.19
Propane	(C3)	7	0.04	21	0.05
Butane	(C4)	1	0.01	4	0.01
Pentane	(C5)	0	0.00	0	0.00
Hexane	(C6)	0	0.00	0	0.00
	Total	679	1.63	738	1.65
	Total (non methane)	50	0.23	109	0.24

RUN No.: 2					
DSCFM: 882					
		ppm	lb/hr	ppm (as Methane)	lb/hr (as Methane)
Methane	(C1)	653	1.46	653	1.46
Ethane	(C2)	43	0.18	86	0.19
Propane	(C3)	7	0.04	21	0.05
Butane	(C4)	1	0.01	4	0.01
Pentane	(C5)	0	0.00	0	0.00
Hexane	(C6)	0	0.00	0	0.00
	Total	704	1.69	764	1.70
	Total (non methane)	51	0.23	111	0.25

RUN No.: 3					
DSCFM: 883					
		ppm	lb/hr	ppm (as Methane)	lb/hr (as Methane)
Methane	(C1)	705	1.57	705	1.57
Ethane	(C2)	44	0.18	88	0.20
Propane	(C3)	7	0.04	21	0.05
Butane	(C4)	1	0.01	4	0.01
Pentane	(C5)	0	0.00	0	0.00
Hexane	(C6)	0	0.00	0	0.00
	Total	757	1.81	818	1.83
	Total (non methane)	52	0.24	113	0.25

PETRO
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SERVICES, INC.

3207 Antonino Avenue
Bakersfield, California 93308
(805) 327-7300
FAX (805) 327-3459

COMPANY	: UNOCAL	DATE RECEIVED :	5-14-93
DATE	: 5-13,14-93	DATE ANALYZED :	5-15-93
REPORT	: 086-317	DATE REPORTED:	5-18-93

EPA METHOD 18
HYDROCARBON ANALYSIS REPORT

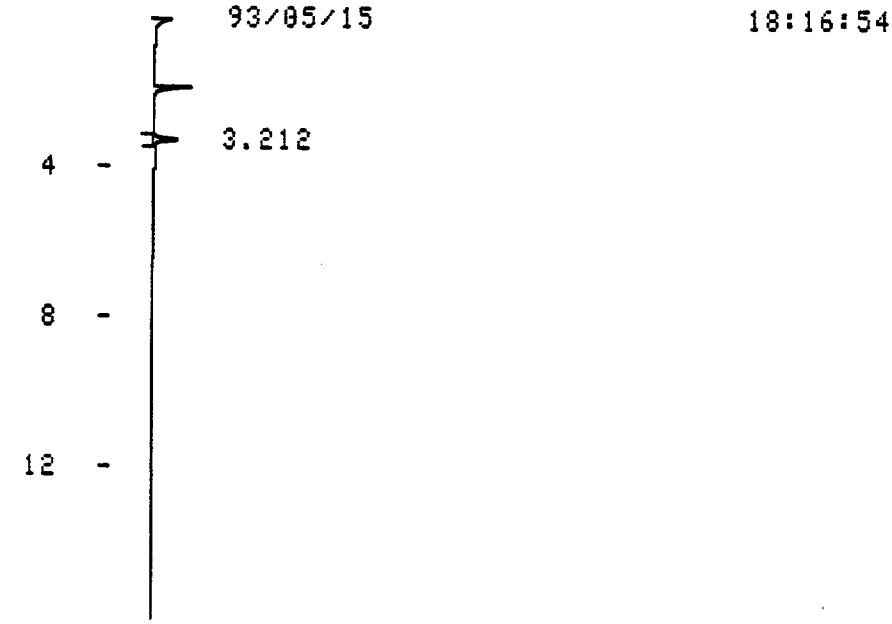
UNIT : COALINGA PLANT I.C. ENGINE (086-317)

CONSTITUENT	RUN # 1 ppm(v/v)	RUN # 2 ppm(v/v)	RUN # 3 ppm(v/v)
METHANE	629.13	652.74	704.59
ETHANE	41.51	42.83	43.87
PROPANE	6.58	6.71	7.12
BUTANE	0.89	1.04	1.10
PENTANE	ND	ND	ND
HEXANES+	ND	ND	ND
TOTAL	678.11	703.32	756.68
NON-METHANE	48.98	50.58	52.09

UNIT : HYDROCARBON SAMPLE BLANK (086-317)

CONSTITUENT	ppm(v/v)
METHANE	6.74
ETHANE	ND
PROPANE	ND
BUTANE	ND
PENTANE	ND
HEXANES+	ND
TOTAL	6.74
NON-METHANE	0.00

UNOCAL UNIT: COALINGA PLANT
5-14-93 PROJECT: 086-317
HC SAMPLE BLANK

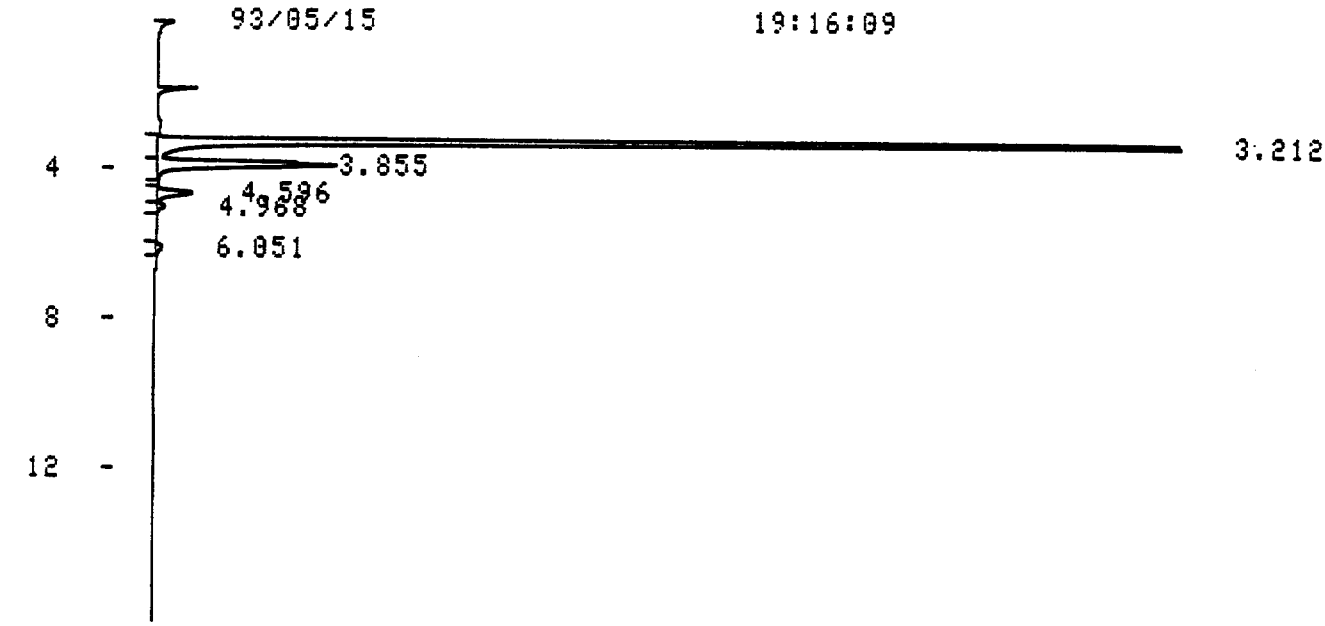


CHROMATOGRAM 23 MEMORIZED

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	3.212	1177		1	6.7391	C-1
	TOTAL	1177			6.7391	

GROUP(NAME)	CONC
C-1	6.7391
C-2	0
C-3	0
C-4	0
C-5	0
C-6+	0

UNOCAL UNIT: COALINGA PLANT
5-14-93 PROJECT: 086-317
HC SAMPLE # 1

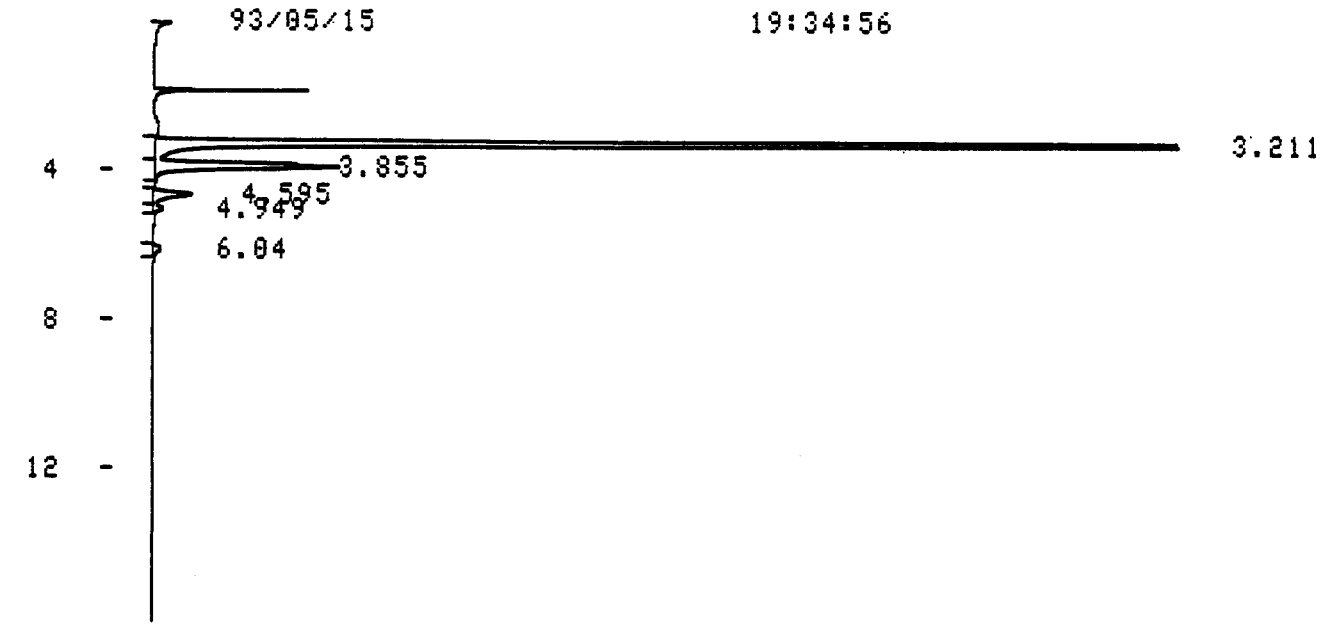


CHROMATOGRAM 24 MEMORIZED

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	3.212	109833		1	629.1277	C-1
2	3.855	14622	V	2	41.5076	C-2
3	4.596	2861		8	5.4208	C-3
4	4.968	613	V	3	1.1621	C-3
5	6.051	617		9	0.892	C-4
	TOTAL	128545			678.1101	

GROUP(NAME)	CONC
C-1	629.1277
C-2	41.5076
C-3	6.5828
C-4	0.892
C-5	0
C-6+	0

UNOCAL UNIT: COALINGA PLANT
5-14-93 PROJECT: 086-317
HC SAMPLE # 2

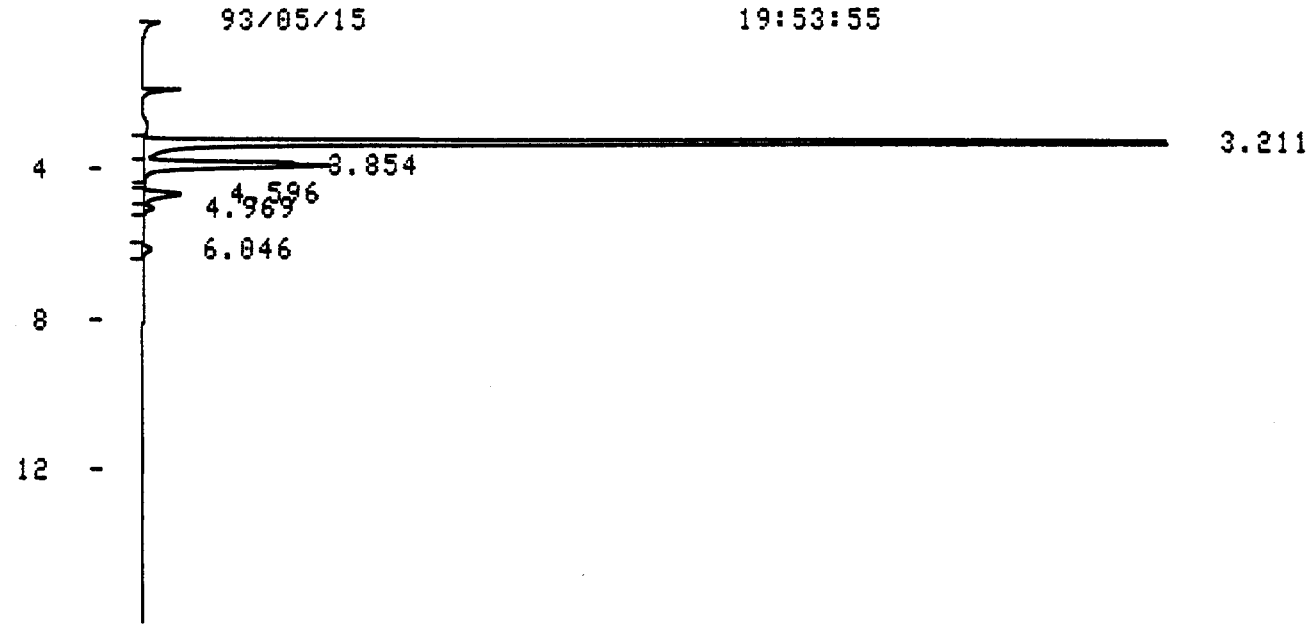


CHROMATOGRAM 25 MEMORIZED

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	3.211	113955		1	652.7421	C-1
2	3.855	15087	V	2	42.829	C-2
3	4.595	2924		8	5.5409	C-3
4	4.949	615	V	3	1.1656	C-3
5	6.04	716		9	1.0355	C-4
	TOTAL	133298			703.3129	

GROUP(NAME)	CONC
C-1	652.7421
C-2	42.829
C-3	6.7065
C-4	1.0355
C-5	0
C-6+	0

UNOCAL UNIT: COALINGA PLANT
5-14-93 PROJECT: 086-317
HC SAMPLE # 3



CHROMATOGRAM 26 MEMORIZED

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	3.211	123006		1	704.5878	C-1
2	3.854	15453	V	2	43.8664	C-2
3	4.596	3051		8	5.7808	C-3
4	4.969	705	V	3	1.336	C-3
5	6.046	764		9	1.1043	C-4
	TOTAL	142979			756.6751	

GROUP(NAME)	CONC
C-1	704.5878
C-2	43.8664
C-3	7.1168
C-4	1.1043
C-5	0
C-6+	0

COMPANY : UNOCAL CORPORATION
UNIT : COALINGA PUMP STATION - IC ENGINE
DATE : 5-14-93
PROJECT : 086-317

METHOD 19
DSCFM CALCULATIONS

RUN #1

SCFM *	100
F @ 60° F	8418
CALORIFIC VALUE, MMBTU/SCF	0.001010
% O2	0.75
DSCFM	882

RUN #2

SCFM *	100
F @ 60° F	8418
CALORIFIC VALUE, MMBTU/SCF	0.001010
% O2	0.76
DSCFM	882

RUN #3

SCFM *	100
F @ 60° F	8418
CALORIFIC VALUE, MMBTU/SCF	0.001010
% O2	0.78
DSCFM	883

* SCFM supplied by Bill Sharrer of UNOCAL.

DSCFM = SCFM * MMBTU/SCF * F FACTOR * (20.9/(20.9-%O2))

PETRO
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3207 Antonino Avenue
Bakersfield, California 93308
(805) 327-7300
FAX (805) 327-3459

COMPANY : UNOCAL
UNIT : COALINGA I.C. ENGINE
DATE : 5-14-93
PROJECT : 086-317

DATE RECEIVED : MAY 17,1993
DATE ANALYZED : MAY 17,1993
DATE REPORTED: MAY 20,1993

FUEL GAS ANALYSIS

CONSTITUENT	MOLE %	WT. %
CARBON DIOXIDE	0.651	1.649
OXYGEN	2.234	4.114
NITROGEN	0.926	1.493
CARBON MONOXIDE	0.000	0.000
METHANE	92.183	85.123
ETHANE	3.374	5.839
PROPANE	0.491	1.246
ISOBUTANE	0.035	0.118
N-BUTANE	0.053	0.176
ISOPENTANE	0.015	0.064
N-PENTANE	0.013	0.056
HEXANES+	0.024	0.121
TOTALS :	100.000	100.000

CHONS Wt.%	
CARBON	70.31
HYDROGEN	22.89
OXYGEN	5.31
NITROGEN	1.49
SULFUR	0.00
H/C	0.326

SPECIFIC GRAVITY (AIR = 1)	0.5999
SPECIFIC VOLUME, cu.ft./lb.	21.85
GROSS CALORIFIC VALUE (DRY), BTU/cu.ft.	1010.45
GROSS CALORIFIC VALUE (WET), BTU/cu.ft.	990.70
GROSS CALORIFIC VALUE (DRY), BTU/lb.	22073.42
NET CALORIFIC VALUE (DRY), BTU/cu.ft.	911.03
NET CALORIFIC VALUE (WET), BTU/cu.ft.	893.22
COMPRESSABILITY FACTOR "Z" @ 60° F, 1 ATM	0.9979
EXPANSION FACTOR (DSCF/CF)	8.51
EPA "F" FACTOR @ 68° F (DSCF/MM BTU)	8546
EPA "F" FACTOR @ 60° F (DSCF/MM BTU)	8418

ASTM METHODS D-1945-81 & D-3588-91

Terry Rowles
Laboratory Manager

CONTINUOUS EMISSION MONITORING SYSTEM (CEMS)

Reference: Manual of Procedures; ST-13A, ST-19A, Jan 1982, State of California, Air Resources Board, Test Methods 1-100, June 1979.
EPA CFR Title 40, Pt. 60, Appendix A, Method 3A, 6C, 7E, & 10.

Instrument Summary

A constant sample of flue gas was extracted, dried, filtered and delivered to an instrument manifold system for distribution to one or more analyzers. Instrument results are recorded on an analog strip chart recorder. System calibration checks are performed as well as calibration checks at the beginning and end of each test run. Final data reduction includes zero and calibration drift corrections.

Sample Conditioning System

Consists of a borosilicate glass tube or 316 grade stainless steel probe fitted with a cindered stainless steel or pyrex glass wool particulate filter. The probe is fitted with a teflon (TFE) sample line which connects to a water condensation system located at the source. The condensation system consists of three 500-ml short stem glass impingers connected in a series, immersed in an ice bath. The gas is delivered to the instrument trailer with a teflon line (3/8" O.D.) through an in-line Balston particulate filter drawn by a teflon-coated diaphragm pump. The sample system is leak checked prior to sampling by plugging the end of the sample probe and adjusting the sample pump to its maximum rate (approximately 22" Hg). The manifold is by-passed and the leak rate monitored through a gas meter or low range flow meter.

Manifold System

Sample gas is delivered to each analyzer through a five way valve and regulated with a needle valve flow meter. Manifold pressure is controlled by a back pressure regulator which is typically set at three psi. Zero gas (N_2) and calibrated gases are delivered to the analyzers using the same five way valve and flow meter. All manifold parts are glass, stainless steel, or teflon materials.

Analog Strip Chart Data Reduction

Analog recordings consists of averaged time increments as shown on the data pages (typically 5,10, or 20 minute increments). Data for each increment was recorded at an average percent of full scale. The readings were then compared with the zero and calibration readings for calculation of the average concentration for each time increment. Any deviation of the zero and calibration readings from the start to the end of a test period was corrected by calculating apparent zero and calibration readings for the mid-point of each time increment. The average concentrations were then calculated from the sample readings and the apparent zero and span readings.

CALIBRATION DRIFT CORRECTION

Strip chart traces will be divided into ten minute intervals; the average reading for that interval being recorded into a spreadsheet along with initial and final calibration values. Using the calibration values, % or ppm drift is then calculated. The drift is divided by the number of time intervals, multiplied by the interval number, and added to that intervals average reading.

CALCULATIONS

PPM DRIFT CALCULATION

$$PPM = \left[\frac{CG}{S_i - Z_i}\right] * (S_f - S_i)$$

CALCULATION FOR CONCENTRATION - DRIFT CORRECTED

$$CONCENTRATION = \left[(FS - Z_i) * \left[\frac{CG}{S_i - Z_i}\right]\right]$$

$$\left[\left[\frac{ZD}{\#I}\right] * (I\# - 0.5)\right] + \left[\left[\frac{CD}{\#I}\right] * (I\# - 0.5)\right]$$

CD = Calibration drift in ppm or %
CG = Calibration gas value in ppm or %
FS = Full scale value in ppm or %
I# = Interval number
#I = Number of intervals
S_f = Final span value in ppm or %
S_i = Initial span value in ppm or %
ZD = Zero drift in ppm or %
Z_i = Initial zero value in ppm or %

CONTINUOUS MONITORING CALCULATIONS
POLLUTANT, PPM @ 3% O2 AND LBS/HR

$$ppm \text{ @ } 3\% \ O_2$$

$$ppm \times \frac{(20.9 - 3)}{(20.9 - ACTUAL\ O_2)}$$

$$\frac{lbs}{hr} = ppm \times MW \times 1.581 \times 10^{-7} \times DSCFM$$

$$MW\ NOx = 46$$
$$MW\ CO = 28$$
$$MW\ SO_2 = 64$$

SAMPLE CALCULATIONS
RUN # #1

DATA INPUT:

NOx, ppm 2679 pg 8 DSCFM 882 pg 19
%O2 0.75 pg 8

Pg 8

$$ppm \text{ @ } 3\% \ O_2$$

$$2679 \times \frac{(20.9 - 3)}{(20.9 - 0.75)} = 2379$$

$$\frac{LBS}{HR},\ POLLUTANT$$

$$2679 \times 46 \times 1.581 \times 10^{-7} \times 882 = 17.18$$

HYDROCARBON EMISSIONS TESTING
EPA METHOD 18 - FID ANALYSIS

SAMPLING PROCEDURES

The sample was drawn via evacuated cannister through a stainless steel/teflon probe into a tedlar bag. Each sample bag was evacuated, and then filled.

ANALYTICAL PROCEDURES

The contents of the tedlar bag was analyzed by gas chromatography. The gas chromatograph was calibrated with an appropriate standard for each carbon #, before and after each set of samples are analyzed. The sample is speciated by carbon #-C_1, C_2, C_3, C_4, C_5, and C_{6+} backflush.

SYMBOL IDENTIFICATION

i = carbon #; i = 1 to 6+
s = refers to standard for that carbon #
Rx_i = response factor for C_i
MW = molecular weight - g/mole
DSCFM = Average volume flow rate of unit tested

EQUATIONS

$$Rx_i = \frac{Area\ std}{ppm\ std}$$

$$Sample\ ppm_i = \frac{1}{Rx_i} \times Area_i$$

$$Sample\ ppm\ (as\ C_1) = Sample\ ppm \times \#\ of\ Carbons$$

$$\frac{lbs}{hr_i} = ppm_i \times MW_i \times DSCFM \times 1.581 \times 10^{-7}$$

$$Total\ non\text{-}methane\ \frac{lbs}{hr} = \sum_{2}^{6+} \frac{lbs}{hr_i}$$

Note 1: If lbs/hr as methane is required, MW will equal 16.0 (MW of methane, CH_4)
Note 2: # of carbons: ethane = 2, propane = 3, etc...

EPA METHOD 19
EPA F-FACTOR

EMISSION FACTOR CALCULATIONS

$$F = \frac{dscf}{MMBtu} = \left[\frac{10^6 \left[3.64\ \%H) + 1.53\ (\%C) + 0.57\ (\%S) + 0.14\ (\%N) - 0.46\ (\%O) \right]}{GCV} \right]$$

Where: GVC = *Gross calorific value of fuel combusted,* $\frac{Btu}{LB}$

$$F_{60°F} = F_{68°F} \times 0.985$$

GENERAL POLLUTANT LB/MMBtu EQUATION

$$E = ppmvd \times F_{60°F} \times C \times \left[\frac{20.9}{20.9 - \%O_2} \right] \times MW$$

Where: $E = \frac{LB}{MMBtu}$

$F_{60°F}$ = *F-FACTOR @ 60° F*

$$C = 2.635 \times 10^{-9}$$

MW = *NOx as 46; CO as 28;* SO_2 *as 64*

COMPANY : UNOCAL

UNIT : 1/C ENGINE COALINGA

DATE : 5-14-93

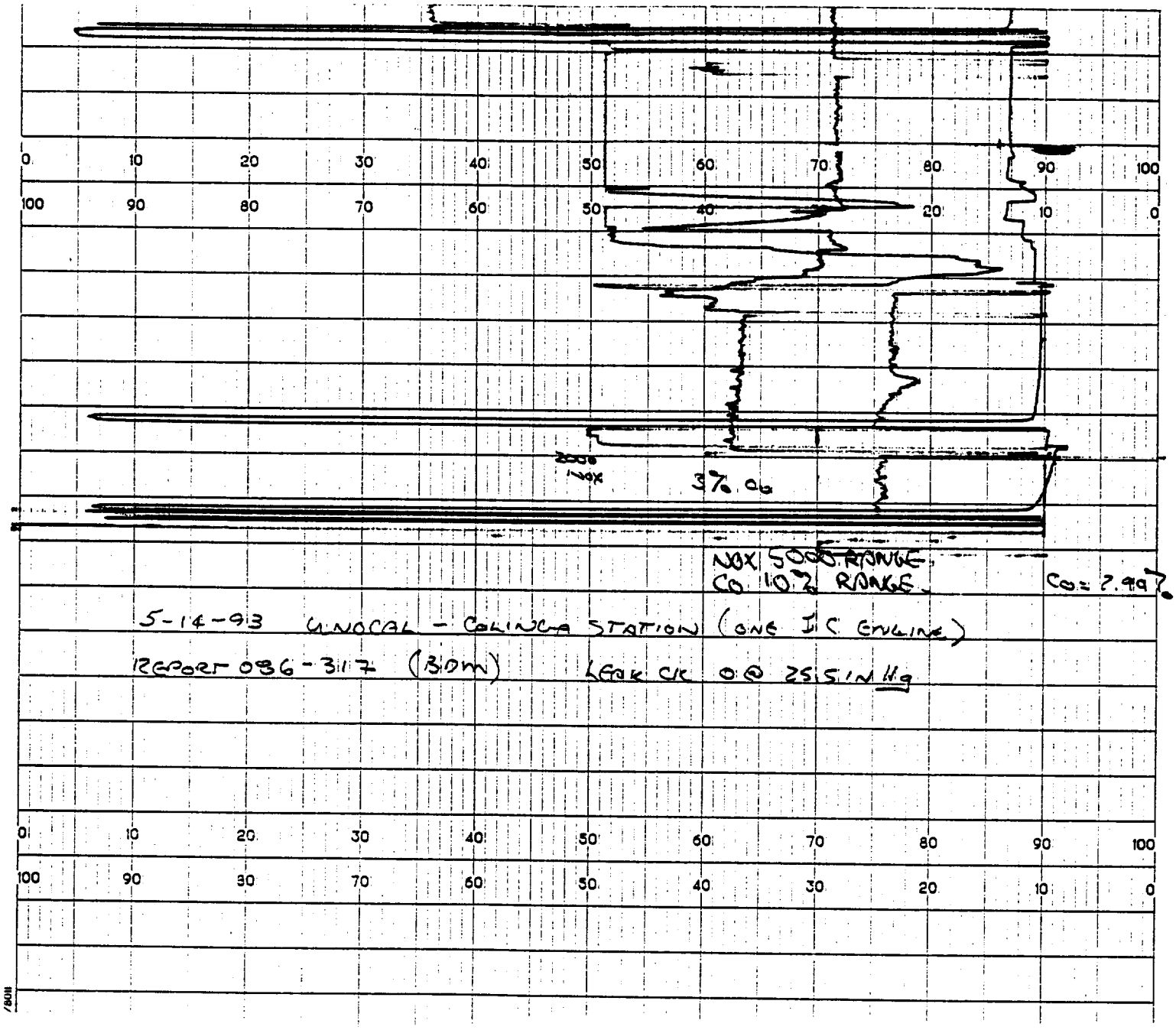
PROJECT : 086-328

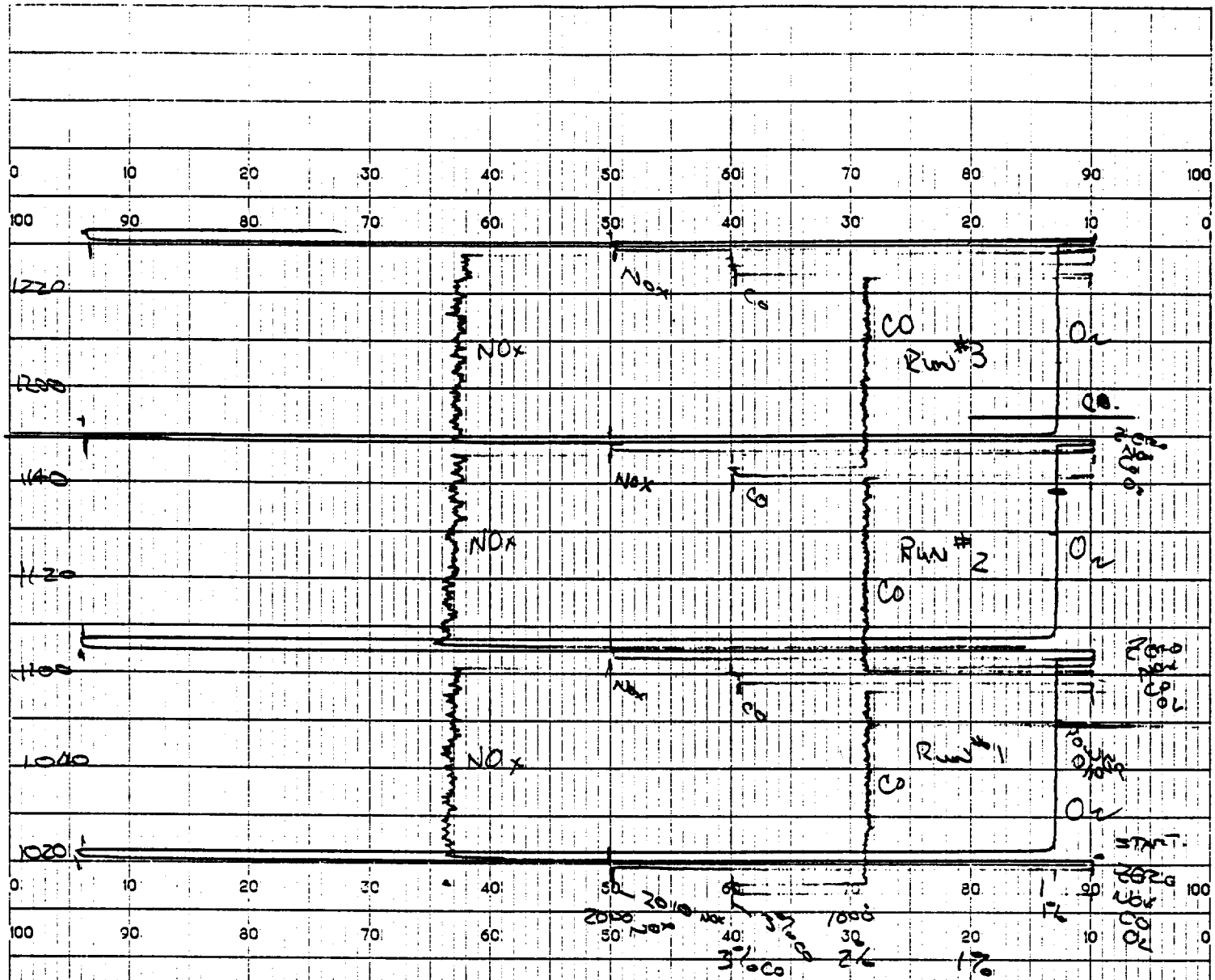
SCFM = ~~10.33~~ 100 per Bill Shaner 5-21-93

	PPM	@15%	LB/HR	DSCFM	% O_2	lb/hr LIMIT.
NOx	1950	570.96	1.389	97.99	0.75	19.00
CO	1800	527.05	0.781	97.99	0.75	75.00
NOx	2700	790.57	1.924	97.99	0.75	19.00
CO	1900	556.33	0.824	97.99	0.75	75.00

WRONG FUEL RATE
SUPPLIED ON SITE
THIS DATA IS IN ERROR

SCFH. ENGINE G-1
RPM 465
PRESS 760 PSIA.


0 10 20 30 40 50 60 70 80 90 100
100 90 80 70 60 50 40 20 10 0
2000 NOX
3% O2
NOX 500 RANGE
CO 10% RANGE
CO = 2.99%
5-14-93 UNOCAL - COLINGA STATION (ONE JC ENGINE)
REPORT 096-3117 (BDM) LEAK CK 0 @ 25.5 IN Hg
0 10 20 30 40 50 60 70 80 90 100
100 90 80 70 60 50 40 30 20 10 0



UNOCAL COALINGA PLANT

5-14-93 LEAK CK 0 @ 26 IN Hg

SCALE:

Nox = 5,000 Nox CAL GAS CC 2010 = 2001 PPM 3/90 mins.

Co = 10% Co CAL GAS ALM 0.0031 3% Co

O_2 = 25%

LINSEIS

PART NO. LO/80H

PRINTED IN U.S.A.

AIRCO

481596

Airco Special Gases
Union Landing & River Roads
P.O. Drawer No. 272
Riverton
New Jersey 08077
Telephones: Marketing; 609-829-7878
Prod. & Admin.; 609-829-7914
International; 609-829-7917

CERTIFICATE OF ANALYSIS - EPA PROTOCOL GAS MIX

CUSTOMER: Bakersfield Welding Supply (Bakersfield Ca)
CYLINDER #: CC-2010
CYLINDER PRESSURE: 1650 psig
LABORATORY: Riverton, NJ
CERTIFICATION DATE: 04-28-92
EXPIRATION DATE: 10-28-93
REFERENCE #: 21273

MIXTURE COMPONENTS	ACTUAL MIXTURE CONCENTRATION	NIST SRM NO.	NIST SRM SERIAL#	NIST SRM CONC.
Nitric Oxide	2001 ppm	2631	FF-18976	2895 ppm
Carbon Monoxide	2028 ppm	2637A	FF-26342	2455 ppm

BALANCE GAS: Nitrogen

COMPONENT 1 GAS ANALYSIS PROCEDURE: Chemiluminescence
MAKE/MODEL/SER#: Beckman/952/0100204
LAST MULTIPOINT CALIBRATION DATE: 04-01-92

COMPONENT 2 GAS ANALYSIS PROCEDURE: Gas Chromatography
MAKE/MODEL/SER#: Varian/3300/3373
LAST MULTIPOINT CALIBRATION DATE: 03-25-92
R=REFERENCE STANDARD Z=ZERO GAS S=SAMPLE GAS

1ST COMPONENT Nitric Oxide
1ST ANALYSIS: DATE 04-15-92 ANALYST: A.Lattanze

1) Z 0001	R 8840	S 6122	CONC (1)	2005 ppm
2) R 8860	Z 0000	S 6133	CONC (2)	2004 ppm
3) R 8862	S 6138	Z 0000	CONC (3)	2005 ppm
			AVE CONC:	2005 ppm

2ND ANALYSIS: DATE: 04-28-92 ANALYST: A.Lattanze

1) Z 0000	R 8440	S 5822	CONC (1)	1997 ppm
2) R 8580	Z 0000	S 5916	CONC (2)	1996 ppm
3) R 8480	S 5853	Z 0000	CONC (3)	1998 ppm
			AVE CONC:	1997 ppm

2ND COMPONENT Carbon Monoxide
1ST ANALYSIS: DATE: 04-09-92 ANALYST: CRC

1) Z 000000	R 120333	S 98946	CONC (1)	2019 ppm
2) R 120114	Z 000000	S 99255	CONC (2)	2029 ppm
3) R 120325	S 99286	Z 000000	CONC (3)	2026 ppm
			AVE CONC:	2025 ppm

2ND ANALYSIS: DATE: 04-16-92 ANALYST: CRC

1) Z 000000	R 119277	S 98467	CONC (1)	2027 ppm
2) R 120239	Z 000000	S 99564	CONC (2)	2033 ppm
3) R 119814	S 99113	Z 000000	CONC (3)	2031 ppm
			AVE CONC:	2030 ppm

THIS CALIBRATION STANDARD HAS BEEN CERTIFIED VERSUS EPA TRACEABILITY PROTOCOL NO. 1, PROCEDURE G1, AND ANALYSES PERFORMED PER SECTION 3.0.4.
CERTIFIED CONCENTRATION: Nitric Oxide= 2001 ppm; Carbon Monoxide= 2028 ppm
Balance= Nitrogen

APPROVED BY J. Lora
LABORATORY MANAGER

Scott Specialty Gases

PLUMSTEADVILLE, PA. 18949 PHONE: 215-766-8861 TWX: 510-665-9344

Date Shipped 1-8-90

Our Project No: 15542

Your P.O. No: 000-00537

Page 3 of 3

PETROCHEM ENV
DIV CAL STATE ELE INC
3207 ANTONIO AVE
BAKERSFIELD CA 93308

CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*

(Concentrations are in mole % or ppm)

Cylinder Number ALM-000319 Certified Accuracy ±1 % NBS Traceable Analysis Dates: First 12-28-89 Last 1-5-90

COMPONENTS	CERTIFIED CONC	EXPIRATION DATE	ANALYTICAL PRINCIPLE	PRIMARY STANDARD NBS/SRM's	REPLICATE CONCENTRATIONS FIRST	SECOND
Carbon Monoxide	2.99%	1-5-91	TCD	2641	2.992%	2.989%
					3.002%	2.988%
					3.001%	2.982%
Nitrogen	Balance					

Cylinder Number _____ Certified Accuracy _____ % NBS Traceable Analysis Dates: First _____ Last _____

COMPONENTS	CERTIFIED CONC	EXPIRATION DATE	ANALYTICAL PRINCIPLE	PRIMARY STANDARD NBS/SRM's	REPLICATE CONCENTRATIONS FIRST	SECOND

*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No: I Procedure G1

Analyst [signature] (for TES) Approved By [signature]

Tom Sassaman Mark S. Sirinides

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

CERTIFIED REFERENCE MATERIALS ■ EPA PROTOCOL GASES ■ ACUBLEND® ■ CALIBRATION & SPECIALTY GAS MIXTURES
PURE GASES ■ ACCESSORY PRODUCTS ■ CUSTOM ANALYTICAL SERVICES

TROY, MICHIGAN / SAN BERNARDINO, CALIFORNIA / HOUSTON, TEXAS / WHEELING, ILLINOIS
SOUTH PLAINFIELD, NEW JERSEY / FREMONT, CALIFORNIA / WAKEFIELD, MASSACHUSETTS / LONGMONT, COLORADO

PETRO
CHEM
ENVIRONMENTAL
SERVICES, INC.

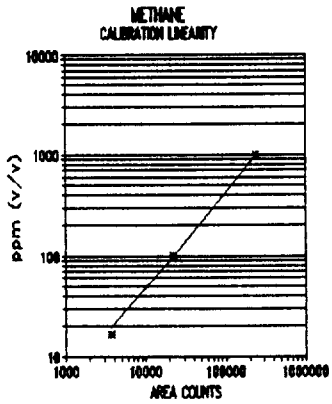
3207 Antonino Avenue
Bakersfield, California 93308
(805) 327-7300
FAX (805) 327-3459

COMPANY	: UNOCAL	DATE RECEIVED :	5-14-93
DATE	: 5-13,14-93	DATE ANALYZED :	5-15-93
PROJECT	: 086-317	DATE REPORTED:	5-18-93

EPA METHOD 18
HYDROCARBON ANALYSIS
CALIBRATION DATA AND STATISTICS

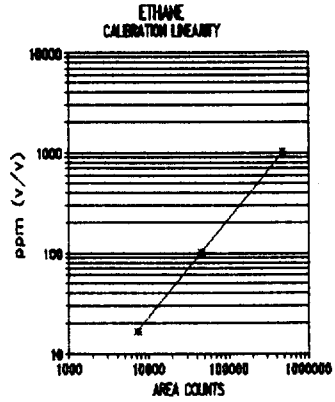
METHANE

CONC. (ppmv)	AREA COUNTS	RESPONSE FACTOR ppmv/AC
16.5	2796	5.90E-03
101	17633	5.73E-03
1000	175950	5.68E-03
	AVERAGE RF	5.77E-03
	STD. DEVIATION	9.40E-05
	RSD%	1.63%



ETHANE

CONC. (ppmv)	AREA COUNTS	RESPONSE FACTOR ppmv/AC
16.5	5500	3.00E-03
101	35579	2.84E-03
1030	360463	2.86E-03
	AVERAGE RF	2.90E-03
	STD. DEVIATION	7.20E-05
	RSD%	2.48%



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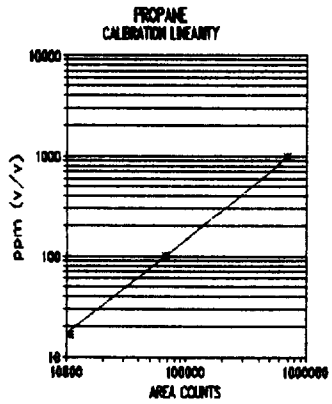
COMPANY: UNOCAL
DATE : 5-13,14-93
PROJECT : 086-317

DATE RECEIVED : 5-14-93
DATE ANALYZED : 5-15-93
DATE REPORTED: 5-18-93

EPA METHOD 18
HYDROCARBON ANALYSIS
CALIBRATION DATA AND STATISTICS

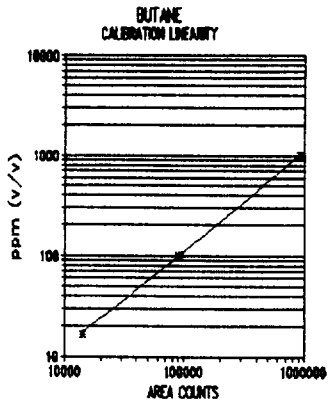
PROPANE

CONC. (ppmv)	AREA COUNTS	RESPONSE FACTOR ppmv/AC
16.5	8256	2.00E-03
100	52774	1.89E-03
1000	540289	1.85E-03
	AVERAGE RF	1.91E-03
	STD. DEVIATION	6.19E-05
	RSD%	3.23%



BUTANE

CONC. (ppmv)	AREA COUNTS	RESPONSE FACTOR ppmv/AC
16.5	11104	1.49E-03
101	69869	1.45E-03
1010	714016	1.41E-03
	AVERAGE RF	1.45E-03
	STD. DEVIATION	2.92E-05
	RSD%	2.02%



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DATE : 5-13,14-93
PROJECT : 086-317

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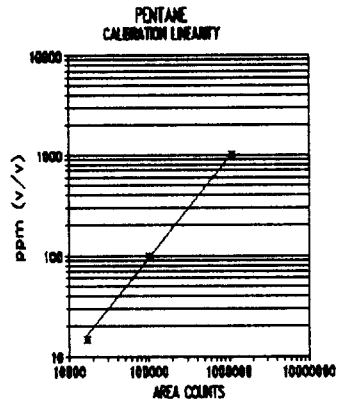
DATE ANALYZED : 5-15-93
DATE REPORTED: 5-18-93

EPA METHOD 18
HYDROCARBON ANALYSIS
CALIBRATION DATA AND STATISTICS

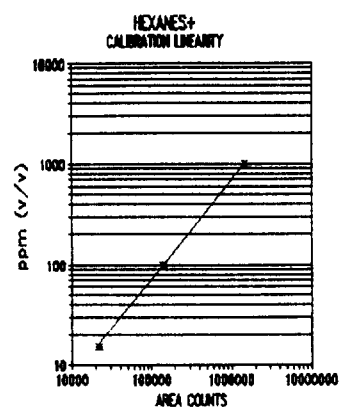
PENTANE

CONC. (ppmv)	AREA COUNTS	RESPONSE FACTOR ppmv/AC
14.8	12712	1.16E-03
99.1	84409	1.17E-03
1020	875381	1.17E-03
	AVERAGE RF	1.17E-03
	STD. DEVIATION	4.41E-06
	RSD%	0.38%



HEXANE

CONC. (ppmv)	AREA COUNTS	RESPONSE FACTOR ppmv/AC
15.2	15846	9.59E-04
100	108117	9.25E-04
1005	1104902	9.10E-04
	AVERAGE RF	9.31E-04
	STD. DEVIATION	2.08E-05
	RSD%	2.23%



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Bakersfield, California 93308
(805) 327-7300
FAX (805) 327-3459

COMPANY: UNOCAL
DATE : 5-13,14-93
PROJECT : 086-317

DATE RECEIVED : 5-14-93
DATE ANALYZED : 5-15-93
DATE REPORTED: 5-18-93

EPA METHOD 18
CALIBRATION DRIFT ANALYSIS

POST ANALYSIS CALIBRATION CHECK (15ppm STD.)

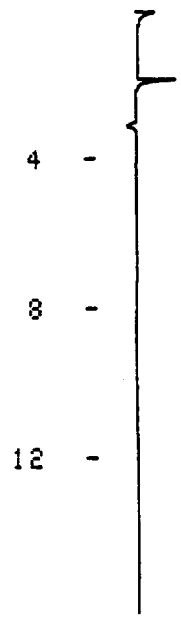
CONSTITUENT	INITIAL RF	POST RF	%DIFF.
METHANE	5.90E-03	6.02E-03	-2.04%
ETHANE	3.00E-03	2.96E-03	1.20%
PROPANE	2.00E-03	1.99E-03	0.60%
BUTANE	1.49E-03	1.51E-03	-1.58%
PENTANE	1.16E-03	1.19E-03	-2.10%
HEXANES+	9.59E-04	9.64E-04	-0.46%

POST ANALYSIS CALIBRATION CHECK (100ppm STD.)

CONSTITUENT	INITIAL RF	POST RF	%DIFF.
METHANE	5.73E-03	5.88E-03	-2.59%
ETHANE	2.84E-03	2.85E-03	-0.45%
PROPANE	1.89E-03	1.90E-03	-0.48%
BUTANE	1.45E-03	1.45E-03	-0.56%
PENTANE	1.17E-03	1.18E-03	-0.55%
HEXANES+	9.25E-04	9.36E-04	-1.22%

SYSTEM BLANK
UHP HELIUM

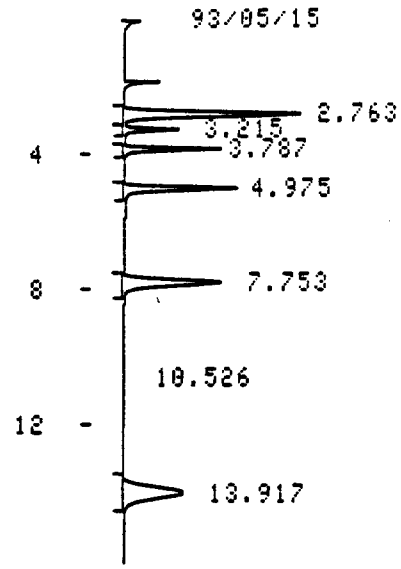
93/05/15 09:00:00



CHROMATOGRAM 1 MEMORIZED
WARNING NO PEAK

15PPm HYDROCARBON STANDARD
SCOTTY CAN MIX 1

93/05/15 11:53:06



CHROMATOGRAM 2 MEMORIZED

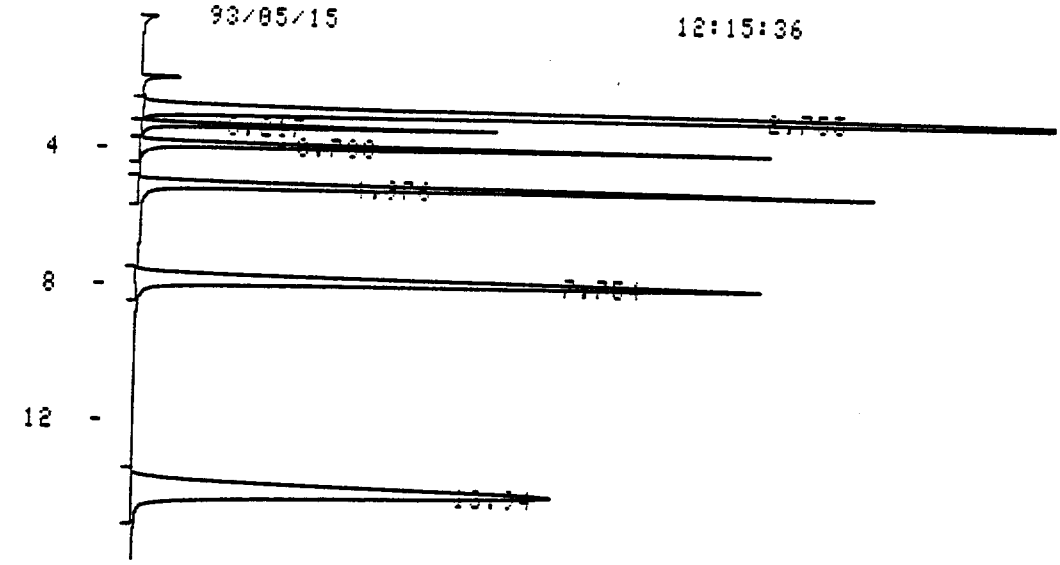
PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	2.763	15846		6		C-6+
2	3.215	2796		1		C-1
3	3.787	5500		2		C-2
4	4.975	8256		3		C-3
5	7.753	11104		4		C-4
6	13.917	12712		5		C-5

	TOTAL	56214				

IDENTIFICATION FILE 0
MODE# 101 WINDOW 3

IDNO	NAME	TIME	FACTOR	CONC
1	C-1	3.2	0.00590034	16.5
2	C-2	3.77	0.00300011	16.5
3	C-3	4.96	0.00199861	16.5
4	C-4	7.74	0.00148589	16.5
5	C-5	13.9	0.00116425	14.8
6	C-6+	2.75	0.000959245	15.2
7	C-2	3.81	0.00300011	16.5
8	C-3	4.3	0.00199861	16.5
9	C-4	5.7	0.00148589	16.5
10	C-4	6.65	0.00148589	16.5
11	C-5	10.24	0.00116425	14.8
12	C-5	10.59	0.00116425	14.8
13	C-5	12.73	0.00116425	14.8
14	C-5	11.3	0.00116425	14.8
15	C-5	15.43	0.00116425	14.8
16	C-5	8.79	0.00116425	14.8
17	C-5	11.82	0.00116425	14.8

100PPm HYDROCARBON STANDARD
SCOTTY CAN MIX 220



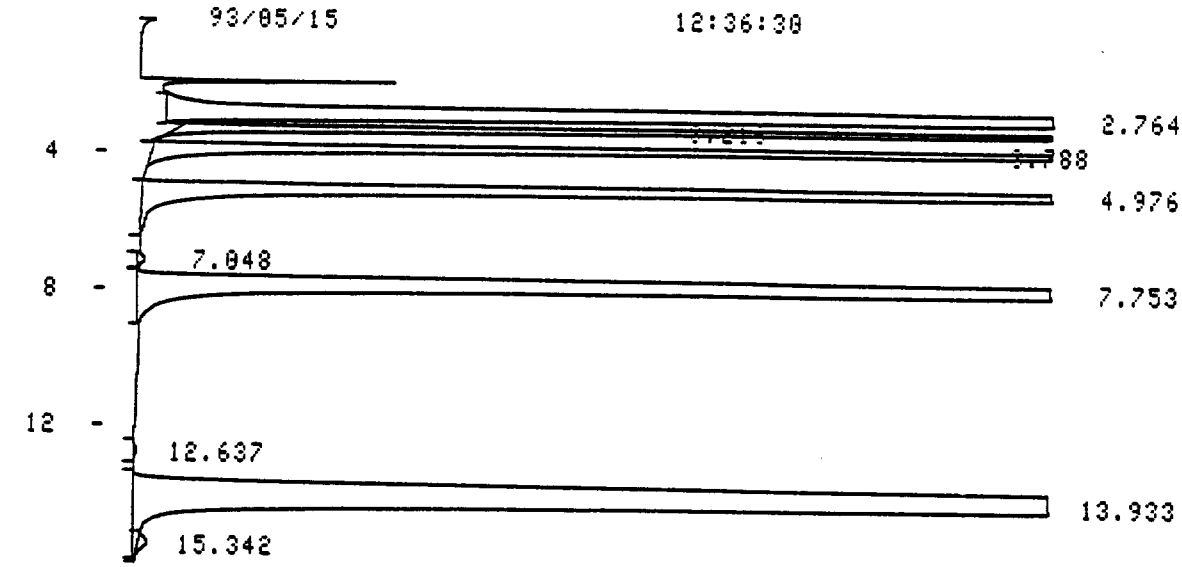
CHROMATOGRAM 3 MEMORIZED

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	2.755	108117		6		C-6+
2	3.217	17633		1		C-1
3	3.788	35579		2		C-2
4	4.976	52774		3		C-3
5	7.754	69869		4		C-4
6	13.94	84409		5		C-5
	TOTAL	368380				

IDENTIFICATION FILE 1
MODE# 101 WINDOW 3

IDNO	NAME	TIME	FACTOR	CONC
1	C-1	3.2	0.00572806	101
2	C-2	3.77	0.00283877	101
3	C-3	4.96	0.00189489	100
4	C-4	7.74	0.00144556	101
5	C-5	13.92	0.00117404	99.1
6	C-6+	2.75	0.000924928	100
7	C-2	4.18	0.00283877	101
8	C-3	4.58	0.00189489	100
9	C-4	6.05	0.00144556	101
10	C-4	7.04	0.00144556	101
11	C-5	10.21	0.00117404	99.1
12	C-5	10.59	0.00117404	99.1
13	C-5	12.71	0.00117404	99.1
14	C-5	11.3	0.00117404	99.1
15	C-5	15.27	0.00117404	99.1
16	C-5	12.19	0.00117404	99.1
17	C-5	11.61	0.00117404	99.1

1000PPm HYDROCARBON STANDARD
SCOTTY CAN MIX 224



CHROMATOGRAM 4 MEMORIZED

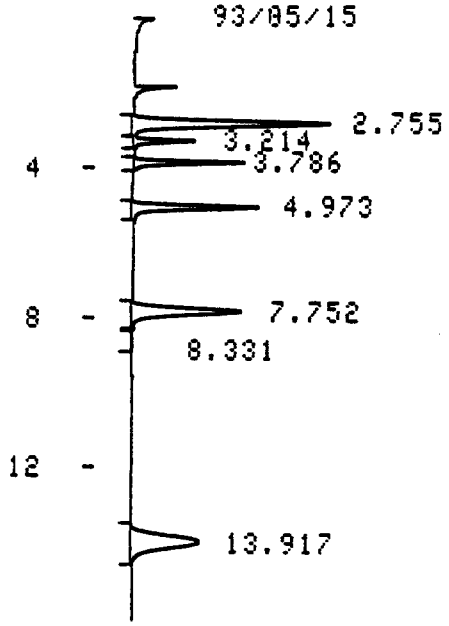
PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	2.764	1104902		6		C-6+
2	3.216	175950		1		C-1
3	3.788	360463		2		C-2
4	4.976	540289		3		C-3
5	7.048	790				
6	7.753	714016		4		C-4
7	12.637	599		14		C-5
8	13.933	875381	S	5		C-5
9	15.342	1789	T			
	TOTAL	3774177				

IDENTIFICATION FILE 2
MODE# 101 WINDOW 3

IDNO	NAME	TIME	FACTOR	CONC
1	C-1	3.2	0.00568345	1000
2	C-2	3.77	0.00285744	1030
3	C-3	4.96	0.00185086	1000
4	C-4	7.74	0.00141453	1010
5	C-5	13.91	0.00116521	1020
6	C-6+	2.75	0.000909583	1005
7	C-2	3.9	0.00285744	1030
8	C-3	4.52	0.00185086	1000
9	C-4	5.94	0.00141453	1010
10	C-4	6.73	0.00141453	1010
11	C-5	10.21	0.00116521	1020
12	C-5	10.59	0.00116521	1020
13	C-5	12.73	0.00116521	1020
14	C-5	12.61	0.00116521	1020
15	C-5	14.73	0.00116521	1020

POST ANALYSIS CALIBRATION CHECK
15PPm HYDROCARBON STANDARD
SCOTTY CAN MIX 1

93/05/15 20:33:09

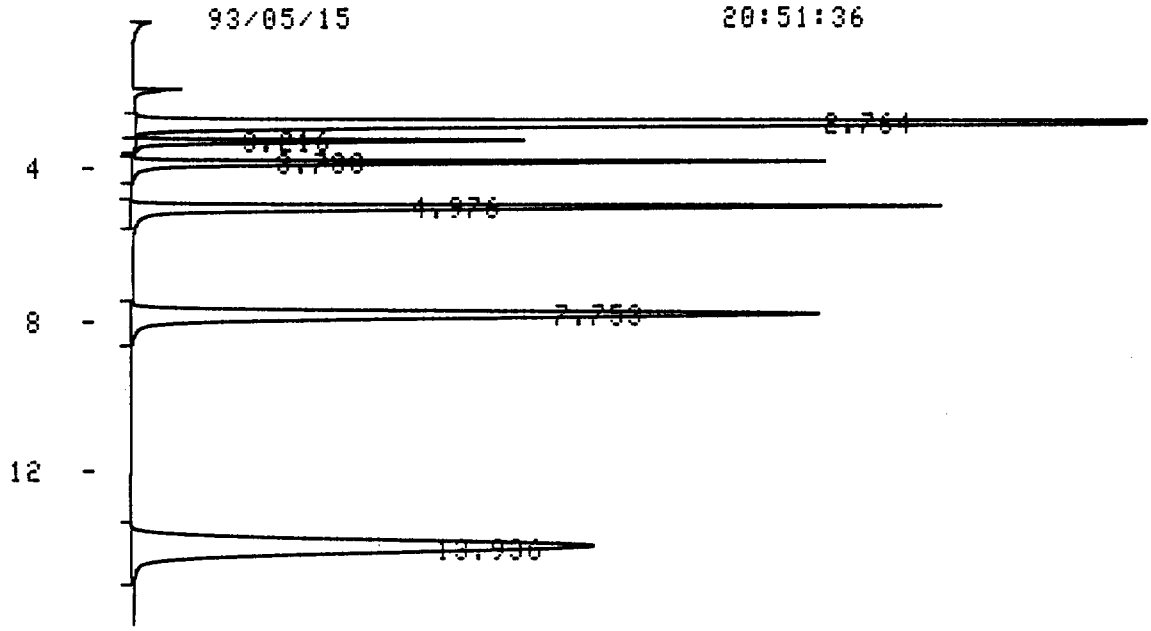


CHROMATOGRAM 28 MEMORIZED

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	2.755	15774		6	14.5895	C-6+
2	3.214	2740		1	15.6937	C-1
3	3.786	5567		2	15.8047	C-2
4	4.973	8306		3	15.7389	C-3
5	7.752	10931		4	15.8016	C-4
6	8.331	264				
7	13.917	12450		5	14.6165	C-5
	TOTAL	56032			92.2449	

GROUP(NAME)	CONC
C-1	15.6937
C-2	15.8047
C-3	15.7389
C-4	15.8016
C-5	14.6165
C-6+	14.5895

POST ANALYSIS CALIBRATION CHECK
100PPm HYDROCARBON STANDARD
SCOTTY CAN MIX 220



CHROMATOGRAM 29 MEMORIZED

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	2.764	106818		6	98.7994	C-6+
2	3.216	17188		1	98.4544	C-1
3	3.788	35418		2	100.5425	C-2
4	4.976	52521		3	99.5221	C-3
5	7.753	69483		4	100.4428	C-4
6	13.936	83950		5	98.5602	C-5
	TOTAL	365379			596.3213	

GROUP(NAME)	CONC
C-1	98.4544
C-2	100.5425
C-3	99.5221
C-4	100.4428
C-5	98.5602
C-6+	98.7994