LIBRARY – AIR RESOURCES BOARD

DETERMINATION OF AIR POLLUTANT EMISSION FACTORS FOR THERMAL TERTIARY OIL RECOVERY OPERATIONS IN CALIFORNIA

KVB 5807-842

FINAL REPORT
VOLUME II–APPENDIX

CONTRACT NO.
A7-075-30

PREPARED FOR:
STATE OF CALIFORNIA
AIR RESOURCES BOARD

PREPARED BY:
H.J. TABACK
KVB, INC.
R & A DIVISION
NOVEMBER 1979

A Research-Cottrell Company
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APPENDIX A

62nd ANNUAL REPORT
OF THE STATE
OIL & GAS SUPERVISOR

KVB 5807-842

62nd ANNUAL REPORT OF THE STATE OIL & GAS SUPERVISOR

1976

California Division of Oil & Gas

Report No. PR06

002

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TABLE 6

STEAM AND HOT WATER INJECTION—1976

Field, area and pool	Type of project	Number of wells injected into	Volume of water as steam injected (bbl)	Cumulative injection (bbl)	Injection started
District 2--Continued					
Sisar Creek Area					
Saugus	cyclic	--	--	19,512	Jan. 1965
Sulphur Mountain Area					
Miocene	cyclic	--	--	6,723	May 1965
Oxnard		3	58,662	643,604	
Pliocene Tar	cyclic	3	58,662	583,305	Dec. 1964
Miocene Tar	cyclic	--	--	60,299	July 1966
Placerita					
Kraft	cyclic	--	--	3,194,739	May 1964
Ramona					
Vasquez	cyclic	--	--	3,264	June 1965
Shiells Canyon					
Shallow	flood	2	204,473	724,324	March 1973
Simi					
Sespe	cyclic	4	69,958	106,611	Oct. 1964
South Mountain		--	--	142,155	
Sespe	cyclic	--	--	126,433	Sept. 1963
Sespe	flood	--	--	15,722	July 1964
Tapo Canyon, South					
Sespe	cyclic	--	--	11,063	May 1964
Torrey Canyon					
Sespe	cyclic	--	--	18,322	June 1964
Totals:					
Cyclic		8	137,185	4,336,536	
Flood		2	204,473	740,046	
District totals		10	341,658	5,076,582	
District 3					
Arroyo Grande					
Tiber Area					
Dollie	cyclic	24	99,234	566,437	Aug. 1965
Casmalia					
Monterey	cyclic	25	347,534	3,689,219	Feb. 1964
Cat Canyon		296	5,946,687	33,360,333	
Central Area		13	174,337	1,565,891	
S_{1b}	cyclic	12	153,103	1,432,335	Dec. 1963
S_2	cyclic	1	21,234	72,513	Aug. 1971
S_6S_9	cyclic	0	0	61,043	March 1964
East Area		94	1,249,894	8,647,141	
S_{1b}	flood	--	--	2,106,206	May 1966
$S_{1b}S_9$	cyclic	90	1,209,918	4,110,007	Dec. 1964
Brooks	cyclic	4	39,976	514,714	May 1965
Brooks	flood	--	--	1,865,571	Feb. 1967
Monterey	cyclic	0	0	50,643	Aug. 1964
Gato Ridge Area		5	16,147	257,184	
Sisquoc	cyclic	0	0	16,571	July 1965
Monterey	cyclic	5	16,147	240,613	June 1964
Sisquoc Area[3]		180	4,432,821	22,563,681	
Foxen	cyclic	1	1,257	[4]10,977	Dec. 1975
S_9	flood	0	0	139,020	Oct. 1967
S_8S_{17}	Flood	--	--	607,826	Dec. 1971
Sisquoc	cyclic	179	4,431,564	[4]21,799,099	Nov. 1963
Monterey	cyclic	0	0	6,759	Feb. 1971

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TABLE 6

STEAM AND HOT WATER INJECTION—1976

Field, area and pool	Type of project	Number of wells injected into	Volume of water as steam injected (bbl)	Cumulative injection (bbl)	Injection started
District 3--Continued					
Tinaquaic Area					
Monterey	cyclic	0	0	4,976	April 1972
West Area		4	73,488	321,460	
S_{1b}	cyclic	0	0	119,891	Nov. 1964
S_2S_5	cyclic	0	0	19,234	May 1965
Monterey	cyclic	4	73,488	182,335	March 1964
Guadalupe					
Sisquoc	cyclic	76	1,455,188	13,678,877	Jan. 1964
Huasna					
LaVoie-Hadley Area					
Monterey	cyclic	--	--	85,386	July 1965
Lynch Canyon					
Lanigan (abd.)	cyclic	--	--	229,407	June 1964
Monroe Swell					
Monterey	cyclic	--	--	2,055	April 1965
Orcutt					
Main Area					
Foxen	cyclic	0	0	7,958	June 1975
Paris Valley					
Main Area		18	155,955	353,422	
Ansberry	cyclic	18	155,955	307,524	July 1962
Ansberry (abd.)	flood	--	--	45,898	Oct. 1963
Russell Ranch					
Main Area		0	0	45,547	-
Santa Margarita	cyclic	0	0	39,576	July 1966
Griggs-Dibblee	cyclic	0	0	5,971	March 1966
San Ardo					
Main Area		199	44,011,178	285,405,754	
Lombardi	cyclic	40	344,841	55,335,944	Feb. 1964
Lombardi	flood	25	5,380,032	65,242,859	July 1966
Aurignac	cyclic	78	672,150	13,942,941	Feb. 1964
Aurignac	flood	56	37,614,155	150,884,010	Jan. 1965
Santa Maria Valley		4	17,153	719,068	
Main Area		0	0	511,827	
Foxen	cyclic	0	0	251,451	Feb. 1965
Foxen	flood	--	--	150,755	Nov. 1966
Sisquoc	cyclic	0	0	17,890	March 1974
Monterey	cyclic	0	0	6,000	Sept. 1965
Pt. Sal	cyclic	0	0	85,731	Dec. 1965
North Area					
Foxen (abd.)	cyclic	--	--	26,834	June 1965
Southeast Area		4	17,153	151,998	
Sisquoc	cyclic	4	17,153	138,295	March 1965
Monterey	cyclic	0	0	13,703	Sept. 1974
West Area					
Monterey	cyclic	0	0	28,409	Sept. 1965
Sargent					
Pliocene	cyclic	--	--	7,800	Oct. 1967
Zaca					
Monterey	cyclic	0	0	147,978	March 1964
Totals:					
Cyclic		561	9,038,742	117,257,096	
Flood		81	42,994,187	221,042,145	
District totals		642	52,032,929	338,299,241	

TABLE 6

STEAM AND HOT WATER INJECTION—1976

Field, area and pool	Type of project	Number of wells injected into	Volume of water as steam injected (bbl)	Cumulative injection (bbl)	Injection started
District 4					
Ant Hill					
Olcese	cyclic	--	--	19,813	April 1967
Antelope Hills					
Williams Area					
Upper	cyclic	--	--	17,000	May 1971
Antelope Hills, North					
Miocene	cyclic	--	--	33,681	Nov. 1970
Belridge, North		34	738,615	1,531,210	
Shallow	cyclic	23	300,637	844,931	Oct. 1964
Shallow	flood	11	437,978	686,279	Aug. 1975
Belridge, South		575	28,961,445	179,674,180	
Tulare-Diatomite	cyclic	210	2,335,292	34,019,089	Mar. 1964
Tulare-Diatomite	flood	365	26,626,153	145,655,091	Feb. 1963
Blackwells Corner					
Agua	cyclic	--	--	16,915	Feb. 1973
Chico-Martinez					
Etchegoin	cyclic	--	--	230,373	May 1967
Comanche Point					
Santa Margarita	cyclic	--	--	21,100	Oct. 1965
Cymric		262	3,821,282	*29,333,540	
McKittrick Front Area		89	1,112,317	15,812,535	
Tulare	cyclic	88	1,002,274	14,980,367	Nov. 1963
Tulare	flood	1	110,043	832,168	Jan. 1972
1-Y Area					
Reef Ridge	cyclic	--	--	217,265	June 1967
Salt Creek Main Area					
Carneros West	cyclic	--	--	17,918	Jan. 1971
Sheep Springs Area					
Etchegoin	cyclic	23	71,653	*130,988	June 1965
Welport Area		150	2,637,312	13,154,834	
Tulare	cyclic	130	1,208,012	10,898,965	June 1964
Tulare	flood	9	1,247,957	1,948,555	June 1968
Etchegoin	cyclic	11	181,343	307,314	Sept. 1974
Deer Creek, North					
Santa Margarita	cyclic	--	--	7,000	June 1965
Devils Den		--	--	81,027	
Alferitz Area		--	--	28,527	
Escudo	cyclic	--	--	16,158	Dec. 1964
Point of Rocks	cyclic	--	--	12,369	Nov. 1964
Old Area		--	--	52,500	
Point of Rocks	cyclic	--	--	13,800	Sept. 1965
Point of Rocks	flood	--	--	38,700	Feb. 1966
Edison		145	1,468,917	6,156,755	
Edison Groves Area					
Chanac	cyclic	46	380,918	902,661	Dec. 1964
Main Area					
Kern River-Schist	cyclic	28	337,032	2,060,604	Jan. 1964
Race Track Hill Area					
Kern River-Transition	cyclic	71	750,967	3,193,490	Aug. 1964
Edison, Northeast					
Chanac	cyclic	6	3,569	34,240	June 1968
Elk Hills					
Tulare	cyclic	—	—	8,500	Mar. 1975
Fruitvale					
Main Area					
Chanac	cyclic	--	--	37,559	Dec. 1964

TABLE 6

STEAM AND HOT WATER INJECTION—1976

Field, area and pool	Type of project	Number of wells injected into	Volume of water as steam injected (bbl)	Cumulative injection (bbl)	Injection started
District 4--Continued					
Jasmin		—	—	21,442	
Pyramid Hill (abd.)	cyclic	—	—	8,742	Mar. 1965
Cantleberry	cyclic	—	—	12,700	June 1965
Kern Bluff		14	206,888	4,054,043	
Miocene	cyclic	10	31,742	3,878,897	April 1965
Miocene	flood	4	175,146	175,146	Aug. 1976
Kern Front		312	3,096,029	25,388,940	
Kern River-Chanac	cyclic	312	3,096,029	25,289,353	Feb. 1964
Kern River-Chanac	flood	—	—	99,587	Dec. 1966
Kern River		4,056	139,472,343	965,940,075	
Kern River	cyclic	2,697	30,085,603	414,053,842	Aug. 1961
Kern River	flood	1,359	109,386,740	551,886,233	Aug. 1962
Lost Hills		97	805,852	6,102,809	
Tulare-Etchegoin	cyclic	93	763,036	5,987,679	June 1964
Tulare	flood	4	42,816	115,130	Aug. 1968
McDonald Anticline					
Layman Area					
Tulare	cyclic	—	—	3,800	Mar. 1967
McKittrick		634	9,679,901	78,875,603	
Main Area		501	6,989,278	64,481,430	
Upper	cyclic	500	6,937,995	63,183,963	May 1962
Upper	flood	1	51,283	1,297,467	Feb. 1965
Northeast Area		133	2,690,623	14,394,173	
Upper	cyclic	123	1,453,486	12,549,135	Sept. 1964
Upper	flood	10	1,237,137	1,845,038	Oct. 1971
Midway-Sunset		3,198	49,208,976	391,607,740	
Upper	cyclic	3,079	34,955,844	329,748,641	Oct. 1963
Upper	flood	119	14,253,132	61,859,099	Oct. 1963
Mount Poso		11	13,001,342	46,849,360	
Dominion Area					
Vedder	cyclic	—	—	177,242	Nov. 1964
Granite Canyon Area					
Vedder	cyclic	—	—	19,069	Jan. 1967
Main Area					
Vedder	cyclic	—	—	116,623	Aug. 1963
Vedder	flood	11	13,001,342	46,536,426	Oct. 1963
Poso Creek		82	946,812	8,993,069	
Enas Area					
Chanac	cyclic	9	113,996	243,476	Dec. 1966
McVan Area					
Etchegoin	cyclic	29	158,130	1,711,627	Dec. 1964
Premier Area		44	674,686	7,037,966	
Etchegoin-Chanac	cyclic	43	573,079	6,599,963	April 1965
Etchegoin	flood	1	101,607	438,003	Aug. 1970
Railroad Gap		10	782,912	1,601,588	
Amnicola	cyclic	4	43,775	580,792	Nov. 1965
Amnicola	flood	6	739,137	1,020,796	Aug. 1975
Rosedale Ranch					
Etchegoin	cyclic	—	—	7,548	Feb. 1966
Round Mountain		—	—	18,133	
Coffee Canyon Area		—	—	12,200	
Pyramid Hill	cyclic	—	—	1,000	April 1968
Vedder	cyclic	—	—	11,200	May 1965
Pyramid Area					
Vedder	cyclic	—	—	3,825	Dec. 1964
Sharktooth Area					
Vedder	cyclic	—	—	2,108	May 1969

TABLE 6

STEAM AND HOT WATER INJECTION—1976

Field, area and pool	Type of project	Number of wells injected into	Volume of water as steam injected (bbl)	Cumulative injection (bbl)	Injection started
District 4--continued					
Tejon					
Western Area					
Transition-Santa Margarita----	cyclic	--	--	167,189	June 1964
Tejon Hills					
Santa Margarita----------	cyclic	--	--	7,495	April 1968
Union Avenue					
Chanac----------	cyclic	--	--	17,000	June 1966
Wheeler Ridge----------		2	130,262	1,905,756	
Central Area					
Coal Oil Canyon----------	cyclic	--	--	309,453	June 1965
Coal Oil Canyon----------	flood	2	130,262	1,592,438	May 1971
Northeast Area					
Santa Margarita----------	cyclic	--	--	3,865	June 1965
White Wolf					
Reef Ridge----------	cyclic	--	--	111,238	Dec. 1964
Totals:					
Cyclic----------		7,535	84,784,412	932,849,565	
Flood----------		1,903	167,540,733	816,026,156	
District Totals----------		9,438	252,325,145	1,748,875,721	
District 5					
Coalinga----------		69	3,119,346	*81,630,129	
Eastside Area----------		0	0	26,351,875	
Temblor----------	cyclic	0	0	1,568,032	Jan. 1962
Temblor----------	flood	0	0	24,783,843	Jan. 1963
Westside Area----------		69	3,119,346	*55,278,254	
Temblor----------	cyclic	41	1,808,076	*43,917,425	Jan. 1962
Temblor----------	flood	28	1,311,270	11,360,829	March 1961
Kreyenhagen----------					
Temblor----------	cyclic	0	0	4,493	Nov. 1965
Pyramid Hills----------		0	0	216,697	
Dagany Area					
Kr----------	cyclic	0	0	165,883	Jan. 1965
West Slope Area					
Kr----------	cyclic	0	0	50,814	May 1966
Totals:					
Cyclic----------		41	1,808,076	45,706,647	
Flood----------		28	1,311,270	36,144,672	
District totals----------		69	3,119,346	81,851,319	
District 6 - None					
STATE TOTALS:					
Cyclic----------		8,635	101,774,221	1,191,938,904	
Flood----------		2,047	217,434,984	1,108,307,823	
GRAND TOTALS----------		10,682	319,209,205	2,300,246,727	

NOTE: Wells in both cyclic and flood projects counted once in area, field, or district totals. Cumulative figures may include minor corrections. Dashes indicate project discontinued.

** Corrected figure.*

1/ Formerly known as Repetto.

2/ Formerly carried as Sherman.

3/ Pool not shown previously.

4/ 9,270 barrels transferred to Foxen pool from Sisquoc pool.

ADDITIONAL ENHANCED - RECOVERY PROJECTS*

Project type	Field & area	County	Zone or pool	Date started	Maximum no. of injection wells	Project operator(s)	Remarks
			District 1				
Fire Flood (In situ combustion)	Brea-Olinda	Orange	1st Miocene	3/72	4	Union Oil Company of California	Three separate fault blocks.
	Newport, West Onshore Area	Orange	A Zone	9/71	1	General Crude Oil Company, Operator	
			B Zone	2/58	37	General Crude Oil Company, Operator	
			District 3				
	Cat Canyon Sisquoc Area	Santa Barbara	Basal "D"	1/74	1	Continental Oil Company	
	Paris Valley Main Area	Monterey	Lower Ansberry	3/76	1	Buckeye Oil Company of Delaware	
	Russell Ranch Main Area	Santa Barbara	Dibblee	4/71	2	Atlantic Richfield Company	Combination air and water injection for several months.
	San Ardo Main Area	Monterey	Lombardi	9/63	10	Mobil Oil Corporation	
			Aurignac	4/74	2	Mobil Oil Corporation	
			District 4				
	Belridge, South	Kern	Tulare	3/56	5	Belridge Oil Company Mobil Oil Corporation	
	Kern River	Kern	Kern River	8/74	1	Thermoil Company	This project was terminated in 1976.
	Lost Hills	Kern	Tulare	4/61	5	Mobil Oil Corporation	
	Midway-Sunset	Kern	Potter	12/71	3	Chanslor-Western Oil and Development Co.	
			Moco	1/60	14	Mobil Oil Corporation	
			District 5				
Polymer Flood	Coalinga Eastside Area	Fresno	Temblor Zone II	7/76	4	Shell Oil Company	Injectivity tests during 1976; water only - no polymers.
			District 1				
Water-Alternating Gas Injection	Las Cienegas Murphy Area	Los Angeles	A, B, and C Sands	12/72	2	Union Oil Company of California	Gas injection began in January 1964.

*Active projects other than waterflood, steam injection, and pressure maintenance.

APPENDIX B

ARB DETERMINATION OF AIR POLLUTANT EMISSION FACTORS FOR THERMAL TERTIARY OIL RECOVERY OPERATIONS IN CALIFORNIA FIELD TEST PLAN

ARB

DETERMINATION OF AIR POLLUTANT EMISSION FACTORS

FOR

THERMAL TERTIARY OIL RECOVERY OPERATIONS

IN CALIFORNIA

FIELD TEST PLAN

0 1 0

KVB 5807-842

TEST SCHEDULE

JULY 17-21, 1978	MOBIL, MONTEREY COUNTY 50 MMBTU STEAM GENERATOR (WITH SO_2 SCRUBBER)
JULY 24-28, 1978	TENNECO, KERN COUNTY 50 MMBTU STEAM GENERATOR (NO SCRUBBER) 3-6 STEAM VENTS
JULY 31-AUG. 4, 1978	*CHEVRON, KERN COUNTY 50 MMBTU STEAM GENERATOR (NO SCRUBBER MOBIL, KERN COUNTY FIRE FLOODING VENTS

*TENTATIVE

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SAMPLING LOCATIONS:
STEAM GENERATORS (50 MMBTU)

WITH SO_2 SCRUBBERS:

SCRUBBER INLET: ALL TESTS

SCRUBBER OUTLET: ALL TESTS
(EFFICIENCY DETERMINATION)

WITHOUT SO_2 SCRUBBERS:

GENERATOR STACK: ALL TESTS

FUEL OIL: BEFORE BURNER OR AT FUEL PUMP

TEST PARAMETERS
STEAM GENERATORS:

1 FUEL SAMPLE--FLUID COLLECTION INTO CAN, LABEL AND SEAL

2 TESTS EACH AT NORMAL (OPERATIONAL) EXCESS AIR

- VELOCITY
- MOLECULAR WEIGHT, CO_2, O_2, CO, H_2O
- PARTICULATES--TRACE METALS, TOTAL LOAD
- SO_2-SO_3-TOTAL SULFUR (AT NORMAL EXCESS AIR ONLY)
- SO_2
- NOx
- HYDROCARBONS--METHANE & NON-METHANE
- ALDEHYDES

1 EACH BACKGROUND HYDROCARBONS

1 TEST EACH AT VERY LOW, MEDIUM AND HIGH EXCESS (O_2) AIR EACH

- VELOCITY
- MOLECULAR WEIGHT, CO_2, O_2, CO, H_2O
- SO_2
- NOx
- HYDROCARBONS--METHANE & NON-METHANE

TEST METHODOLOGY
STEAM GENERATORS:

VELOCITY:	EPA METHOD 1 AND 2
MOLECULAR WEIGHT:	EPA METHOD 3, 4 AND PART OF 5 (CONDENSATE)
CO_2, O_2, CO, H_2)	INFRARED GAS ANALYZER (HORIBA PIR-2000)
	DRAEGER DETECTOR TUBES
PARTICULATES:	EPA METHOD 5 SASS TRAIN (4 SCFM)
	(NO CYCLONES) JOY TRAIN (1 SCFM)
SO_2-SO_3:	EPA METHOD 8 OR SHELL-EMERYVILLE
SO_2:	DUPONT 400 PHOTOMETRIC ANALYZER
	CAL GAS INJECTION AT PROBE
	CAL GASES: 2 CONCENTRATIONS ~100 PPM
	(CERTIFIED) ~1000 PPM FOR SCRUBBER TEST
	EQUIVALENT METHOD 8 BACK-UP (REFERENCE METHOD)
	DRAEGER DETECTOR TUBES BACK-UP
NOx:	TECO 10/A CHEMILUMINISCENT ANALYZER
	EQUIVALENT METHOD 7 (PDS) BACK-UP
	CAL GAS INJECTION AT PROBE
	DRAEGER DETECTOR TUBES BACK-UP
	PDS FLASKS
HYDROCARBONS:	BOROSILICA GAS COLLECTION BOTTLES, GRAB SAMPLING
	DRAEGER DETECTOR TUBES
ALDEHYDES:	DRAEGER DETECTOR TUBES

FUGITIVES - TEST PARAMETERS

STEAM VENTS:

- Flow Velocity, CO_2, CO
- Moisture Content
- H_2S
- Hydrocarbons: methane & non-methane
- Particulates--Trace metals, total particulates
- Production Rate (by information)
- Field Energy Consumption (fuel/steam) Data

FIRE FLOODING:

- Flow Velocity--CO_2, O_2, CO, moisture
- Liquid Hydrocarbon Mass Determination (by information)
- H_2S
- Hydrocarbons: Methane & non-methane
- NOx
- Field Production/Energy Consumption Data

FUGITIVES TEST METHODOLOGY

STEAM VENTS

VELOCITY:	DUCTING--MOISTURE CONDENSING--GAS METER --ANEMOMETER --PITOT
MOISTURE CONTENT:	CONDENSER-ICE BATH (VOLUMETRIC)
H_2S:	DRAEGER DETECTOR TUBES BOROSILICA GAS COLLECTION BOTTLE GRAB SAMPLING
HYDROCARBONS:	BOROSILICA GAS COLLECTION BOTTLE GRAB SAMPLING DRAEGER DETECTOR TUBES
PARTICULATES:	MODIFIED METHOD 5--FREE FLOW INTO SASS TRAIN CONDENSER REPLACES CYCLONES, ONLY FILTER AND LARGE IMPINGERS (CONDENSER CONTENT ANALYZED TOGETHER WITH IMPINGERS)
WELL HEAD:	STUFFING BOX TENTING--TIME RATED KNOWN VOLUME DILUTION BY FILTERED (CHARCOAL) AIR INTO TEDLAR BAG AND BOROSILICA GAS COLLECTION BOTTLES HYDROCARBON AND H_2S DETERMINATION DRAEGER DETECTOR TUBES--BACK-UP

FUGITIVES TEST METHODOLOGY

FIRE FLOODING

VELOCITY: DRAFT GAUGE AND ORIFICE METERS

H_2S: BOROSILICA GAS COLLECTION BOTTLE
DRAEGER DETECTOR TUBES

HYDROCARBONS: BOROSILICA GAS COLLECTION BOTTLE
DRAEGER DETECTOR TUBES

CO_2, CO: DRAEGER DETECTOR TUBES

NOx: DRAEGER DETECTOR TUBES

LIQUID CONDENSATE: VOLUMETRIC MEASUREMENT (BY INFORMATION)

ANALYTICAL PROCEDURES

PARTICULATES:

MOISTURE BY VOLUMETRIC AND GRAVIMETRIC MEASUREMENT

ORGANICS: METHYL CHLOROFORM EXTRACTION AND GRAVIMETRY

INORGANICS: GRAVIMETRY

TRACE ELEMENTS: X-RAY FLUORESCENCE

SULFUR: PHOTOMETRY, PERCHLORATE TITRATION

NOx: CHEMILUMINISCENCE, DISULFONIC ACID-ADSORBANCE COLORIMETRY

HYDROCARBONS: GAS CHROMATOGRAPHY

ALDEHYDES: COLORIMETRY

H_2S: COLORIMETRY

CO_2, CO: IR, ADSORBANCE

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INFORMATION REQUESTED

ON

STEAM GENERATOR:

- Boiler Description, steam production data, quality, efficiency
- Burner Description
- Fuel Consumption Rate
- Fuel Analysis (if available)
- Fuel Sample
- Maintenance Schedule
- Overhaul
- Nozzles Cleaned
- Instrumentation Calibration

STEAM VENTS:

- Number of vents per known area
- Barrels (net) of oil produced by area (per unit time)
- Number of wells per known area (producing)
- Barrels of oil burned to stimulate area (per unit time)

or Btu input into area to stimulate

or Number of active generators and their size used to stimulate area

- Relative size of known area to overall production field

or All the above data for overall production field

- Number of pumping well motors and their HP size per area

FIRE FLOODING:

- Number and size of air compressors active per burn zone
- Approximate concentration of H_2S vented
- Number of producing wells in stimulated zone
- Barrels of oil (net) produced per unit time by zone
- Accumulator fluid hydrocarbon reclaim/unit time in zone

ADDITIONAL INFORMATION: Production field map copy

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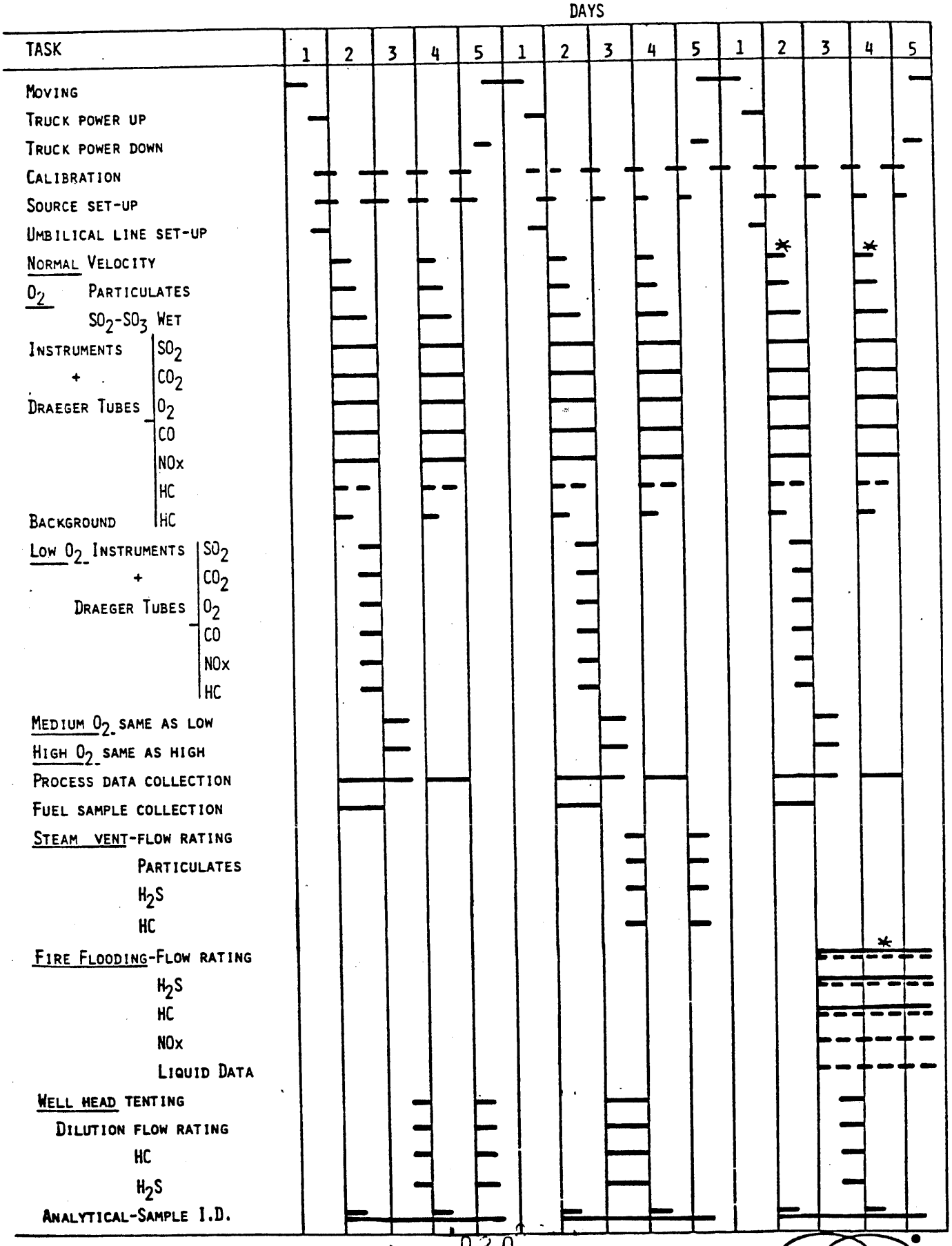
TIME SCHEDULE



* TENTATIVE (DEPENDING ON AVAILABILITY)

KVB 5807-842

APPENDIX C

KVB-ARB THERMAL OIL RECOVERY
DATA BASE: MOBIL OIL CO. SAN ARDO

KVB

Sample Code MSA 1-5 7-18-1978 — 7-21-78

Tested by: N. Brunetz, F. Ducey, J. Macko

Date 7-21-1978

STATEMENT OF PROCESS WEIGHT OR VOLUME

Firm Name MOBIL OIL CO

Address SAN ARDO, California,

DATA ON OPERATING CYCLE TIME: No. 22-5 Steam Generator, 50 MMBtu

Start of Operation, Time

End of Operation, Time

Elapsed Time, Minutes

Idle Time During Cycle, Min.

Net Time of Cycle, Minutes

} 24 hrs/7 days/46 week a year

DATA ON MATERIAL CHARGED TO PROCESS DURING OPERATING CYCLE:

8400 - 9240 gal/day

Material	Net Crude Oil Burned	Weight or Volume	200-220 BOD	~~lbs~~, gal
Material				lbs, gal
Material	Total Oil (neat) Produced (the 200-220 BOD burned comes from this 766 BOD)		766 BOD	lbs, gal
Material				lbs, gal
Material	Scrubber Water (from heater-treater-desalter		8000 BWD	lbs, gal
Material	unit well water)			lbs, gal
Material	Water used for 80% steam injection		16,579 BWD	lbs, gal

Total:

Oil Field: Burned 1080 BOD

Oil Field: Produced 4103 BOD (1080 BOD is part of this) = 3.8 Bo gross produced per Bo burned

Unit Section tested $\frac{766 \text{ BOD produced}}{210 \text{ BOD burned}}$ = 3.6 Bbls oil gross produced per Bbl burned.

Signature N. Brunetz

Title test director

J. Sklar, Mobil Superintendent's Confirmation 8/10/79 14:15 hr.

9/76

KVB 5807-842

KVB – ARB THERMAL OIL RECOVERY

PARTICULATE TEST DATA BASE

MOBIL OIL CO.

COMPANY NAME & TEST NO.		#1 IN	OUT	#2 IN	OUT
MOBIL OIL, SAN ARDO 22-5 w/scrubber					
Std. CF sampled DSCF		176.1	53.5	117.2	60.98
water content %		8.8	24.6	12.3	30.3
Mass Flowrate DSCFM		11,033	11,033	10,152	10,152
EPA Meth. 5 (Front + Filter)	grams	0.5373	0.2754	0.6732	0.1901
Total Particulates (Impingers included	grams	1.8633	0.3412	1.3528	0.2448
INORGANICS COLLECTED	grams	1.8633	0.3412	1.3528	0.2448
Organics (condensibles) COLLECTED	grams	NOT EXTRACTED		NO FREE CONDENSATE	

REPORT

TRUESDAIL LABORATORIES, INC.

CHEMISTS - MICROBIOLOGISTS - ENGINEERS
RESEARCH — DEVELOPMENT — TESTING

4101 N. FIGUEROA STREET
LOS ANGELES 90065
AREA CODE 213 • 225-1564
CABLE: TRUELABS

CLIENT KVB, Inc.
17332 Irvine Boulevard
Tustin, California 92680
Attention: N. Brunetz

DATE August 2, 1978

RECEIVED July 6, 1978

SAMPLE 16 - NOx samples in 2-liter PDSA flasks
P. O. No. 14259

LABORATORY NO. 21880

INVESTIGATION Prepare and deliver 16 NOx flasks to the KVB, Inc. office. Analysis of returned flasks for nitrogen oxides (NOx) by the PDSA method - equivalent to EPA Method 7. Analysis for CO_2 and O_2 on the gas phase of each sample flask.

RESULTS

Flask No.	Location	Time	Nitrogen Oxides (NOx), ppm	CO_2, %	O_2, %
		1st Test, July 19, 1978			
1386	outlet	12:08	230	13.2	3.8
1345	"	12:10	207	13.0	3.9
808	"	12:05	232	13.0	4.1
1357	"	12:11	265	11.7	5.8
AVG.:		-	234	12.7	4.4
1315	inlet	12:31	214	12.8	4.0
1061	"	12:29	214	12.7	4.0
1334	"	12:28	236	13.1	3.6
1320	"	12:27	243	13.0	3.7
AVG.:		-	227	12.9	3.8
		2nd Test, July 20, 1978			
1328	outlet	12:55	191	13.9	3.1
1029	"	12:56	195	13.9	2.8
980	"	12:57	195	13.4	3.5
1046	"	12:59	190	12.8	4.2
AVG.:		-	193	13.5	3.4
1329	inlet	12:45	198	13.8	3.6
1181	"	12:46	196	13.6	3.1
1136	"	12:47	190	12.6	4.1
718	"	12:48	186	13.1	3.6
AVG.:		-	193	13.3	3.6

Respectfully submitted,
TRUESDAIL LABORATORIES, INC.

Ignas Bandziulis

IGNAS BANDZIULIS, Supervisor Air Pollution Dept.

This report applies only to the sample, or samples, investigated and is not necessarily indicative of the quality or condition of apparently identical or similar products. As a mutual protection to clients, the public and these Laboratories, this report is submitted and accepted for the exclusive use of the client to whom it is addressed and upon the condition that it is not to be used, in whole or in part, in any advertising or publicity matter without prior written authorization from these Laboratories.

AGRICULTURE
CHEMICAL ANALYSIS
PETROLEUM

BC LABORATORIES, INC.

4100 PIERCE ROAD, 93308 BAKERSFIELD, CALIFORNIA 93308 PHONE 327-4911

KVB, Inc.
17332 Irvine Boulevard
Tustin, California 92680

Date Reported: 7/28/78
Date Received: 7/21/78
Laboratory No.: 5993

Attention Mr. Nickolas Brunetz

GAS ANALYSES

Sample Description: 22-5 Steam Generator Scrubber
Inlet, Outlet, Burner Background 7/19/78

Container	Source	Time	Total Hydrocarbon	Methane	Non Methane
103	Outlet	12:00	10.0 : 6.8	2.7 : 1.8	7.3 : 5.0
28	Outlet	12:00	16.3 : 11.1	2.7 : 1.8	13.6 : 9.2
17	Background	13:00	24.8 : 16.9	2.6 : 1.8	22.2 : 15.1
21	Inlet	12:25	14.1 : 9.6	0.8 : 0.5	13.3 : 9.0
5	Inlet	12:26	16.8 : 11.4	1.5 : 1.0	15.3 : 10.4

Answers expressed as ppm by volume : µg per liter as Methane.
(0.725g / 1 liter methane)

Sample Description: 22-5 Steam Generator Scrubber
Inlet, Outlet, Burner Background 7/20/78

Container	Source	Time	Total Hydrocarbon	Methane	Non Methane
6	Outlet	12:55	25.1 : 17.1	3.6 : 2.4	21.5 : 14.6
20	Outlet	12:56	16.6 : 11.3	3.4 : 2.3	13.2 : 9.0
13	Inlet	12:45	21.3 : 14.5	3.9 : 2.7	17.4 : 11.8
19	Inlet	12:46	15.8 : 10.7	1.0 : 0.7	14.8 : 10.1
18	Background	11:32	34.4 : 23.4	4.5 : 3.1	29.9 : 20.3

Answers expressed as ppm by volume : µg per liter as Methane.

µg - Micrograms.

KVB, Inc.
Gas analyses - continued

Sample Description: 22-5 Steam Generator w/Scrubber 7/20/78

Container	Source	Time	Total Hydrocarbon	Methane	Non Methane
14	Inlet O_2 1.8%	16:45	21.6 : 14.7	0.9 : 0.6	20.7 : 14.1
10	Inlet O_2 1.8%	16:45	26.5 : 18.0	1.0 : 0.7	25.5 : 17.3
25	Outlet O_2 1.8%	16:50	37.8 : 25.7	4.5 : 3.1	33.3 : 22.6
A	Outlet O_2 1.8%	16:50	24.8 : 16.9	4.3 : 2.9	20.5 : 13.9
23	Inlet O_2 3%	17:20	10.1 : 6.9	0.7 : 0.5	9.4 : 6.4
6	Inlet O_2 3%	17:20	13.8 : 9.4	1.2 : 0.8	12.6 : 8.6
104	Outlet O_2 3%	17:20	25.5 : 17.3	4.6 : 3.1	20.9 : 14.2
9	Outlet O_2 3%	17:20	23.4 : 15.9	5.5 : 3.7	17.9 : 12.2
2	Inlet O_2 6%	17:45	5.6 : 3.8	0.2 : 0.1	5.4 : 3.7
102	Inlet O_2 6%	17:45	5.5 : 3.7	0.7 : 0.5	4.8 : 3.3
13	Outlet O_2 6%	17:55	30.5 : 20.8	0.7 : 0.5	29.9 : 20.3
B	Outlet O_2 6%	17:55	52.9 : 36.0	4.3 : 2.9	48.6 : 33.0

Answers expressed as ppm by volume : µg per liter as Methane.

µg - Micrograms. (0.725 g / 1 liter Methane)

B C LABORATORIES, INC.

BY J. J. Eglin
J. J. Eglin

ch

KVB

Test No. ____ Date 7/19/78 Location SAN ARDO Unit No. ____

Fuel SAN ARDO CRUDE Fuel Sample No. 2 Fuel Sample Point ____

LIQUID OR SOLID FUEL CALCULATIONS

(f)(CL REG), (f) (P>S), (f)(CL REG), Load data card, then PGRM card (both sides)

*Input HHV (Btu/lb)	18220	, (A)
*Input wt % C	84.16	, (R/S)
*Input wt % H	10.70	, (R/S)
*Input wt % S	2.25	, (R/S)
*Input wt % O	1.41	, (R/S)
*Input wt % N	0.94	, (R/S) - decimal point blinks after pressing; item #1 displayed

1. Dry stoichiometric moles flue gas/lb fuel = 0.4374.
(One may proceed to items 9, 17, or 18 by pressing (f)(A), (E), or entering MW and pressing (B), respectively.)

*Input wt % H_2O in fuel (0 if none) 0.40

(C)	2.	Moles H_2O in flue gas/lb fuel	0.0537
(R/S)	3.	Total moles of flue gas (stoichiometric)/lb fuel	0.4911
(R/S)	4.	Dry volume/wet volume	0.8907
(R/S)	5.	Volume % H_2O in flue gas	10.93
(R/S)	6.	Volume % CO_2, dry in flue gas	16.02
(R/S)	7.	SO_2 (ppm by vol.), dry at stoichiometric	1604.53
(R/S)	8.	NO (ppm by vol.), dry at stoichiometric	1534.29
(f)(A)	9.	Stoichiometric air/fuel ratio (lb air/lb fuel)	13.42

(Before items 10-16 may be determined, items 1-9 must be completed.)

(D) → 20.95 displayed

			3	4	5	
		*Input measured vol. % O_2 for O_2 correction				
(R/S)	10.	$\frac{\text{Gas moles at \% } O_2}{\text{Gas moles, stoic.}} = \frac{20.95}{20.95 - \%\ O_2}$ =	1.167	1.236	1.314	
(R/S)	11.	Dry moles flue gas/lb fuel at % O_2	0.511	0.541	0.575	
(R/S)	12.	Vol. % CO_2, dry at % O_2	13.73	12.96	12.20	
(R/S)	13.	SO_2 (ppm by vol.) dry at % O_2	1374.77	1298.18	1221.59	
(R/S)	14.	NO (ppm by vol.) dry at % O_2	1314.59	1241.35	1168.11	
(R/S)	15.	Vol. % H_2O at % O_2	9.52	9.04	8.55	
(R/S) (decimal pt. blinks)	16.	Percent Excess Air	15.78	22.28	29.59	

(RCL)(2)(E) 17. Converts item 1 to SCF dry flue gas at stoich/10^6 Btu = 9284.98

Item 18.

a. *Input MW, (B), program calculates K (lb/10^6 Btu = ppm/K)
(MW = 46 for NOx, CO = 28, HC = 16, SOx = 64)

1. *Input measured ppm at 3% O_2, dry, (R/S), program calculates lb/10^6 Btu.
2. (Optional) No input, (R/S), program converts lb/10^6 Btu → ng/J
3. Repeat steps (1) and (2) as necessary.

b. *Enter next value of MW, complete step (a) followed by steps (1), (2), and (3). Repeat for all species desired.

		MW	K for lb/10^6 Btu	16/10⁶BTU	ng/J
1314.6	NOx	46	776.2	1.694	728.2
75	CO	28	1275.2	0.0588	25.29
25	HC	16	2221.8	0.0112	4.82
1374.8	SOx	64	567.93	2.464	1059.6

*Indicates input is required

Data Sheet 6015-19
Revised 7/6/78

KVB 5807-842

KVB

Test No. _____ Date 7-20-78 Location SAN ADDO Unit No. _____

Fuel CRUDE Fuel Sample No. 3 Fuel Sample Point _____

LIQUID OR SOLID FUEL CALCULATIONS

(f)(CL REG), (f) (P≥S), (f)(CL REG), Load data card, then PGRM card (both sides)

*Input HHV (Btu/lb)	18120	, (A)
*Input wt % C	84.15	, (R/S)
*Input wt % H	10.49	, (R/S)
*Input wt % S	3.24	, (R/S)
*Input wt % O	1.47	, (R/S)
*Input wt % N	0.94	, (R/S) - decimal point blinks after pressing; item #1 displayed

1. Dry stoichiometric moles flue gas/lb fuel = 0.4345.
(One may proceed to items 9, 17, or 18 by pressing (f)(A), (E), or entering MW and pressing (B), respectively.)

*Input wt % H_2O in fuel (0 if none) 0.64

(C)	2.	Moles H_2O in flue gas/lb fuel	0.0524
(R/S)	3.	Total moles of flue gas (stoichiometric)/lb fuel	0.4869
(R/S)	4.	Dry volume/wet volume	0.8924
(R/S)	5.	Volume % H_2O in flue gas	10.76
(R/S)	6.	Volume % CO_2, dry in flue gas	16.12
(R/S)	7.	SO_2 (ppm by vol.), dry at stoichiometric	1607.93
(R/S)	8.	NO (ppm by vol.), dry at stoichiometric	1544.32
(f)(A)	9.	Stoichiometric air/fuel ratio (lb air/lb fuel)	13.32

(Before items 10-16 may be determined, items 1-9 must be completed.)

(D) → 20.95 displayed

*Input measured vol. % O_2 for O_2 correction

			3	4	5	
(R/S)	10.	$\frac{\text{Gas moles at \% } O_2}{\text{Gas moles, stoic.}} = \frac{20.95}{20.95 - \text{\% } O_2}$ =	1.167	1.236	1.314	
(R/S)	11.	Dry moles flue gas/lb fuel at % O_2	0.507	0.537	0.571	
(R/S)	12.	Vol. % CO_2, dry at % O_2	13.82	13.05	12.28	
(R/S)	13.	SO_2 (ppm by vol.) dry at % O_2	1377.60	1300.85	1224.10	
(R/S)	14.	NO (ppm by vol.) dry at % O_2	1323.17	1249.46	1175.74	
(R/S)	15.	Vol. % H_2O at % O_2	9.36	8.89	8.41	
(R/S) (decimal pt. blinks)	16.	Percent Excess Air	15.80	22.30	29.63	

(RCL)(2)(E) 17. Converts item 1 to SCF dry flue gas at stoich/10^6 Btu = 9275.64

Item 18.

a. *Input MW, (B), program calculates K (lb/10^6 Btu → ppm/K)
(MW = 46 for NOx, CO = 28, HC = 16, SOx = 64)

1. *Input measured ppm at 3% O_2, dry, (R/S), program calculates lb/10^6 Btu.
2. (Optional) No input, (R/S), program converts lb/10^6 Btu → ng/J
3. Repeat steps (1) and (2) as necessary.

b. *Enter next value of MW, complete step (a) followed by steps (1), (2), and (3). Repeat for all species desired.

		MW	K for lb/10^6 Btu	lb/10^6 BTU	ng/J
1323.17	NOx	46	777.0	1.703	732.22
75	CO	28	1276.5	0.0588	25.26
25	HC	16	2232.0	0.0112	4.81
1377.6	SOx	64	558.5	2.467	1060.66

*Indicates input is required

Data Sheet 6015-19
Revised 7/6/78

KVB 5807-842

MSA-1
INLET
Front end wt: 0.5377
(Filter + wash)
V_m Std. = 176.08
0.047 gr/DSCF
4.47 lb/hr

Mobil
San Ardo

ARMAMENT SYSTEMS, INC.
712-F N. Valley St.
Anaheim, Calif. 92801
(714) 635-1524

MOBIL OIL
San Ardo 22-5

ENERGY DISPERSIVE X-RAY ELEMENT ANALYSIS

9/ 5/78

Prepared for: KVB Engineering/Brunetz
Sample lable: 22 MSA-1
Sample description: glass fiber filter
Remarks: sample flaked from filter surface

P.O.# 14430
Run # 789-140

Results are in micrograms per gram (dry weight/estimated error) unless otherwise indicated.

Aluminum - not detrmd	Indium 3.6^{-5} <8	Rubidium 2.7^{-5} <6
Antimony 8.5^{-5} <20	Iodine 1.3^{-4} <30	Ruthenium 3.1^{-5} <7
Arsenic 4.9^{-4} - 110/20	Iridium 3.6^{-4} <80	Scandium 1.3^{-3} <300
Barium 4.3^{-4} - 96/20	Iron 4.4^{-2} - 9900/1000	Selenium 4.3^{-5} (9.6)
Bismuth 8.9^{-5} <20	Lead 1.3^{-4} (30)	Silicon 8.5^{-2} (1.9%)
Bromine 2.2^{-5} <5	Manganese 8.9^{-4} (200)	Silver 2.5^{-4} - 57/7
Cadmium 3.1^{-5} <7	Mercury 8.0^{-5} (18)	Strontium 9.8^{-4} - 220/30
Calcium 4.9^{-2} - 1.1%/0.2%	Molybdenum 3.3^{-3} - 740/80	Sulfur 6.3^{-1} - 14%/3%
Cesium 1.8^{-4} <40	Nickel 7.2^{-2} - 1.6%/0.2%	Tantalum 4.5^{-4} <100
Chlorine 2.2^{-2} <0.5%	Niobium 4.5^{-5} <10	Tellurium 8.9^{-5} <20
Chromium 8.9^{-4} <200	Osmium 1.3^{-4} <30	Thallium 8.9^{-5} <20
Cobalt 8.5^{-4} - 190/40	Palladium 3.1^{-5} <7	Tin 8.9^{-5} <20
Copper 2.2^{-4} <50	Phosphorus 4.5^{-2} <1%	Titanium 4.3^{-3} - 970/200
Gallium 1.6^{-3} - 350/40	Platinum 8.9^{-5} <20	Tungsten 2.2^{-4} <50
Germanium 8.9^{-5} <20	Potassium 8.5^{-3} - 1900/300	Vanadium 1.2^{-1} - 2.7%/0.3%
Gold 8.9^{-5} <20	Rhenium 1.3^{-4} <30	Yttrium 2.2^{-4} (49)
Hafnium 1.8^{-4} <40	Rhodium 3.1^{-5} <7	Zinc 1.9^{-3} - 420/50
		Zirconium 4.2^{-4} - 95/20
		other 39° 75.55%

$8.5^{-5} = 8.5 \times 10^{-5}$ lb/hr

4.470

( ) Semiquantitative

$\Sigma ppm_i = 244,522 = 24.452\%$ by weight

MSA-1 OUTLET
Front End • filter + wash
0.2754 grams
Vmstd. 53.54 DSCF
0.0795 gr/DSCF
7.55 lb/hr

ARMAMENT SYSTEMS, INC.
712-F N. Valley St.
Anaheim, Calif. 92801
(714) 635-1524

Mobil
San Diego

ENERGY DISPERSIVE X-RAY ELEMENT ANALYSIS

9/ 5/78

Prepared for: KVB Engineering/Brunetz
Sample lable: 104 MSA-1
Sample description: glass fiber filter
Remarks:

P.O.# 14430
Run # 789-141

Results are in micrograms per square centimeter (dry weight/estimated error). A. 109 cm^2 = 0.2244 grams = 0.0021 gram/cm^2 = 2100 $\mu g/cm^2$

Aluminum - not detrmd	Indium 2.2^{-4} <0.06	Rubidium 1.4^{-3} <0.4
Antimony 7.2^{-4} <0.2	Iodine 1.1^{-3} <0.3	Ruthenium 2.2^{-4} <0.06
Arsenic 5.8^{-4} 0.16/0.04	Iridium 2.5^{-3} <0.7	Scandium 3.6^{-3} <1
Barium 2.2^{-3} <0.6	Iron 1.9^{-2} - 5.3/0.7	Selenium 1.8^{-4} (0.05)
Bismuth 3.6^{-4} <0.1	Lead 4.7^{-4} (0.13)	Silicon - not detrmd
Bromine 1.4^{-4} <0.04	Manganese 3.6^{-4} <0.1	Silver 1.8^{-4} <0.05
Cadmium 2.2^{-4} <0.06	Mercury 2.5^{-4} (0.07)	Strontium 2.8^{-3} 0.77/0.1
Calcium 3.1^{-1} (86)	Molybdenum 3.6^{-3} 0.84/0.1	Sulfur 2.8^{0} - 770/200
Cesium 1.4^{-3} <0.4	Nickel 1.0^{-1} - 28/3	Tantalum 2.9^{-3} <0.8
Chlorine 3.2^{-2} <9	Niobium 3.6^{-4} <0.1	Tellurium 7.2^{-4} <0.2
Chromium 1.4^{-3} <0.4	Osmium 2.9^{-3} <0.8	Thallium 3.6^{-4} <0.1
Cobalt 7.2^{-4} <0.2	Palladium 2.2^{-4} <0.06	Tin 7.2^{-4} <0.2
Copper 7.2^{-4} <0.2	Phosphorus 2.2^{-1} <60	Titanium 7.6^{-3} (2.1)
Gallium 3.3^{-3} - 0.92/0.1	Platinum 7.2^{-4} <0.2	Tungsten 7.2^{-4} <0.2
Germanium 1.8^{-4} <0.05	Potassium 1.1^{-2} <3	Vanadium 9.3^{-2} - 26/3
Gold 3.6^{-4} <0.1	Rhenium 3.6^{-4} <0.1	Yttrium 3.6^{-4} <0.1
Hafnium 3.6^{-3} <1	Rhodium 2.2^{-4} <0.06	Zinc 4.0^{-3} - 1.1/0.2
		Zirconium 1.5^{-3} (0.43)
		Other 3.9^{0} 1097.19

030

( ) Semiquantitative

1002.81 $\mu g/cm^2$

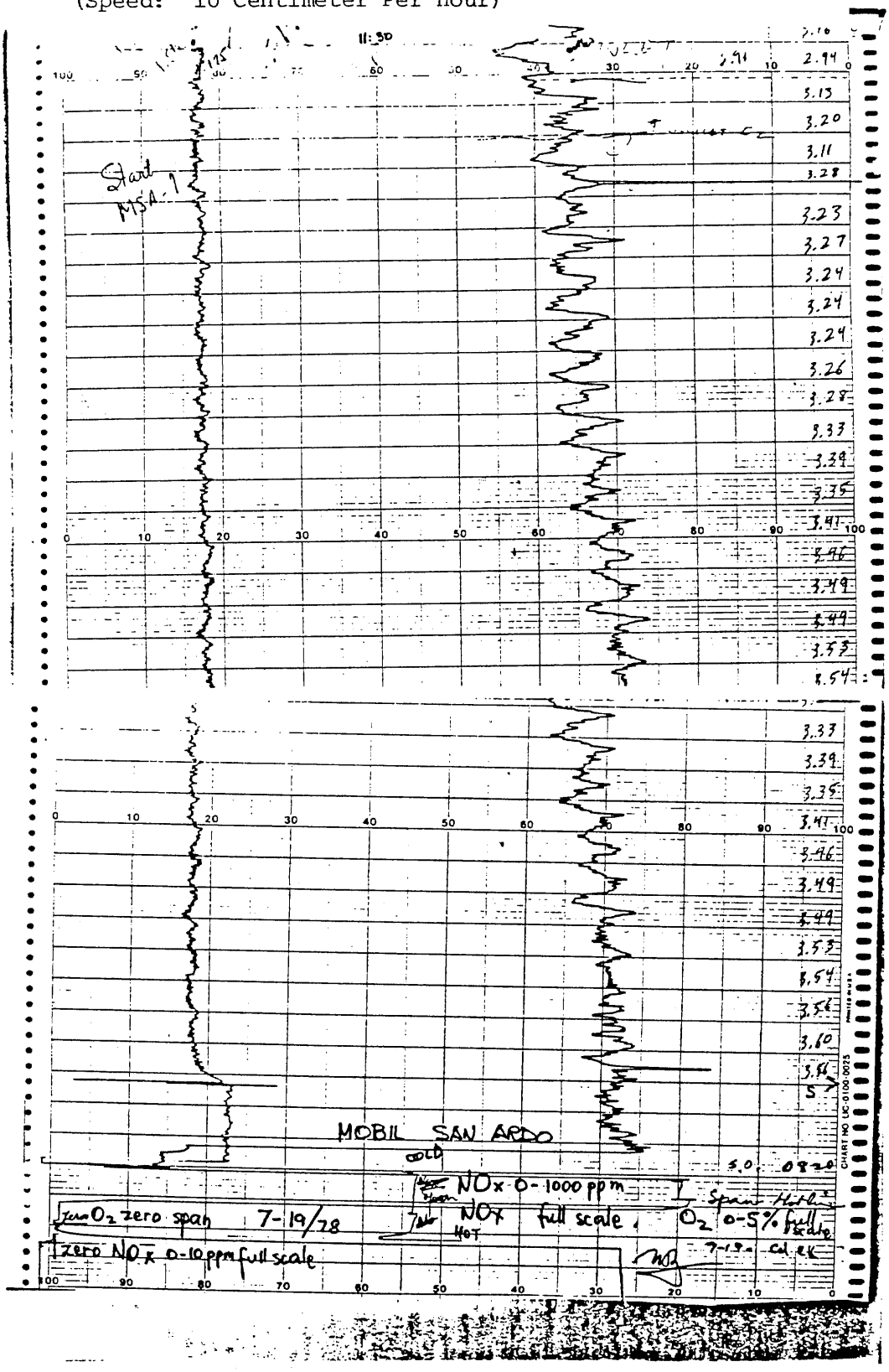
KVB 5807-842

7.55 lb/hr

MOBIL TEST - SAN ARDO

INSTRUMENT RECORDED DATA ON NO_x IN TEST 1

(Speed: 10 Centimeter Per Hour)



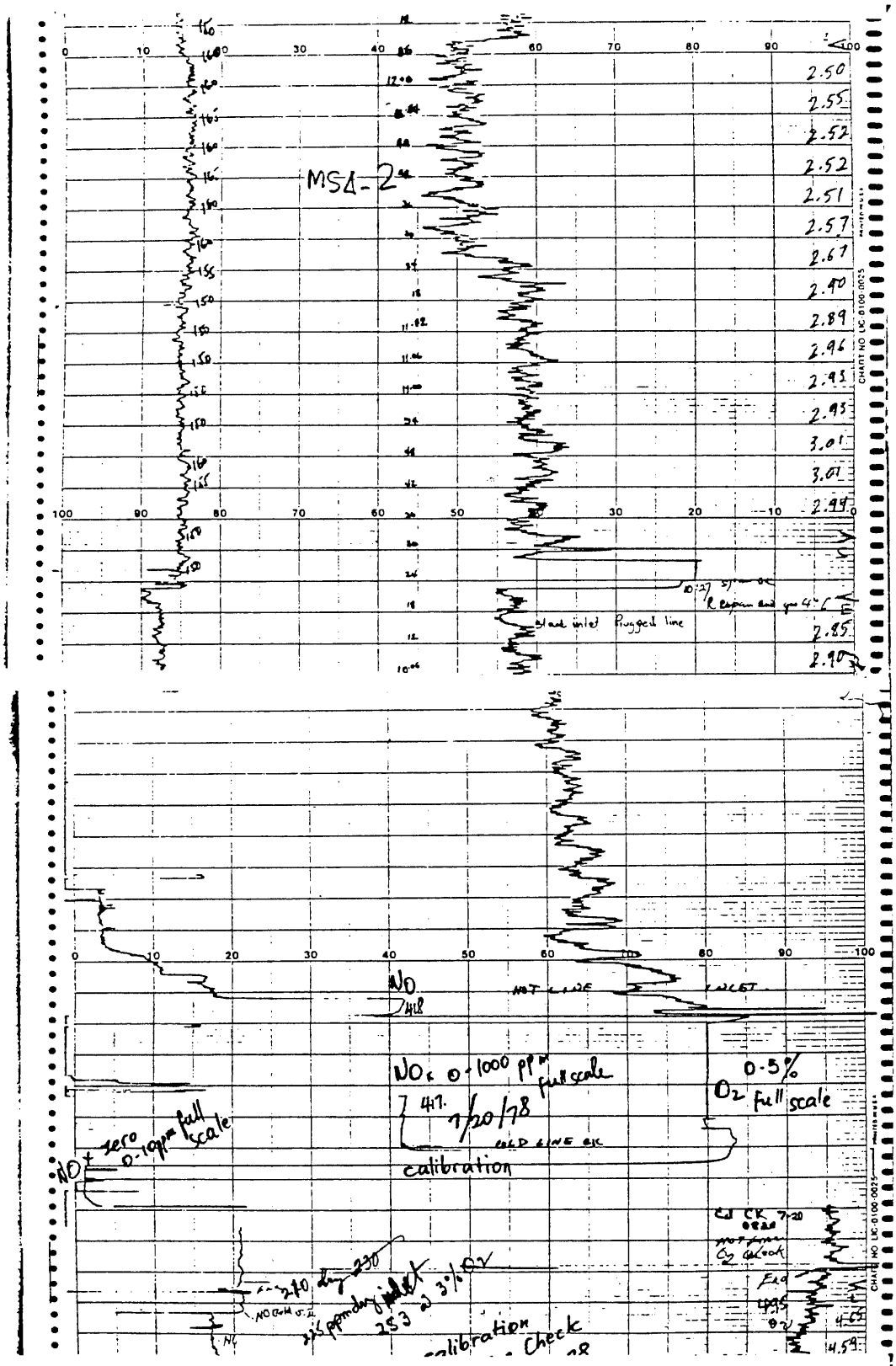
KVB 5807-842

NO NOx
Span
7-19-78
0-1000 ppm full scale end
Cold
Hot
NOx
Zero 0=10 ppm full scale
MSA 1
outlet
Burner Box O2 3.5%
7/19/78
outlet
inlet
sample line valving
INLET
dry
3% O2

MOBIL TEST - SAN ARDO

INSTRUMENT RECORDED DATA ON NO_x AND O_2 IN TESTS 2

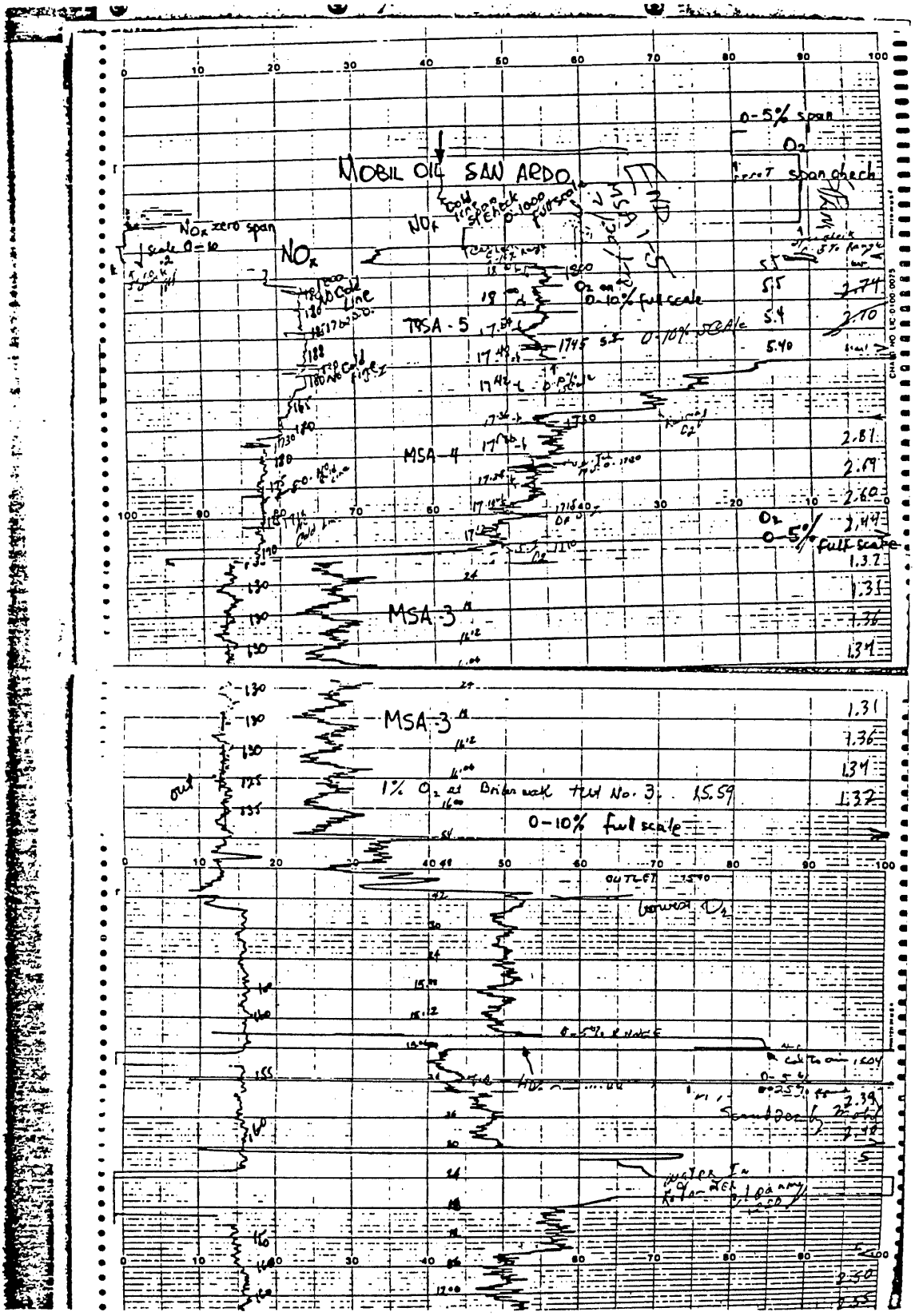
(Speed: 10 Centimeter Per Hour)



KVB 5807-842

MOBIL TEST - SAN ARDO

INSTRUMENT RECORDED DATA ON NO_x AND O_2 IN TESTS 3,4, AND 5

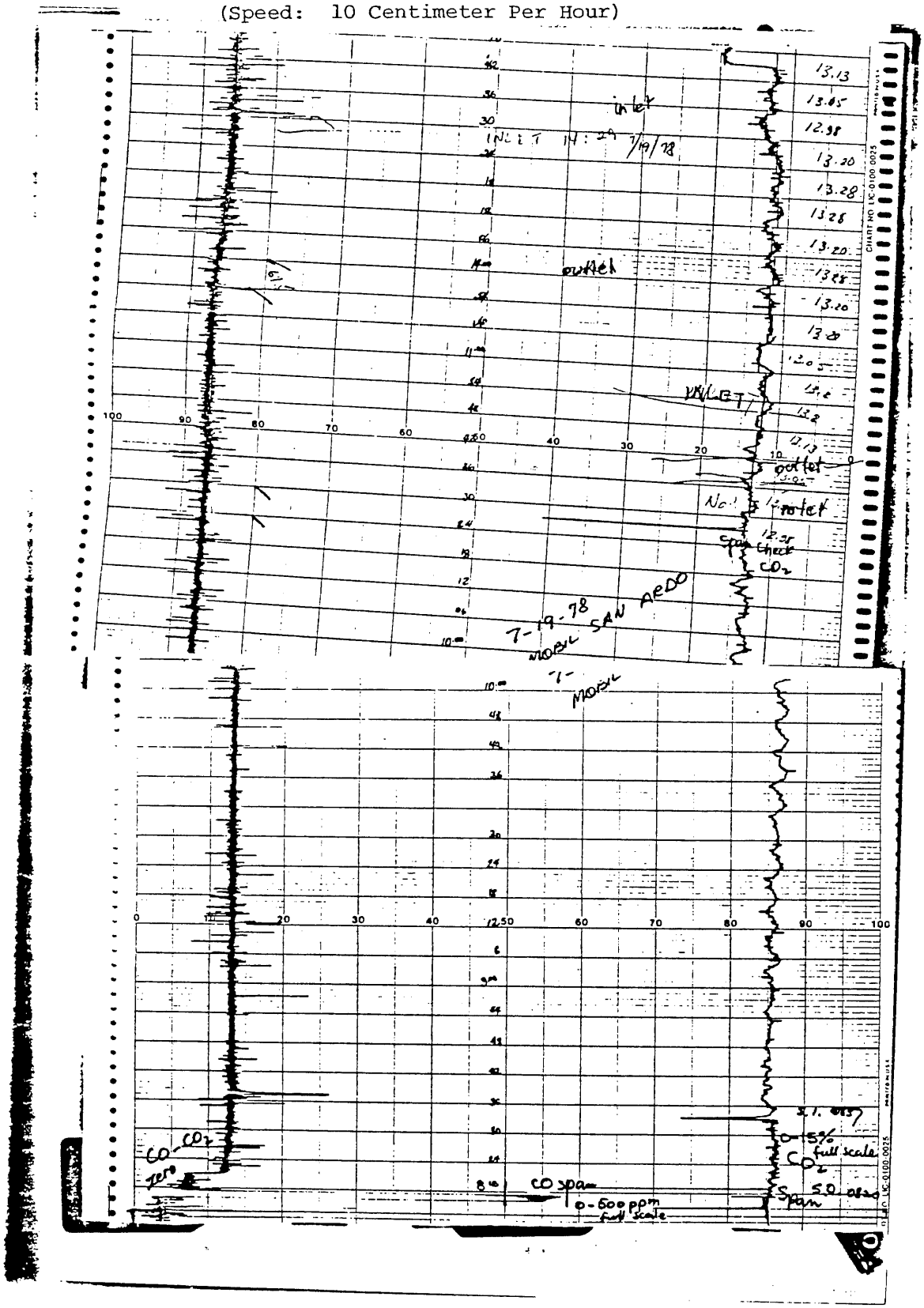


KVB 5807-842

MOBIL TEST - SAN ARDO

INSTRUMENT RECORDED DATA ON CO AND CO_2 IN TEST 1

(Speed: 10 Centimeter Per Hour)

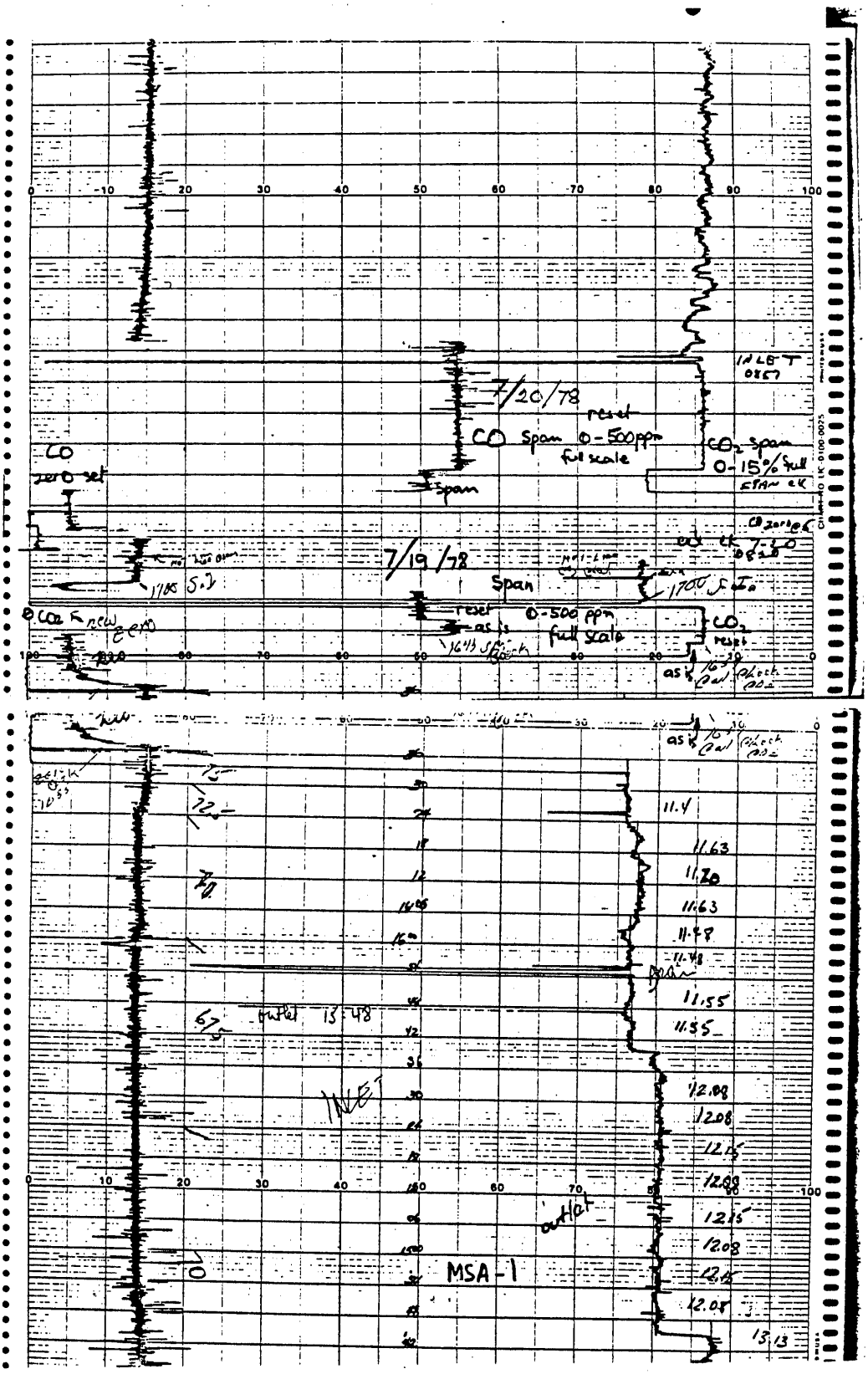


KVB 5807-842

MOBIL TEST - SAN ARDO

INSTRUMENT RECORDED DATA ON CO AND CO_2 IN TEST 1 AND 2

(Speed: 10 Centimeter Per Hour)

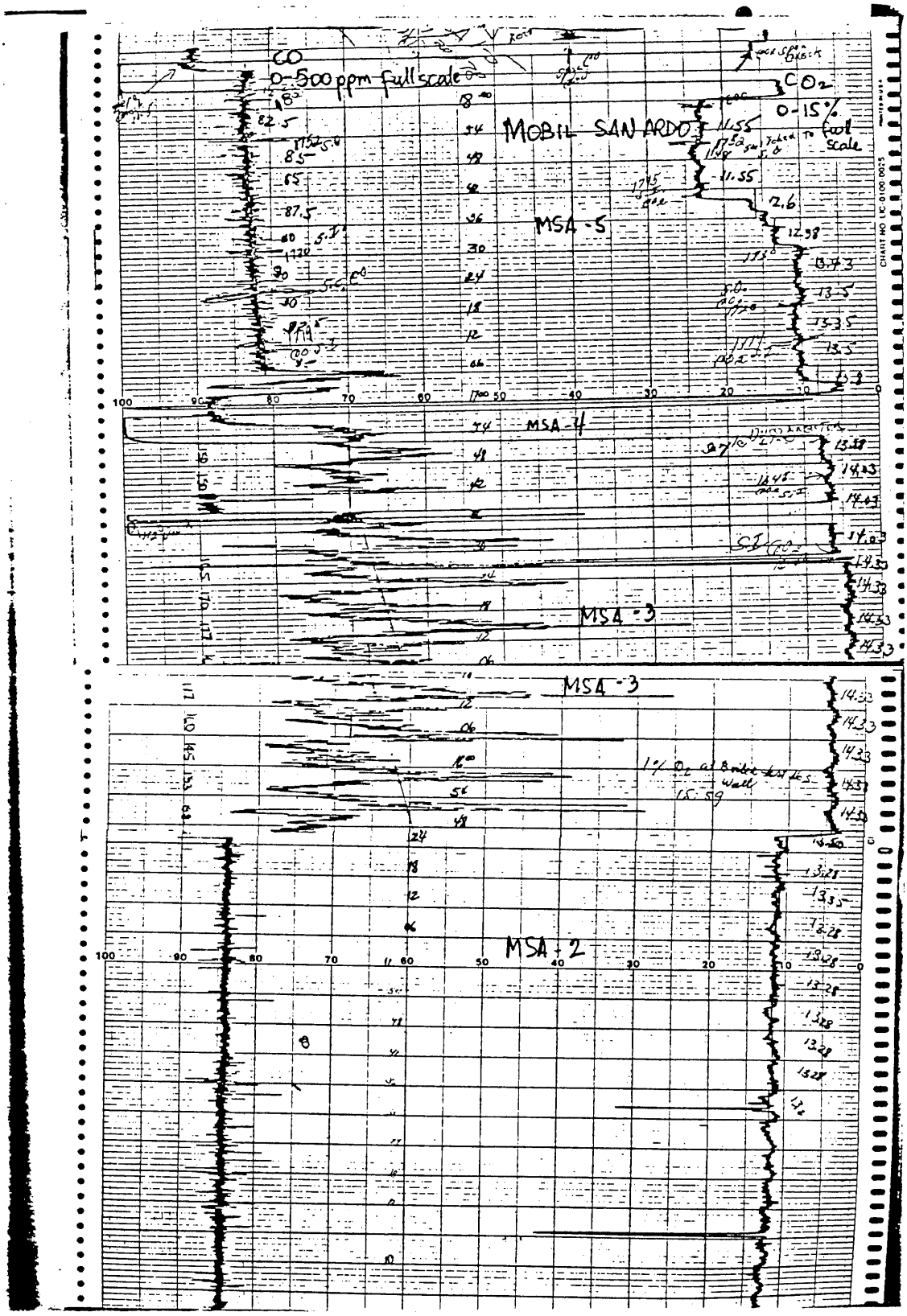


KVB 5807-842

MOBIL TEST - SAN ARDO

INSTRUMENT RECORDED DATA ON CO AND CO_2 IN TESTS 5,4,3

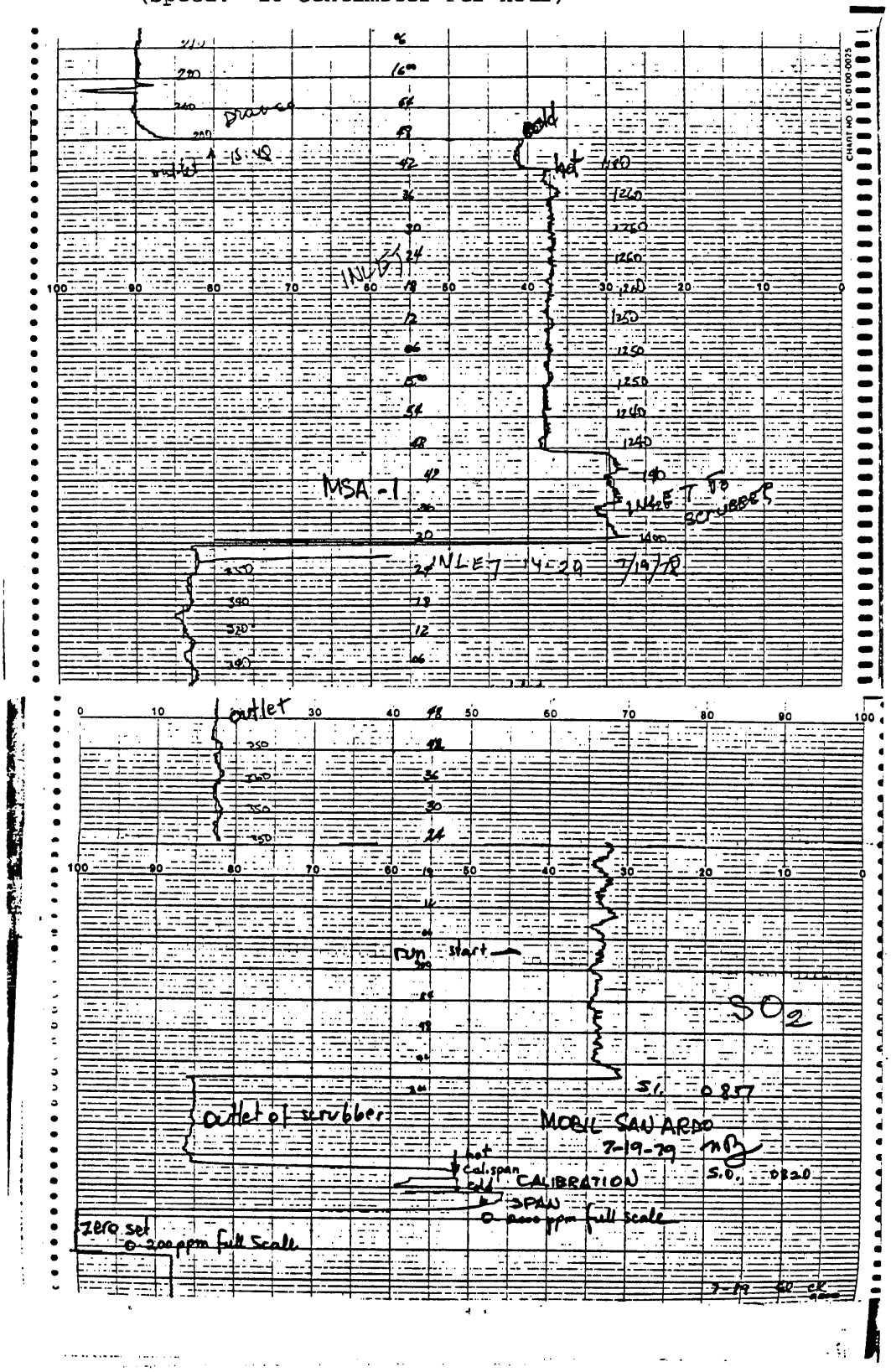
(Speed: 10 Centimeter Per Hour)



MOBIL TEST - SAN ARDO

INSTRUMENT RECORDED DATA ON SO_2 in Test 1

(Speed: 10 Centimeter Per Hour)

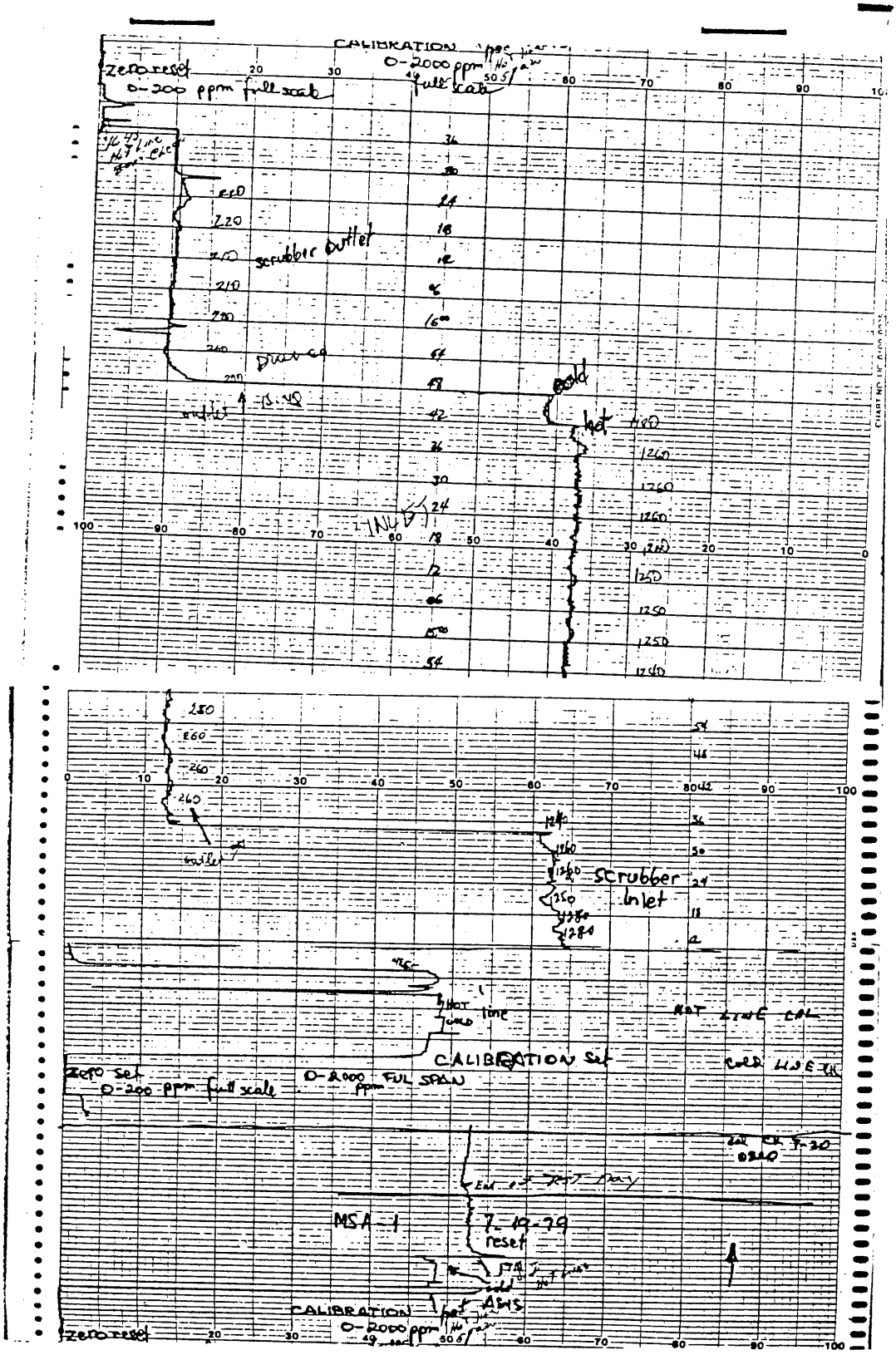


KVB 5807-842

MOBIL TEST - SAN ARDO

INSTRUMENT RECORDED DATA ON SO_2 IN TESTS 2 AND 1

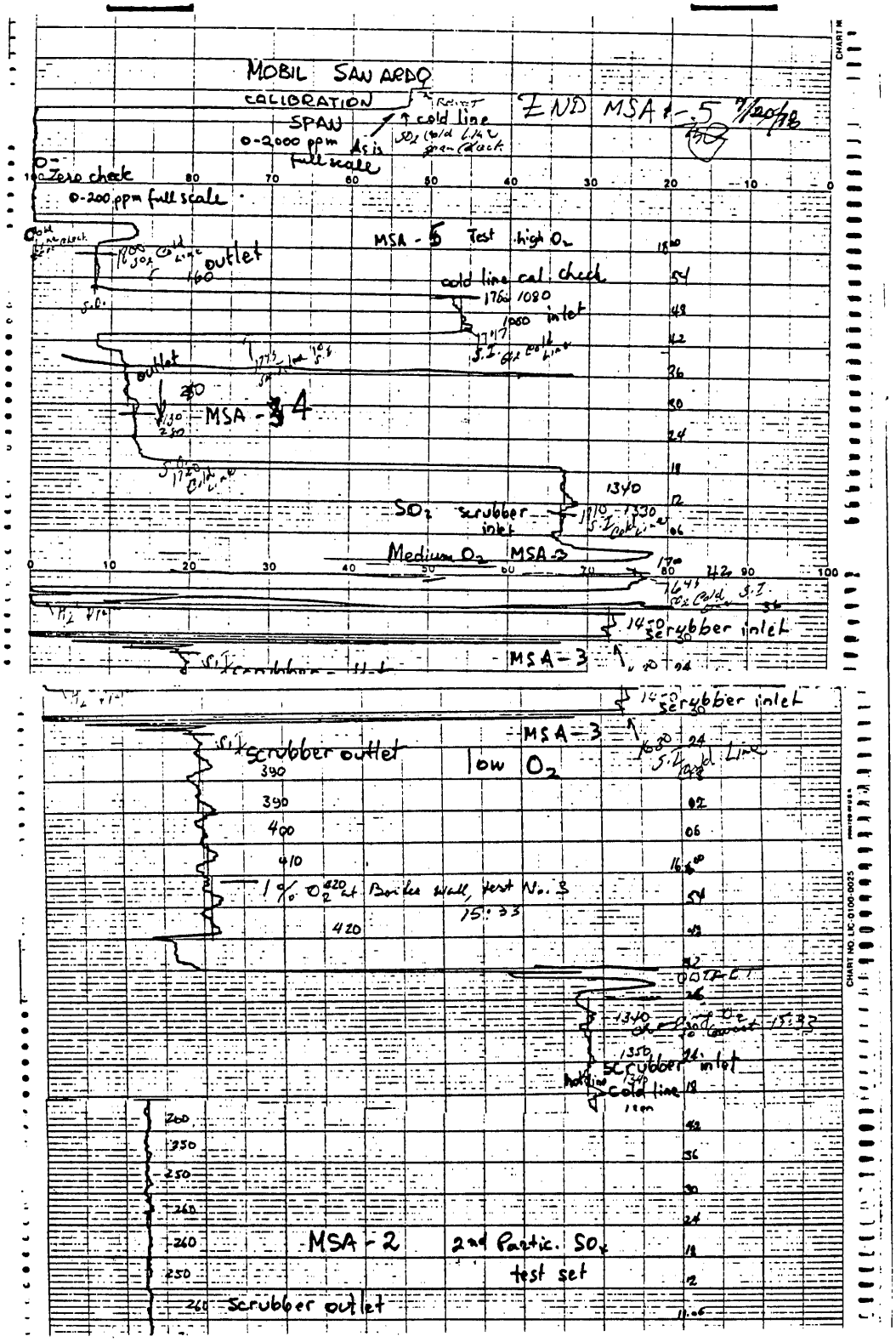
(Speed: 10 Centimeter Per Hour)



MOBIL TEST - SAN ARDO

INSTRUMENT RECORDED DATA ON SO_2 IN TEST 5,4,3 AND 2

(Speed: 10 Centimeter Per Hour)



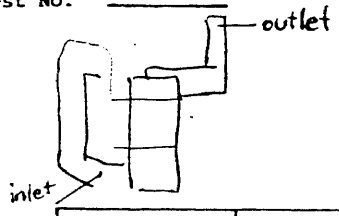
KVB 5807-842

KVB

Sample Code MSA 1 O_2N 71878

Firm and Unit MOBIL SAN ARD No. 22-5 50 mm Btu

Test No. 1



Page

Date 7/19/78

inlet to Scrubber

GRAB AND BAG SAMPLE RESULTS
HYDROCARBONS, ALDEHYDES

INLET to SCRUBBER

SAMPLE STATION	Sample Type and Sampling Time	Components	ppm Dry Basis	ppm Stack Conditions	Grains/SCF Stack Conditions	LBS/HR Loss
Location	~~No. time~~	NOx				
INLET to Scrubber	time	PDS	Time			
		No				
Temp., °F	Danes more at 12:38	1315 2028 cc	1231			
		1061 2060 cc	1232			
		~~1151 2090 cc~~	~~[illegible]~~			
Humidity, %		1334 2052 cc	1228			
		1320 2055 cc	1227			
Location	Time	HC	Time			
INLET To SCRUBBER		No				
		~~103~~	~~12:07~~			
		~~28~~	~~12:08~~			
Temp., °F	500	21	1225			
	250	5	1226			
Humidity, %	Danes more at 12:38					
Location						
Temp., °F						
Humidity, %						

KVB 5807-842

KVB

Sample Code MSA 1 O_2N 7/18/78

Firm and Unit Mobil San Ardo No. 22-5 50 mm Btu

Test No. 1

Page

Date 7-18-78

OUTLET of SCRUBBER

GRAB AND BAG SAMPLE RESULTS
HYDROCARBONS, ALDEHYDES

OUTLET STACK

SAMPLE STATION	Sample Type and Sampling Time	Components	ppm Dry Basis	ppm Stack Conditions	Grains/SCF Stack Conditions	LBS/HR Loss
Location OUTLET STACK Temp., °F Humidity, %	Time Same - More at 12:15	NO_x PDS No 1356 204 cc 12:08 1345 202 cc 12:10 808 - 1974 cc 1205 460 207 cc 1357 203 cc 12:11				
Location OUTLET STACK Temp., °F Humidity, %	Time 500 cc 500 cc Same More at 12:23	HC No 103 12:00 28 12:00				
Location Temp., °F Humidity, %	Background 500 cc.	No. 17	13:00			

KVB

Sample Code MSA 2 O2 N 4%

Firm and Unit Mobil San Ardo 22-5 50 MM Btu

Test No. 2

Page

Date 7-20-78

INLET to SCRUBBER

GRAB AND BAG SAMPLE RESULTS
HYDROCARBONS, ALDEHYDES

SAMPLE STATION	Sample Type and Sampling Time	Components	ppm Dry Basis	ppm Stack Conditions	Grains/SCF Stack Conditions	LBS/HR Loss
Location INLET to Scrubber Temp., °F 100 Humidity, % 30	PDS 12:45 at lower duct mobil O_2 4% Fyrite	1324 2062 cc 1181 2090 cc 1136 1999 cc 718 2060 cc				
Location INLET to Scrubber Temp., °F 100 Humidity, % 30	HC 12:45 at lower Duct 4% O_2 by Mobil	13-250 cc 19-250 11:32 → 18-500 Background				
Location Temp., °F Humidity, %						

KVB

Sample Code MSA 2 O.N 4% 72078

Firm and Unit Mobil San Ardo, 22-5 w/scrubber

Test No. 2

Page

Date 7/20/78

outlet of scrubber

GRAB AND BAG SAMPLE RESULTS
HYDROCARBONS, ALDEHYDES

50mm Btu outlet to 22-5 steam generator w/scrubber

SAMPLE STATION	Sample Type and Sampling Time	Components	ppm Dry Basis	ppm Stack Conditions	Grains/SCF Stack Conditions	LBS/HR Loss
Location outlet stack Temp., °F 100 Humidity, % 30	12:55 NOx PDS	~~HC~~				
		1328 2070cc				
		1029 2008cc				
		980 2072cc				
		1046 2054cc				
Location outlet stack Temp., °F 100 Humidity, % 30	12:56 HC	No 6 250cc				
		No 20 250cc				
Location Temp., °F Humidity, %						

SULFUR SOx

Method 8

INLET · B

LOCATION Mobil San Pedro 50 MM Btu
UNIT 22-S FUEL Crude
OPERATORS Jack Burns

TEST NUMBER	NSA 1 O2 N 7878
DATE	1-19-78
AMBIENT TEMPERATURE, °F	98
METER VOL. (START/END)	/

Page 2 of 2

Fuel Analysis (% By Weight)

C = H = S = O =
N = CO_2 = H_2O =
ASH = INERT =
DENSITY = HHV =

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
$\Delta H_@$ = Noz (Ideal) =
% H_2O = Noz (Actual) =
▼ =

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1	68	100	-32
#2	134	100	34
#3	116	100	16
		Total	18

#4 (Silica Gel)	g (End)	g (Start)	Δ grams
	218.6	200	18.6

Total Vol. H_2O 36.6 ml

Filter# ____

Particulate Wts
Filter ____ mg
Acetone ____ mg
Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In.Hg-Gauge	Barometric Pressure
single point							

TEST RESULTS

Test Averages:
ΔPs = ____ T_{stack} = 600 °F
ΔH = 1.1 T_{meter} = 120 °F
Sample Vol. = 13.44 Ft^3

Percent O_2 = ____
$MW_{stack\ gas}$ = ____ (~28)
Velocity = ____ ft/sec

Total Sample Time = ____ min.

ISOKINETICS = ____ %

Particulate Emissions

____ lbs/10^6 BTU

Sample Point	Time	METER CONDITIONS ΔPs	METER CONDITIONS ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
START B	13:18		1.1	5594.32	—	—	—		85	120		13
END	1335		1.1	5607.76	600				100	120		
Average												

PURGE START 1350
END 1410

COMMENTS:

265.6

284.2
65.6
218.6

LEAK RATE > .01

046

KVB 5807-842

SULFUR SO_x METHOD 8 OUTLET. (1)

LOCATION Mobil San Ardo 50mm Btu
UNIT 22-5 FUEL Crude
OPERATORS Jack Burns

TEST NUMBER	MSA 1 O_2 N
DATE	7-10-78
AMBIENT TEMPERATURE, °F	
METER VOL. (START/END)	8104.15 / 8138.51

Page 1 of 2

Fuel Analysis (% By Weight)

C = H = S = O =
N = CO_2 = H_2O =
ASH = INERT =
DENSITY = HHV =

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
$\Delta H_@$ = Noz (Ideal) =
% H_2O = Noz (Actual) =
▼ =

Imp.	Vol. (End)		Vol. (Start)		ΔVol. (ml)
#1	258	−	100	=	158
#2	143	−	100	=	43
#3	118	−	100	=	18
				Total	219
#4 (Silica Gel)	g (End)		g (Start)		Δ grams
	230	−	200	=	30
				Total Vol. H_2O	249 ml

Filter# ____

Particulate Wts

Filter ____ mg
Acetone ____ mg
Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In.Hg-Gauge	Barometric Pressure
single point	—	249	—	—	—	—	30.15

TEST RESULTS

Test Averages:
ΔP_s = — T_{stack} = 175 °F
ΔH = 1.1 T_{meter} = 110 °F
Sample Vol. = 34.36 Ft^3

	Sample Point	Time	METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
START	18 in	1549			8104.15	175							
		1606		1.2	8120.3	—	—	—		110			120
		1621		.9	8132.5	—	—			111			120
	END	1627			8138.51								
	Average												

Percent O_2 = ____
$MW_{stack\ gas}$ = ____ (~28)
Velocity = ____ ft/sec
Total Sample Time = ____ min.
ISOKINETICS = ____ %

Particulate Emissions

____ lbs/10^6 BTU

COMMENTS:

64.0

SUN ~~HEATING~~ HITTING [illegible] THERMISTER
LEAK CK less than .01 CFM

PURGE START 1642
END 1709

KVB 5807-842

047

SULFUR SO_x METHOD 8 INLET

(1)

LOCATION Mobil SAN ARDO 50 MMBtu
UNIT 22-5 FUEL Crude
OPERATORS J. Burns

TEST NUMBER	MSA / O_2N
DATE	7-19-78
AMBIENT TEMPERATURE, °F	100
METER VOL. (START/END)	5568.56 / 5582.16

Page 1 Of 2

Fuel Analysis (% By Weight)

C = H = S = O =
N = CO_2 = H_2O =
ASH = INERT =
DENSITY = HHV =

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
$\Delta H_@$ = Noz (Ideal) =
% H_2O = Noz (Actual) =
▼ =

Imp.	Vol. (End)		Vol. (Start)		ΔVol. (ml)
#1 IPA	68	−	100	=	−32
#2 H_2O_2	138	−	100	=	38
#3 H_2O_2	114	−	100	=	14
				Total	20
#4 (Silica Gel)	g (End)		g (Start)		Δ grams
	15.6	−	200	=	15.6
				Total Vol. H_2O	35.6 ml

Filter#

Particulate Wts

Filter ____ mg
Acetone ____ mg
Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In.Hg-Gauge	Barometric Pressure
EAST PORT 15 MIN							30.15

TEST RESULTS

Test Averages:
ΔP_s = — T_{stack} = 600 °F
ΔH = 1.1 T_{meter} = 100 °F
Sample Vol. = 13.60 Ft^3

Sample Point	Time	METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
START	1100		1.2	5568.56	600	—	—			100		13
	1107		1.1	5576.						100		13
	1115			5582.16								
	15											
Average			1.15		600					100		13

Percent O_2 = ____
$MW_{stack\ gas}$ = ____ (~28)
Velocity = ____ ft/sec
Total Sample Time = ____ min.
ISOKINETICS = ____ %

Particulate Emissions

____ lbs/10^6 BTU

COMMENTS:

290.8 total
MEOTH #8
1/2" probe 14" in
LEAK RATE less than .01 CFA

PURGE STARTED 1131
STOP 1146

KVB 5807-842

048

291.1
63.8
227.3

Scrubber Outlet

SOx Method 8

LOCATION Mobil San Ardo
UNIT 22-5 FUEL Crude
OPERATORS

TEST NUMBER	MSA 2 02N
DATE	7-28-78
AMBIENT TEMPERATURE, °F	
METER VOL. (START/END)	8139.23 /

Page ____ Of ____

Fuel Analysis (% By Weight)

C = H = S = O =

N = CO_2 = H_2O =

ASH = INERT =

DENSITY = HHV =

Nomograph Setup

P_{meter} = C =

P_{stack} = T_{stack} =

T_{meter} = ΔP =

$\Delta H_@$ = Noz (Ideal) =

% H_2O = Noz (Actual) =

Y =

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1	232	100	132
#2	144	100	44
#3	128	100	28
		Total	304

#4 (Silica Gel)	g (End)	g (Start)	Δ grams
	227.3	200	27.3

Total Vol. H_2O 331.3 ml

Filter# ____

Particulate Wts

Filter ____ mg

Acetone ____ mg

Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In.Hg-Gauge	Barometric Pressure
SINGLE POINT	—	331.3	—	—	—	—	30.08

Sample Point	Time	METER CONDITIONS ΔPs	METER CONDITIONS ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
START	1229		1.2	8139.23					95	100		11
	[illegible]		1.1						100	109		16
	1249		1.2	8159.0					101	111		15
	1259			8168.43								
Average												

TEST RESULTS

Test Averages:

ΔPs = — T_{stack} = 175 °F

ΔH = 1.2 T_{meter} = 107 °F

Sample Vol. = 29.2 Ft^3

Percent O_2 = ____

$MW_{stack\ gas}$ = ____ (~28)

Velocity = ____ ft/sec

Total Sample Time = ____ min.

ISOKINETICS = ____ %

Particulate Emissions

____ $lbs/10^6$ BTU

COMMENTS:

049

KVB 5807-842

MOBIL TESTS - SAN ARDO

METHOD 8 DETERMINATION OF SO_2 AND SO_3 SUMMARY OF RESULTS AND TITRATION DATA

SUMMARY SOx DATA

LOCATION / TEST	DATE	SO_3 ppm	$C_{H_2SO_4}$ as Sulfuric Acid lb/ft³	SO_2 ppm	C_{SO_2} As SO_2 lb/ft³
MOBLE OIL SAN ARDO					
INLET (A)	7-19	37	9.65×10^{-6} Test 1	1241	2.09×10^{-4} Test 1
INLET (B)	7-19	38	9.87×10^{-6} Test 2	1315	2.22×10^{-4} Test 2
OUTLET	7-19	21	5.46×10^{-6} Test 1	199	3.36×10^{-6} Test 1
OUTLET	7-20	NOT DETECTED	Test 2	250	4.20×10^{-5} Test 2

KVB 5807-842

MOBIL OIL SAN ARDO 7-19-78

UNIT # 22-5 FUEL CRUDE OIL

INLET TO SCRUBBER

MSA 1 O_2 N. B.

SAMPLE SIZE = 13.60 cf

METER TEMP = 100 °F = 560 °R

NOTE: TEMP COMPENSATED METER USE 530 °F.

STACK TEMP = 600 °F = 1060 °R.

B.P. = 30.15 " N_3

ΔH = 1.1 " H_2O

H_2O CONDINSATE = 35.6 ml H_2O

SAMPLE VOL IN SCF = $13.60 \times 17.71 \times \frac{30.15 + \frac{1.1}{13.6}}{530} = 13.74$

% H_2O = $\frac{1.69 \times 100}{13.74 + 1.69} = 10.9\%$ .0474 (35.6) = 1.687

SO_3

TOTAL VOLUME = 282 ml

ALIQUOT = 15 A ml , 25 B ml

ml $Ba(ClO_4)_2$ = 7.9 ml 9.3 ml

N $Ba(ClO_4)_2$ = .0098

Blank ml Ba(ClO$_4$)$_2$ = .1 ml

SO_3 ppm = $(7.9 - .1) \times .0098 \times .04 \times \frac{10,400}{13.74} \times \frac{282}{15}$ = 44 ppm SO_3 STACK CONDITION

SO_3 ppm = $(9.3 - .1) \times .0098 \times .04 \times \frac{10,400}{13.74} \times \frac{282}{25}$ = 31 ppm SO_3 STACK CONDITION

37.5 ppm SO_3 ave.

SO_3 continued

$C_{H_2SO_4}$ lb/dscf $= 1.08 \times 10^{-4} \times (7.9-.1) \times .0098 \times \frac{252}{15} \div 13.74 = 1.13 \times 10^{-5}$

$C_{H_2SO_4}$ lb/scf $= 1.08 \times 10^{-4} \times (9.3-.1) \times .0098 \times \frac{252}{25} \div 13.74 = 7.99 \times 10^{-6}$

ave 9.65×10^{-6}

SO_2

TOTAL VOLUME = 425 ml

ALIQUOT = 1 ml

ml ~~of~~ $Ba(ClO_4)_2$ = 9.9 ml

N $Ba(ClO_4)_2$ = .0098

ml FOR BLANK = .1

$SO_{2\,ppm} = (9.9-.1) \times .0098 \times \frac{425}{1} \times .03203 \times \frac{13040}{13.74} =$ 1241 ppm at STACK CONDITION dry

C_{SO_2} lb/scf $= 7.05 \times 10^{-5} \times (9.9-.1) \times .0098 \times \frac{425}{13.74} = 2.09 \times 10^{-4}$

(3)

MSA 1 O_2 N B INLET TO SCRUBBER

TIME 1318

SAMPLE SIZE = 13.44 cf

METER TEMP = 530°R

STACK TEMP = 600°F

B.P. = 30.15 "H_g

ΔH = 1.1 "H_2O

H_2O CONDENSATE = 36.6 ml

$$\text{SAMPLE Vol IN SCF} = 13.44 \times 17.71 \times \frac{30.15 + \frac{1.1}{13.6}}{530} = 13.58$$

Vol H_2O VAPOR = .0474 (36.6) = 1.73

$$\%\ H_2O = \frac{1.73}{13.58 + 1.73} = 11.3\%$$

SO_3

TOTAL VOLUME = 344 ml

ALIQUOT = 25 ml

ml $Ba(ClO_4)_2$ = 9.3 ml (9.4, 9.1, 9.3)

N $Ba(ClO_4)_2$ = .0098

Blank = .1 ml

$$SO_{3\,ppm} = (9.3 - .1) \times .0098 \times .04 \times \frac{344}{25} \times \frac{10,400}{13.58} = 38\ ppm$$

$$C_{H_2SO_4}\ lb/ft^3 = 1.08 \times 10^{-4} \times (9.3 - .1) \times \frac{.0098 \times \frac{344}{25}}{13.58} = 9.87 \times 10^{-6}\ lb/ft^3$$

KVB 5807-842

MSA 1 O_2 N (B) INLET TO SCRUBBER

SO_2

TOTAL VOLUME = 574 ml

ALIQUOT = 1 ml

ml $Ba(ClO_4)_2$ = 7.8, 7.4, 7.8 = 7.7

N $Ba(ClO_4)_2$ = .0098

ml Blank = .1

$$SO_2 \text{ ppm} = (7.7-.1) \times .0098 \times \frac{574}{1} \times .03203 \times \frac{18040}{13.58} = 1315 \text{ ppm}$$

$$C_{SO_2} \text{ lb/ft}^3 = 7.05 \times 10^{-5} \times (7.7-.1) \times .0098 \times \frac{574}{13.58} = 2.22 \times 10^{-4}$$

MSA 1 O_2 N (A) OUTLET OF SCRUBBER

TIME 1549

SAMPLE SIZE = 34.36 CF

METER TEMP = 530°R

STACK TEMP = 175°F

B.P. = 30.15" Hg

ΔH = 1.1" H_2O

H_2O in CONDENSATE = 249

$$\text{SAMPLE VOL IN SCF} = 34.36 \times 17.71 \times \frac{30.15 + \frac{1.1}{13.6}}{530} = 34.71$$

$$\text{Vol } H_2O \text{ VAPOR} = .0474 (249) = 11.80$$

$$\%\ H_2O \text{ IN STACK} = 100 \times \frac{11.80}{34.71 + 11.80} = 25.4\%$$

(5)

MSA / O_2 N (A) OUTLET OF SCRUBBER

SO_3

TOTAL VOL = 503

ALIQUOT = 25 ml

ml $Ba(ClO_4)_2$ = (9.7, 9.1, 9.1) = 9.0 ml

N $Ba(ClO_4)_2$ = .0098

ml Blank = .1 ml

$$SO_3\ ppm = (9.0 - .1) \times .0098 \times \frac{503}{25} \times .04 \times \frac{10,400}{34.71} = 21\ ppm$$

$$C_{H_2SO_4}\ lbs/ft^3 = 1.03 \times 10^{-4} \times (9.0 - .1) \times \frac{.0098 \times \frac{503}{25}}{34.71} = 5.46 \times 10^{-6}$$

SO_2

TOTAL VOL = 626 ml

ALIQUOT = 1 ml

ml $Ba(ClO_4)_2$ = (2.8, 2.8, 2.8) = 2.8 ml

N $Ba(ClO_4)_2$ = .0098

ml Blank = .1 ml

$$SO_2\ ppm = (2.8 - .1) \times .0098 \times \frac{626}{1} \times .08203 \times \frac{13040}{34.71} = 199\ ppm$$

$$C_{SO_2} = 7.05 \times 10^{-5} \times (2.8 - .1) \times .0098 \times \frac{626}{34.71} = 3.36 \times 10^{-6}\ lb/ft^3$$

(6)

MSA 2 O_2N OUTLET OF SCRUBBER 7-20-78

SAMPLE SIZE = 29.2 CF
METER TEMP = 530 °R
STACK TEMP = 175 °F
B.P. = 30.08 "H_g
ΔH = 1.2 "H_2O
H_2O CONDENSATE = 331.3 ml

SAMPLE SIZE IN SCF = $29.2 \times 17.71 \times \frac{30.15 + \frac{1.2}{13.6}}{530} = 29.50$
Vol H_2O VAPOR = .0474 (331.3) =

% H_2O = $100 \times \frac{15.70}{29.50 + 15.70} = 34.7$ % H_2O

SO_3

TOTAL VOL = 430 ml
ALIQUOT = 25 ml
ml $Ba(ClO_4)_2$ = not detected ~~O~~ SO_3
N $Ba(ClO_4)_2$ = .0098
ml Blank = .1 ml.

(7)

MSA 2 O_2N OUTLET TO SCRUBBER 7-20-78

TOTAL VOLUME = 667 ml
ALIQUOT = 1 ml
ml $Ba(ClO_4)_2$ = (2.85, 2.8, 2.8) = 2.8 ml
N $Ba(ClO_4)_2$ = .0098
ml Blank = .1 ml

$$SO_2 \text{ ppm} = (2.8 - .1) \times .0098 \times \frac{667}{1} \times .03203 \times \frac{13040}{29.5} = 250 \text{ ppm}$$

$$C_{SO_2} \text{ lb/ft}^3 = 7.05 \times 10^{-5} \times (2.8 - .1) \times .0098 \times \frac{667}{29.5} = 4.2 \times 10^{-5}$$

~~MOBIL San Ardo~~

PARTICULATE EMISSION CALCULATIONS TEST 1, inlet N. Burnett

Test No. MSA-1 Date 7/19/78 Location MOBIL San Ardo Engr. Macko

Unit No. 22-5 Fuel Crude Sampling Train and Method SASS

Pitot Factor, Fs ~~.83~~ 1.0 Barometric Pressure, P_{bar} 30.18 (STO 0) in. Hg

Tot. Liquid Collected, V_{lc} 359 (STO 1) ml Total Particulate, M_n 1863.3 (STO 2) m gm

Velocity Head, ΔP see Nick (STO 3) iwg Stack Temp., Ts 600 °F (STO 4) Stack Area, As 22 (STO 5) ft^2

Sample Volume, Vm 191.29 (STO 6) ft^3 Stack Press., Psg -.8 (STO 7) iwg Excess O_2, XO_2% 3.3 (STO 8) %

Orifice Press. Diff., H 2.057 (STO 9) iwg Stack Gas Sp. Gravity, Gs 1.02 (29.49) (STO A) n.d.

Sample Time, θ 50 (STO B) min Nozzle Dia., Dn 1 3/16 (STO C) in. Meter Temp., T_m 108 (STO D) °F

Select F_e	Oil (A)	Gas (B)	Coal (C)	Other:
SC Feet/10^4 Btu	92.2	87.4	98.2	(D)

Press (E) if meter is not temperature compensated.

1. Sample Gas Volume $Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)\left(\frac{520}{T_m}\right)$ 30.02 .915 — 176.08 SCF } 193.1
2. Water Vapor $Vw_{std} = 0.0474\ V_{lc}$ — 17.02 SCF
3. Moisture Content Bwo = Eq. 2/(Eq. 1 + Eq. 2) — .0881 N.D.
4. Concentration a. $C = 0.0154\ Mn/Vm_{std}$ — 0.163 grains/DSCF
   b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$ — 2.33×10^{-5} lb/DSCF
   c. C = Eq. 4b x 16.018 x 10^3 — 0.374 grams/DSCM
5. Abs. Stack Press. $Ps = (P_{bar} \times 13.6) + Psg$ — 410 in. w abs.
6. Stack Gas Speed at ind. sample points $Vs = 174\ Fs\ \sqrt{\Delta PTs}\ \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$ 229 ft/sec x 60 .06 in H_2O outlet DSCF/(1-.0881) — 1375 ft/min
7. Stack Gas Flow Rate @ 70°F a. $Qsw = \cancel{Eq.\ 6} \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$ — 12,099 WSCF/min
   b. Qsd = Eq. 7a x (1. - Eq. 3) assuming outlet DSCF — 11,033 DSCF/min
8. Material Flow Ms = Eq. 7b x Eq. 4b x 60 — 15.42 lb/hr 901.8
9. XO_2 factor $XO_2f = 2090/(20.9 - XO_2\%)$ — 118.75 N.D.
10. Emission a. E = Eq. 4b x Fe x Eq. 9 — lb/MMBtu
    b. E = Eq. 4c x Fm x Eq. 9 x 1000 — ng/joule
11. % Isokinetic $I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$ 1060 $(1\frac{3}{16})^2$ — 72.5 % No direct access to inlet.

*If calculating by hand:
1) Convert T_s and T_m to °R
2) Multiply EQ 1 by $530/T_m$(°R) if meter not temperature compensated.
3) $F_m = 2.684 \times 10^{-5} \times F_e$

Data Sheet 6002-4
Revised 2/15/78

KVB 5807-842

PARTICULATES

SASS

INLET to SCRUBBER

11 AM 93°F 34% RH

1.42

LOCATION Mobil San Pedro 50MM Btu

UNIT 22-5 FUEL Coal

OPERATORS Jack Burns

SASS

TEST NUMBER	MSA 1 O_2 N
DATE	7-18-78
AMBIENT TEMPERATURE, °F	10 AM 84°F 40%RH 105°F 30%RH
METER VOL. (START/END)	643.71 / 835.00

Page 1 of 1

Fuel Analysis (% By Weight)

C = H = S = O =

N = CO_2 = / H_2O =

ASH = INERT =

DENSITY = HHV =

Nomograph Setup

P_{meter} = 30.18 C =

P_{stack} = T_{stack} = 600

T_{meter} = 108 ΔP = 0.6-0.8

$\Delta H_@$ = 1.8 Noz (Ideal) =

% H_2O = 10 Noz (Actual) = 13/16

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1	770	437	333
#2	305	394	-89
#3	58	0	58
		Total	302

#4 (Silica Gel)	g (End)	g (Start)	Δ grams
	4485	4428	57

Total Vol. H_2O 359 ml

Filter # 22

Particulate Wts

Filter ____ mg

Acetone ____ mg

Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. ~~Inwlg-Gauge~~	Barometric Pressure
		359			0	-.8" H_2O	30.18 Local

TEST RESULTS

Test Averages:

ΔP_s = ____ T_{stack} = 600 °F

ΔH = 2.05 T_{meter} = 108 °F

Sample Vol. = ____ Ft^3

Sample Point	Time	Std. METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
33	4.06	.07	2.8	643.71	600	400	330	HH	HH	114-111		6
2	10	.06	2.2	670.05	"		380			116-100		2
3	12	.07	2.6	690.60	"		378			115-110		8
4	14	.08	2.2	709	"		378			115-111		8
5	18	.07 est.	2.0	716	"		375			106-106		7½
6	22		1.9	733	"		"			109-106		7½
	30		1.9	760.9	600		378			106-106		7½
	35		1.85	779	600		378			110-105		8"
	40		1.8	797.7	600		377			109-103		9.0
	45		2.0	817.1	600		377			108-103		9.0
	50		1.9	835.00	600		373			109-103		9.0
			2.05	191.29	600							
Average												

Percent O_2 = ____

$MW_{stack\ gas}$ = ____ (~28)

Velocity = ____ ft/sec

Total Sample Time = ____ min.

ISOKINETICS = ____ %

Particulate Emissions

____ lbs/10^6 BTU

COMMENTS:

Did Not Using std. Sample Probe, using ¼" SS Tubing

Leak Rate: 0.06 cfm

059

KVB 5807-842

MOBIL San Ardo

PARTICULATE EMISSION CALCULATIONS Test 1 outlet

Test No. M-A-1 Date 7/19/78 Location San Ardo Engr. M. Dunnell

Unit No. 22-5 Fuel Crude Sampling Train and Method Jay Train

Pitot Factor, F_p .835 Barometric Pressure, P_{bar} (STO 0) 30.18 in. Hg

Tot. Liquid Collected, V_{lc} (STO 1) 369 ml Total Particulate, M_n (STO 2) 341.2 m gm

* MULTIPOINT SAMPLING Velocity Head, ΔP (STO 3) ____ iwg Stack Temp., Ts (STO 4) 630 °R Stack Area, As (STO 5) 4.91 ft²

Sample Volume, Vm (STO 6) 57.56 ft³ Stack Press., Psg (STO 7) -.8 iwg Excess O_2, XO_2 % (STO 8) 3.3 %

* Orifice Press. Diff., H (STO 9) 1.2 iwg Stack Gas Sp. Gravity, Gs (STO A) 0.945 (27.36) w.d.

Sample Time, θ (STO B) 60 min Nozzle Dia., Dn (STO C) 5/16" 1/4" in. * Meter Temp., T_m (STO D) 105 °F

Select Fe	Oil (A)	Gas (B)	Coal (C)	Other:
SC Feet/10^4 Btu	92.2	87.4	98.2	(E)

Press (E) if meter is not temperature compensated.

1. Sample Gas Volume	$Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)\frac{520°R}{565°R}$	53.54 *	SCF
2. Water Vapor	$Vw_{std} = 0.0474\ V_{lc}$	17.49	SCF } 71.03
3. Moisture Content	Bwo = Eq. 2/(Eq. 1 + Eq. 2)	.246	N.D.
4. Concentration a.	$C = 0.0154\ Mn/Vm_{std}$	0.0982	grains/DSCF
b.	$C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$	1.41×10^{-5}	lb/DSCF
c.	C = Eq. 4b x 16.018×10^3	0.226	grams/DSCM
5. Abs. Stack Press.	$Ps = (P_{bar} \times 13.6) + Psg$	411	in. w abs.
6. Stack Gas Speed at single point	$Vs = 174\ Fs \sqrt{\Delta PTs}\sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$	3610	ft/min
7. Stack Gas Flow Rate @ 70°F a.	Qsw = ~~Eq. 6~~ Coal Eq. x As x $\frac{530}{Ts} \times \frac{Ps}{407}$	14,633	WSCF/min
b.	Qsd = Eq. 7a x (1. - Eq. 3)	11,033	DSCF/min
8. Material Flow	Ms = Eq. 7b x Eq. 4b x 60	9.33	lb/hr
9. XO_2 factor	$XO_2f = 2090/(20.9 - XO_2\%)$	118.8	N.D. 40% off Scrubber
10. Emission a.	E = Eq. 4b x Fe x Eq. 9	(.154)	lb/MMBtu
b.	E = Eq. 4c x Fm x Eq. 9 x 1000		ng/joule
11. % Isokinetic	$I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$	98	% overall

*If calculating by hand:
1) Convert T_s and T_m to °R
2) Multiply EQ 1 by 530/T_m(°R) if meter not temperature compensated.
3) $F_m = 2.684 \times 10^{-5} \times F_e$

Data Sheet 6002-4
Revised 2/15/78

* Multi Point Sampling, see attached sheets

KVB 5807-842

PARTICULATES Scrubber outlet Test 1 Page 1

11:00 73°F 34% RH

LOCATION Mobil San Ardo 50 mm Btu
UNIT 22-5 FUEL Crude oil
OPERATORS Jack Burns

Leak Rate .005 cfm

TEST NUMBER	NSA 1 Orsat
DATE	7-19-78
AMBIENT TEMPERATURE, °F	84 40% RH
METER VOL. (START/END)	8046.45 / 8104.01

Page 1 of 2

Fuel Analysis (% By Weight)

C = H = S = O =
N = CO_2 = H_2O =
ASH = INERT =
DENSITY = °API = HHV =

Nomograph Setup

P_{meter} = 30.0 C =
P_{stack} = 30.0 T_{stack} = 170°F
T_{meter} = 110 ΔP =
$\Delta H_@$ = Noz (Ideal) =
% H_2O = 35 Noz (Actual) = 1/4

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1	315	150	165
#2	325	150	175
#3	16	—	16
		Total	356

#4 (Silica Gel)	g (End)	g (Start)	Δgrams
	871	858	13
		Total Vol. H_2O	369 ml

Filter # 104
Particulate Wts
Filter ____ mg
Acetone ____ mg
Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In. Hg-Gauge	Barometric Pressure
		369			.833	30.08	30.18 lbs

← 510.8 "H_2O @ Stack

TEST RESULTS

Test Averages:
ΔP_s = ____ T_{stack} = 170°F
$\sqrt{\Delta H}$ = ____ T_{meter} = 105°F
Sample Vol. = 57.56 ft^3
Percent O_2 = ____
$MW_{stack\ gas}$ = ____ (~28)
Velocity = ____ ft/sec
Total Sample Time = ____ min.
ISOKINETICS = ____ %

Particulate Emissions
____ lbs/10^6 BTU

COMMENTS:

Sample Point	Time	METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
#2	11:20	.13	.8	8046.75	170	230	260	~~100~~	~~75~~	95 lc		3
#2	23	.13	.25	8047.30	170	250	270	100	85	95 lc		3
#2	11	.13	.6	8053.10	170	250	270	230	80	105 100		2½
#2	15	.32	.6	8058	170	250	250	230	75	100 100		
#3	16	.40	.9		170	250	260	230	80	105 100		3½
#3	20	.42	.85	8063	170	250	260	230	82	105 100		3½
#4	23	.6	1.1									
#4	25	.6	1.1	8066.5	170	"	"	"	"	105 100		5
#4	28	.6	1.25	8069	170	"	"	"	"	"		5
#4	30.1	.6		8071.40	170	"	"	"	"	"		5
		Sheet Train off			Fa	moyc	Lock					
		Nick & Mark Took			ine	PDS	Flask					
6	1443	1.8	1.2	8071.40	0	240	200	160	80	110 106		4½
6	35.8	1.8	1.35	8075.40	170	260	230	180	65	110 110		5
6	36.3	1.8	1.35	8078.1								
7	37.8	2.0	1.75	8080	"	"	240	"	"	"		6½
	40.2	2.0	1.7	8082.4	"	"	"	"	"	"		6½
Average												

5/16" Nozzle

1/4" Nozzle

061

KVB 5807-842

PARTICULATES SCRUBBER OUTLET Page 2 Test 1

LOCATION Mobil San Ardo Test 1
UNIT
FUEL Scrubber outlet
OPERATORS JOY

TEST NUMBER	NSA 102 N
DATE	7-19-78
AMBIENT TEMPERATURE, °F	92° 305 K
METER VOL. (START/END)	/8104.01

Page 2 of 2

Fuel Analysis (% By Weight)

C = H = S = O =

N = CO_2 = H_2O =

ASH = INERT =

DENSITY = HHV =

Nomograph Setup

P_{meter} = C =

P_{stack} = T_{stack} =

T_{meter} = ΔP =

$\Delta H_@$ = Noz (Ideal) =

% H_2O = Noz (Actual) = 1/4

▼ =

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1			
#2			
#3			
		Total	

#4 (Silica Gel)	g (End)	g (Start)	Δ grams

Total Vol. H_2O ml

Filter#

Particulate Wts

Filter mg

Acetone mg

Total mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In. Hg-Gauge	Barometric Pressure
				See page 1			

Sample Point	Time	METER CONDITIONS ΔPs	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
7	45	2.0	1.7		180	250	260	75	238	105 110		7
7	45	"	"	8088.2								
8	45.1	1.9	1.6		"	"	"	"	"	"		7
8	48	1.9	1.6	8092	"	"	"	"	"	"		6½
8	52	1.8	1.6	8096	"	"	"	"	"	"		"
5	52.1	1.3	1.1	8	"	"	"	"	"	"		5
5	54.7	1.2	1.1	8098.9	"	"	"	"	"	"		5
6	56	1.2	1.1		"	"	"	"	"	"		5
6	59	1.3	1.0	8103.1	"	"	"	"	"	"		5
5	60	1.3	1.0	8104.01	"	"	"	"	"	"		5
Average												

TEST RESULTS

Test Averages:

ΔPs = Tstack = °F

ΔH = Tmeter = °F

Sample Vol. = See page 1 Ft^3

Percent O_2 =

$MW_{stack\ gas}$ = (~28)

Velocity = ft/sec

Total Sample Time = min.

ISOKINETICS = %

Particulate Emissions

lbs/10^6 BTU

COMMENTS:

062

KVB 5807-842

CALCULATIONS OF ISOKINETIC SAMPLING RATES

MOBIL San Ardo

.327 scfl Isokinetics MSA-1 53.48 scf Page 1 of 2

Joy -2- 1 O_2 N 7-19-78

SCRUBBER OUTLET MSA-1 No. 1 Test

6

30.1 - 32.8

$$I = \frac{14077 \times 630 \times (7.95 + 2.60)}{7.7 \times 4893 \times 411 \times (.25)^2}$$

ΔH = 1.31
ΔP = 1.8
T_M = 109

8071.4 - 8080 = 8.6

= 97 %

7

32.8 - 45

$$I = \frac{14077 \times 630 \times (7.59 + 2.48)}{7.2 \times 5157 \times 411 \times (.25)^2}$$

ΔH = 1.7
ΔP = 2.0
T_M = 569

8080 - 8088.2 = 8.2

= 94 %

8

45 - 52 = 7

$$I = \frac{14077 \times 630 \times (7.23 + 2.37)}{7 \times 5027 \times 411 \times .25^2}$$

ΔH 1.6
ΔP 1.9
T_M 568°R

8088.2 - 8096 = 7.8

= 94 %

5

52 - 60 = 8

$$I = \frac{14077 \times 630 \times (7.41 + 2.42)}{8 \times 4158 \times 411 \times .25^2}$$

ΔH = 1.1
ΔP = 1.3
T_M = 568°R

8096 - 8104.01 = 8.01

= 102 %

97.85 % Av Isokinetic

KVB 5807-842

MOBIL San Ardo

Soy MSA 1 O_2 N 7-19-78 Page 2 of 2

ISOKINETICS MSA-1 OUTLET

No. 1 Test

$$I = \frac{14077 \times T_s (V_{m\,std.} + V_{w\,std.})}{\theta \times V_s \times P_s \times D_n^2}$$

6.41 cal/°F

Sample Point

11.55

2 $I = \frac{14077 \times 630 (0.85 + 3.55)}{15 \times 1997.4 \times 411 \times (.3125)^2}$ $\Delta H = .67$ $T_m = 559°K$

0-15 $= 106\%$

3 $I = \frac{14077 \times 680 (7.00 + 2.29)}{7\frac{1}{2} \times 2335 \times 411 \times (.3125)^2}$ $\Delta H = 0.875$ $T_m = 563°K$

15 - 22½ $= 117\%$

8058 - 8065.5

8063
8058
5

$\frac{5\ \text{ft}^3}{5\ \text{min}}$ = 1 acf m, 1 acf m × 7½ min.

4 $I = \frac{14077 \times 630 (3.45 + 1.78)}{7.6 \times 2825 \times 411 \times (.3125)^2}$ $\Delta H = 1.17$ $\Delta p = .6$ $T_m = 568°K$

22½ - 30.1

8065.5 - 8071.4 = 5.9 $= 75\%$

KVB 5807-842

MOBIL San Ardo Test 2

HP-67 KEYED CALCULATION SHEET*

PARTICULATE EMISSION CALCULATIONS INLET to Scrubber

Test No. MSA-2 Date 2/20/78 Location San Ardo Engr. J. M

Unit No. 22-5 Fuel Crude Sampling Train and Method SASS

Pitot Factor, Fs ~~.83~~ 1 Barometric Pressure, P_{bar} 30.08 (STO 0) in. Hg

Tot. Liquid Collected, V_{lc} 346 (STO 1) ml Total Particulate, M_n 1352.8 (STO 2) m gm

Velocity Head, ΔP .06 (STO 3) iwg Stack Temp., Ts ~~600~~ 545 (STO 4) °F Stack Area, As 22 (STO 5) ft^2

Sample Volume, Vm 129.738 (STO 6) ft^3 Stack Press., Psg -.8 (STO 7) iwg Excess O_2, XO_2% 4.2 (STO 8) %

Orifice Press. Diff., H 1.92 (STO 9) iwg Stack Gas Sp. Gravity, Gs _____ (STO A) n.d.

Sample Time, θ 35.7 (STO B) min Nozzle Dia., Dn 1 (STO C) in. Meter Temp., T_m 117 (STO D) °F 577

Select F_e	Oil (A)	Gas (B)	Coal (C)	Other:
SC Feet/10^4 Btu	92.2	87.4	98.2	(D)

Press (E) if meter is not temperature compensated.

1. Sample Gas Volume $Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)\frac{520}{T_m}$ ~~30.08~~ 30.02 − 0.059 .901 577 117.21 ~~118.019~~ SCF } 133.6
2. Water Vapor $Vw_{std} = 0.0474\ V_{lc}$ 16.4 SCF
3. Moisture Content Bwo = Eq. 2/(Eq. 1 + Eq. 2) .123 N.D.
4. Concentration a. $C = 0.0154\ Mn/Vm_{std}$ 0.178 grains/DSCF
   b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$ 2.54×10^{-5} lb/DSCF
   c. C = Eq. 4b x 16.018 x 10^3 0.408 grams/DSCM
5. Abs. Stack Press. $Ps = (P_{bar} \times 13.6) + Psg$ 22.5 x 60 408 in. w abs.
6. Stack Gas Speed at sample point $Vs = 174\ Fs\sqrt{\Delta PTs}\sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$ 1351 ft/min
7. Stack Gas Flow Rate @ 70°F a. $Qsw = \cancel{Eq.\ 6}$ Comb. Calc. $\times As \times \frac{530}{Ts} \times \frac{Ps}{407}$ 11576 WSCF/min
   b. Qsd = Eq. 7a x (1. − Eq. 3) 10,152 DSCF/min
8. Material Flow Ms = Eq. 7b x Eq. 4b x 60 15.5 lb/hr
9. XO_2 factor $XO_2f = 2090/(20.9 - XO_2\%)$ 125.15 N.D.
10. Emission a. E = Eq. 4b x Fe x Eq. 9 _____ lb/MMBtu
    b. E = Eq. 4c x Fm x Eq. 9 x 1000 _____ ng/joule
11. % Isokinetic $I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$ 96%

1005 133.6 35.7 1351 408 1

*If calculating by hand:
1) Convert T_s and T_m to °R
2) Multiply EQ 1 by $530/T_m$(°R) if meter not temperature compensated.
3) $F_m = 2.684 \times 10^{-5} \times F_e$

Data Sheet 6002-
Revised 2/15/78

KVB 5807-842

INLET to SCRUBBER Test 2, Particulates

Leak Rate 0.02 cfm

LOCATION MOBIL SCRUBBER Inlet
UNIT _____ FUEL _____
OPERATORS _____
SASS Train 2nd Test

TEST NUMBER	MSA-2
DATE	2/20/78
AMBIENT TEMPERATURE, °F	
METER VOL. (START/END)	/

Page ____ Of ____

Fuel Analysis (% By Weight)

C = H = S = O =
N = CO_2 = H_2O =
ASH = INERT =
DENSITY = HHV =

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} = 600
T_{meter} = 110 ΔP =
$\Delta H_@$ = Noz (Ideal) = 1.03
% H_2O = 10 Noz (Actual) = 1"

Imp.	Vol. (End)		Vol. (Start)		ΔVol. (ml)
#1	505	−	400	=	105
#2	550	−	400	=	150
#3	42 ~~75~~	−	0	=	42
				Total	297
#4 (Silica Gel)	g (End) 4300	−	g (Start) 4251	=	Δ grams 49
				Total Vol. H_2O	346 ml

Filter# 4

Particulate Wts

Filter ____ mg
Acetone ____ mg
Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. ~~In. Hg Gauge~~	Barometric Pressure
35.7					1	−.8" H_2O	30.08

16.4

TEST RESULTS

Test Averages:
ΔP_s = .06 T_{stack} = 600 °F
ΔH = 1.92 T_{meter} = 117 °F
Sample Vol. = 129.738 Ft^3

Sample Point	Time	METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
				~~[illegible]~~	545							
35"	11.35	.06	1.95	840.062			300	−	77	115/106		6
"	17		2.00	870	545		395	−	77	115/109		7½
"	14.0		1.95	892.5	545		383	−	89	120/113		7
"	21.0		1.9	918.0	545		381	−	96	123/116		7
"	28.0		1.85	943.2			381	−	88	124/117		8
"	35.7		1.85	969.800	545		381	−	80	124/121		8.5
			1.92	129.738	545		380	−		117		
		3.6		118 [illegible]						577		
	36	130										
Average												

Percent O_2 = ____
$MW_{stack\ gas}$ = ____ (~28)
Velocity = 23.1 ft/sec
Total Sample Time = 35.7 min.
ISOKINETICS = 99

Particulate Emissions

____ lbs/10^6 BTU

COMMENTS:
1) Not using std Sampling probe
2) Taken From Velocity Traits

066

KVB 5807-842

MOBIL San-Ardo SCRUBBER OUTLET TEST 2

PARTICULATE EMISSION CALCULATIONS

Test No MSA-2 Date 7/20/78 Location San Ardo Engr. J. M

Unit No. 22-5 Fuel Crude Sampling Train and Method Joy - Method 5

Pitot Factor, Fs .835 Barometric Pressure, P_{bar} 30.08 (STO 0) in. Hg

Tot. Liquid Collected, V_{lc} 559 (STO 1) ml Total Particulate, M_n 244.8 (STO 2) m gm

Velocity Head, ΔP ____ (STO 3) iwg* Stack Temp., Ts 175 (STO 4) °F Stack Area, As 4.91 (STO 5) ft^2

Sample Volume, Vm 67.33 (STO 6) ft^3 Stack Press., Psg +.8 (STO 7) iwg Excess O_2, XO_2% 4.1 (STO 8) %

Orifice Press. Diff., H ____ (STO 9) iwg* Stack Gas Sp. Gravity, Gs .923 (26.73) (STO A) n.d.

Sample Time, θ 60 (STO B) min Nozzle Dia., Dn 5/16 (STO C) in. Meter Temp., T_m 118 (STO D) °F*

Select F_e	Oil (A)	Gas (B)	Coal (C)	Other:
SC Feet/10^4 Btu	92.2	87.4	98.2	(D)

Press (E) if meter is not temperature compensated.

1. Sample Gas Volume $Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)\ \frac{520}{T_m}$ 30.14 118 .90 — ~~61.05~~ 60.98 SCF *
2. Water Vapor $Vw_{std} = 0.0474\ V_{lc}$ — 26.50 SCF } 87.48
3. Moisture Content Bwo = Eq. 2/(Eq. 1 + Eq. 2) — .303 N.D.
4. Concentration a. $C = 0.0154\ Mn/Vm_{std}$ — .062 grains/DSCF
   b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$ — 8.85×10^{-6} lb/DSCF
   c. C = Eq. 4b x 16.018×10^3 — 0.142 grams/DSCM
5. Abs. Stack Press. $Ps = (P_{bar} \times 13.6) \pm Psg$ — 410 in. w abs.
6. Stack Gas Speed at sample point $Vs = 174\ Fs\ \sqrt{\Delta PTs}\ \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$ — 3594 ft/min
7. Stack Gas Flow Rate @ 70°F a. $Qsw = \cancel{Eq.\ 6}$ Comb. Calc. $\times As \times \frac{530}{Ts} \times \frac{Ps}{407}$ — 14565 WSCF/min
   b. Qsd = Eq. 7a x (1. - Eq. 3) — 10,152 DSCF/min
8. Material Flow Ms = Eq. 7b x Eq. 4b x 60 — 5.39 lb/hr 65% eff.
9. XO_2 factor $XO_2f = 2090/(20.9 - XO_2\%)$ — 124.4 N.D.
10. Emission a. E = Eq. 4b x Fe x Eq. 9 — (.102) lb/MMBtu
    b. E = Eq. 4c x Fm x Eq. 9 x 1000 — ____ ng/joule
11. % Isokinetic $I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$ 635 87.48 (90.25) 60 x 3594 x 410 .098 — 92 % overall*

If calculating by hand:
1) Convert Ts and T_m to °R
2) Multiply EQ 1 by $530/T_m$(°R) if meter not temperature compensated.
3) $F_m = 2.684 \times 10^{-5} \times F_e$

* Multipoint Sampling, See attached sheets for individual point samples

Data Sheet 6002-4
Revised 2/15/78

KVB 5807-842

SCRUBBER OUTLET Test 2, Particulates

Mobil San Ardo

Leak Rate

LOCATION Scrubber Outlet

UNIT _____ FUEL _____

OPERATORS _____

Joy Train 2nd Run

TEST NUMBER	MSA 2 C2 N
DATE	7-7-78
AMBIENT TEMPERATURE, °F	
METER VOL. (START/END)	/

Page ____ Of ____

Fuel Analysis (% By Weight)

C = H = S = O =

N = CO_2 = H_2O =

ASH = INERT =

DENSITY = HHV =

Nomograph Setup

P_{meter} = C =

P_{stack} = T_{stack} =

T_{meter} = ΔP =

$\Delta H_@$ = Noz (Ideal) =

% H_2O = Noz (Actual) = 5/16"

▼ =

Imp.	Vol. (End)		Vol. (Start)		ΔVol. (ml)
#1	340	−	150	=	190
#2	365	−	150	=	215
#3	130	−	—	=	130
				Total	535
#4 (Silica Gel)	g (End) 933	−	g (Start) 909	=	Δ grams 24
				Total Vol. H_2O	559 ml

Filter# 120

Particulate Wts

Filter ____ mg

Acetone ____ mg

Total ____ mg

96.5 ref

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In.Hg-Gauge	Barometric Pressure
		559			835	0.8" H_2O	30.08

TEST RESULTS

Test Averages:

ΔP_s = .98 T_{stack} = 175 °F

ΔH = 1.45 T_{meter} = ____ °F

Sample Vol. = 67.33 Ft^3

Sample Point	Time	METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
7	1430	1.6	2.1	8168.52	175	250	250	90	90	115/115	—	6
7	8	1.5	2.1	8178.50	175	"	"	200	75	115/120	117	6½
7	13	1.6	2.2	8186	175	"	280	210	85	115/120		6½
	20	1.5	2.2									
5	21.4	1.0	1.50	8197	"	"	"	"	"	"		5
5	24	1.0	1.50	8200.2	"	"	"	210	90	115/120		5
5	27	1.0	1.45	8203.4	"	"	"	"	"	"	119	5
5	32	1.0	1.45	8208.6	"	260	260	210	85	120/120		5
5	39.8	1.0	1.45		"	"	"	"	"	"		"
4	40	.6	.90	8218	"	"	"	"	"	"		4
4	42	.5	.85	8220	"	"	"	"	"	"		4
4	46	.5	.85	8222.5	"	"	"	"	"	"	120	4
4	53	.5	.90	8229.8		"	"	"	"	"		4
4	60	.5	.85	8235.85	"	"	"	"	"	"		4
	60	.98	1.45	67.33	175							
Average												

Percent O_2 = ____

$MW_{stack\ gas}$ = ____ (~28)

Velocity = ____ ft/sec

Total Sample Time = ____ min.

overall ISOKINETICS = 92% ft. 7 5 4

Particulate Emissions

____ lbs/10^6 BTU

COMMENTS:

[illegible]

068

KVB 5807-842

CALCUATIONS OF ISOKINETIC SAMPLING RATES

MOBIL San Ardo Page 1

SCRUBBER OUTLET

MSA-2 ISOKINETICS 26.50 scf (H_2O)

Joy Train — 7/29/78

7

0 - 20

8168.52 - 8197

$$I = \frac{14077 \times 635 \times (25.92 + 11.25)}{20 \times 4529 \times 410 \times (.3125)^2}$$

$\Delta P = 1.53$
$\Delta H = 2.15$
$T_m = 577°R$

$= 92\%$

5

20 - 40

8197 - 8218

$$I = \frac{14077 \times 635 \times (19.02 + 8.26)}{20 \times 3661 \times 410 \times .3125^2}$$

$\Delta P = 1.00$
$\Delta H = 1.45$
$T_m = 579°R$

$= 83$

4

40 - 60

8218 - 8235.85

$$I = \frac{14077 \times 635 \times (16.11 + 6.99)}{20 \times 2589 \times 410 \times .3125^2}$$

$\Delta P = .5$
$\Delta H = .85$
$T_m = 580°R$

$= 100\%$

overall: 92% sampling rate of isokinetic

KVB 5807-842

APPENDIX D

KVB-ARB THERMAL OIL RECOVERY
DATA BASE: TENNECO OIL CO.

KVB

Sample Code T 1-5 7-25-1978 — 7-26-1978

Tested by: N. Brunetz, F. Ducey

Date 7-26-1978

STATEMENT OF PROCESS WEIGHT OR VOLUME

Firm Name TENNECO OIL CO Taft, California.

Address Kendon Lease, Northern, Southern (3 sections)
No. 43 Steam Generator, 50 MMBtu

DATA ON OPERATING CYCLE TIME:

Start of Operation, Time _____
End of Operation, Time _____
Elapsed Time, Minutes _____
Idle Time During Cycle, Min. _____
Net Time of Cycle, Minutes _____

} 24 hrs/7days/46-50wk/yr.

DATA ON MATERIAL CHARGED TO PROCESS DURING OPERATING CYCLE:

Material	Net Crude Oil Burned (houled in)	Weight	199 BOD	~~lbs~~, gal/day (8358)
Material		or		lbs, gal
Material	Crude Oil Produced Kendon 620 BOD North 125 BOD South 185 BOD	Volume		lbs, gal
Material			930 BOD	lbs, gal
Material				lbs, gal
Material	Water used for 80% steam injection		2571 BWD	lbs, gal
Material	(75 GPM)			lbs, gal

Total: _____

Production data: 930 BOD Burned / 199 BOD Burned = 4.7 Barrel oil Produced per 1 Barrel of Oil Burned Gross

Signature N. Brunetz
Title test director

Reconfirmed by H. Swan, Ch. Environm Engr. TENNECO
8/10/79 15:40 hr.

KVB 5807-842

PARTICULATE TEST DATA BASE
TENNECO OIL CO.

COMPANY NAME & TEST NO.						
TENNECO KENDON LEASE		#43 - 1		#43 - 2		
Std. CF sampled DSCF		48.4		36.9		
water content %		11		11		
Mass Flowrate DSCFM		9951		9460		
EPA Meth. 5 (Front + Filter)	grams		0.1149		0.0836	
Total Particulates (Impingers included	grams		0.3128		0.1673	
INORGANICS COLLECTED	grams		0.3128		0.1673	
Organics (condensibles) COLLECTED	grams	NOT EXTRACTED NO FREE CONDENSABLES →		—	—	

072

KVB 5807-842

Frontend
Filter + Wash - 0.1157 gram
V_{mstd} - 48.39 DSCF
0.0368 gr/DSCF
3.2 lb/hr

Tenneco

ARMAMENT SYSTEMS, INC.
712-F N. Valley St.
Anaheim, Calif. 92801
(714) 635-1524

See next Page

TENNECO Kendon #43

ENERGY DISPERSIVE X-RAY ELEMENT ANALYSIS

9/ 5/78

Prepared for: KVB Engineering/Bruntez
Sample lable: 102 T-1
Sample description: glass fiber filter
Remarks:

P.O.# 14430
Run # 789-142

Results are in micrograms per square centimeter (dry weight/estimated error). $A = 109\ cm^2 = 0.0314$ gram $= 0.0003$ gram/cm^2 $= 288.07\ \mu g/cm^2$

Aluminum	- not detrmd	Indium	- <0.06	Rubidium	- <0.04
Antimony	- <0.2	Iodine	- <0.3	Ruthenium	- <0.06
Arsenic	4.2^{-3} 0.39/0.05	Iridium	- <0.6	Scandium	- <2
Barium	- <0.6	Iron	2.0^{-1} 19/3	Selenium	8.5^{-4} (0.08)
Bismuth	- <0.1	Lead	1.5^{-3} (0.14)	Silicon	- not detrmd
Bromine	- <0.03	Manganese	3.2^{-3} (0.3)	Silver	- <0.05
Cadmium	- <0.05	Mercury	- <0.03	Strontium	9.3^{-2} 8.7/0.1 ?
Calcium	8.2^{-1} (77) ±50%	Molybdenum	- <0.2	Sulfur	1.7^{0} 160/50
Cesium	- <0.4	Nickel	2.8^{-1} 26/3	Tantalum	- <0.8
Chlorine	- <10	Niobium	- <0.2	Tellurium	- <0.2
Chromium	- <0.2	Osmium	- <0.2	Thallium	- <0.1
Cobalt	- <0.2	Palladium	- <0.06	Tin	- <0.2
Copper	- <0.2	Phosphorus	- <50	Titanium	1.9^{-2} (1.8) ?
Gallium	3.1^{-3} 0.29/0.04	Platinum	- <0.2	Tungsten	- <0.2
Germanium	- <0.03	Potassium	- <3	Vanadium	6.4^{-2} 6.0/1
Gold	- <0.2	Rhenium	- <0.05	Yttrium	- <0.2
Hafnium	- <0.3	Rhodium	- <0.06	Zinc	4.6^{-3} 0.43/0.05
				Zirconium	- <0.3
				other	- 0

$\Sigma = 371.75\ \mu g/cm^2$
$\Sigma >+ (\ ) = 300.13\ \mu g/cm^2$
( ) Semiquantitative

3.20 lb/hr

Tenneco

via Jim Kulik - Armanet Systems, Inc 1-31-79

keeping

			$\dot{m}_j$, lb/hr
Arsenic	0.39	$\mu g/cm^2$	4.3×10^{-3}
Iron	19.	"	2.1^{-1}
Nickel	26	"	2.9^{-1}
Sulfur	160	"	1.8^{0}
Vanadium	6	"	6.7^{-2}
Zinc	0.43	"	4.8^{-3}
	211.82	"	
Other*	76.25	"	8.5^{-1}
	288.07	"	3.2

* = 288.07 − 211.82

$$\dot{m}_j = \dot{m} * \frac{(\mu g/cm^2)_j}{288.07}$$

$\dot{m}$ = 3.2 lb/hr

AGRICULTURE
CHEMICAL ANALYSIS
PETROLEUM

BC LABORATORIES, INC.

4100 PIERCE ROAD, 93308 BAKERSFIELD, CALIFORNIA 93308 PHONE 327-4911

KVB, Inc.
17332 Irvine Boulevard
Tustin, California 92680

Date Reported: 8/7/78
Date Received: 7/25, 7/26, 7/27/78
Laboratory No.: 6365 to 6376

Attention Mr. Nickolas Brunetz

GAS ANALYSES

Sample Description: Tenneco Thermotics 43

Container	Source	Time	Total Hydrocarbon	Methane	Non Methane
T-1/10	Stack	14:45 7/25	10.4 : 7.1	0.3 : 0.2	10.1 : 6.9
T-1/1 (Test 1)	Stack	14:45 7/25	3.3 : 2.2	0.2 : 0.1	3.1 : 2.1
T-1/2	Background	14:45 7/25	0.4 : 0.3	0.1 : 0.1	0.3 : 0.2
T-2/10 (Test 3)	Stack	14:30 7/26	4.8 : 3.3	0.5 : 0.3	4.3 : 2.9
T-2/100	Stack	14:30 7/26	42.9 : 29.2	0.5 : 0.3	42.4 : 28.8
T-3/101 (Test 4)	Stack	14:45 7/26	1.6 : 1.1	0.2 : 0.1	1.4 : 1.0
T-3/22	Stack	14:45 7/26	30.5 : 20.7	0.3 : 0.2	30.2 : 20.5
T-4/4 (Test 5)	Stack	15:15 7/26	34.9 : 23.7	2.0 : 1.4	32.9 : 22.4
T-4/102	Stack	15:15 7/26	25.4 : 17.3	0.2 : 0.1	25.2 : 17.1
T-5/104	Stack	11:25 7/26	36.8 : 25.0	0.2 : 0.1	36.2 : 24.6
T-5/103 (Test 2)	Stack	11:25 7/26	0.3 : 0.2	0.2 : 0.1	0.1 : 0.1
T-5/3	Background	11:25 7/26	0.3 : 0.2	0.2 : 0.1	0.1 : 0.1

Answers expressed as ppm by volume : µg per liter as Methane.

B C LABORATORIES, INC.

BY J. J. Eglin
J. J. Eglin

ch -

KVB 5807-842

AGRICULTURE
CHEMICAL ANALYSIS
PETROLEUM

BC LABORATORIES, INC.

4100 PIERCE ROAD, 93308 BAKERSFIELD, CALIFORNIA 93308 PHONE 327-4911

KVB, Inc.
17322 Irvine Boulevard
Tustin, California 92680

Attention Mr. Nickolas Brunetz

Date Reported: 8/11/78
Date Received: 7/27/78
Laboratory No.: 6351 to 6364

GAS ANALYSIS

Sample Description: Tenneco Thermotics 43 7/25/78 and 7/26/78

				NO_x values expressed as NO_2	
Sample	Source	Time		µg/liter	PPM (volume)
T-1/1	#43 Steamer	14:00	7/25	240	125
T-1/2 Test 1	#43 Steamer	14:00	7/25	230	120
T-1/3	#43 Steamer	14:00	7/25	330	170
T-1/4	#43 Steamer	14:00	7/25	320	165
T-2/11 Test 3	#43 Steamer	14:15	7/26	160	85
T-2/12	#43 Steamer	14:15	7/26	340	175
T-3/13 Test 4	#43 Steamer	14:45	7/26	340	175
T-3/14	#43 Steamer	14:45	7/26	410	215
T-4/15 Test 5	#43 Steamer	15:15	7/26	400	210
T-4/16	#43 Steamer	15:15	7/26	330	170
T-5/17	#43 Steamer	11:25	7/26	345	180
T-5/18 Test 2	#43 Steamer	11:25	7/26	340	175
T-5/19	#43 Steamer	11:25	7/26	310	160
T-5/20	#43 Steamer	11:25	7/26	390	200

PPM and µg/liter at 20°C, 760 mm Mercury.

B C LABORATORIES, INC.

BY J. J. Eglin
J. J. Eglin

ch

KVB 5807-842

ULTIMATE ANALYSIS OF FUELS (MOBIL OIL AND TENNECO OIL)

	SAN ARDO			TENNECO	
	No. 1	No. 2	No. 3	No. 4	No. 5
Moisture, %	0.32	0.40	0.64	0.19	0.26
Carbon, %	84.21	84.16	84.15	85.64	86.06
Hydrogen, %	10.68	10.78	10.49	10.881	10.97
Nitrogen, %	0.93	0.94	0.94	0.69	0.69
Sulfur, %	2.27	2.25	2.24	0.99	1.01
Ash, %	0.067	0.064	0.071	0.016	0.028
Oxygen, % (by difference)	1.52	1.41	1.47	1.59	0.98
API Gravity @ 60°F	11.1	11.0	10.9	13.7	13.7
Asphaltenes, %	10.30	10.34	9.87	3.08	3.01
Heat of Combustion:					
Gross BTU/lb.	18,170	18,220	18,120	18,580	18,440
Net BTU/lb.	17,190	17,230	17,160	17,580	17,440

Respectfully submitted,

TRUESDAIL LABORATORIES, INC.

ALVIN E. MAY
Director of Laboratories

THEORETICAL COMBUSTION CALCULATIONS

Tenneco

Test No. _____ Date 7-25-78 Location 25 Mile Hill Unit No. _____

Fuel Crude Fuel Sample No. 4 Fuel Sample Point _____

LIQUID OR SOLID FUEL CALCULATIONS

(f)(CL REG), (f) (P?S), (f)(CL REG), Load data card, then PGRM card (both sides)

*Input HHV (Btu/lb)	18580	(A)
*Input wt % C	85.64	(R/S)
*Input wt % H	10.68	(R/S)
*Input wt % S	0.99	(R/S)
*Input wt % O	1.59	(R/S)
*Input wt % N	0.69	(R/S)

- decimal point blinks after pressing; item #1 displayed

1. Dry stoichiometric moles flue gas/lb fuel = 0.4420.
(One may proceed to items 9, 17, or 18 by pressing (f)(A), (E), or entering MW and pressing (B), respectively.)

*Input wt % H_2O in fuel (0 if none) 0.19

(C)	2.	Moles H_2O in flue gas/lb fuel	0.0541
(R/S)	3.	Total moles of flue gas (stoichiometric)/lb fuel	0.4961
(R/S)	4.	Dry volume/wet volume	0.8910
(R/S)	5.	Volume % H_2O in flue gas	10.90
(R/S)	6.	Volume % CO_2, dry in flue gas	16.13
(R/S)	7.	SO_2 (ppm by vol.), dry at stoichiometric	698.6
(R/S)	8.	NO (ppm by vol.), dry at stoichiometric	1114.4
(f)(A)	9.	Stoichiometric air/fuel ratio (lb air/lb fuel)	13.6

(Before items 10-16 may be determined, items 1-9 must be completed.)

(D) → 20.95 displayed

			3	4	5	
		*Input measured vol. % O_2 for O_2 correction				
(R/S)	10.	$\frac{\text{Gas moles at \% } O_2}{\text{Gas moles, stoic.}} = \frac{20.95}{20.95 - \%\ O_2}$ =	1.167	1.236	1.314	
(R/S)	11.	Dry moles flue gas/lb fuel at % O_2	0.516	0.546	0.581	
(R/S)	12.	Vol. % CO_2, dry at % O_2	13.82	13.05	12.28	
(R/S)	13.	SO_2 (ppm by vol.) dry at % O_2	588.5	565.0	531.9	
(R/S)	14.	NO (ppm by vol.) dry at % O_2	954.8	901.6	848.4	
(R/S)	15.	Vol. % H_2O at % O_2	9.49	9.01	8.52	
(R/S) (decimal pt. blinks)	16.	Percent Excess Air	15.78	22.28	29.54	

(RCL)(2)(E) 17. Converts item 1 to SCF dry flue gas at stoich/10^6 Btu = 9201.68

Item 18.

a. *Input MW, (B), program calculates K (lb/10^6 Btu = ppm/K)
(MW = 46 for NOx, CO = 28, HC = 16, SOx = 64)

1. *Input measured ppm at 3% O_2, dry, (R/S), program calculates lb/10^6 Btu.
2. (Optional) No input, (R/S), program converts lb/10^6 Btu → ng/J
3. Repeat steps (1) and (2) as necessary.

b. *Enter next value of MW, complete step (a) followed by steps (1), (2), and (3). Repeat for all species desired.

	MW	K for lb/10^6 Btu	lb/10^6 BTU	ng/J
9548 NO_x	46	783.27	1.219	524.2
100 CO	28	1396.81	0.078	33.4
100 HC	16	2251.92	0.044	19.
5985 SO_x	64	562.98	1.063	451.

*Indicates input is required

Data Sheet 6015-19
Revised 7/6/78
KVB 5807-842

Tenneco — KVB —

Test No. _____ Date 7-26-78 Location 95 Mile Hill Unit No. _____

Fuel Crude Fuel Sample No. 5 Fuel Sample Point _____

LIQUID OR SOLID FUEL CALCULATIONS

(f)(CL REG), (f) (P$_2$S), (f)(CL REG), Load data card, then PGRM card (both sides)

*Input HHV (Btu/lb)	18440	(A)
*Input wt % C	86.06	(R/S)
*Input wt % H	10.57	(R/S)
*Input wt % S	1.01	(R/S)
*Input wt % O	0.98	(R/S)
*Input wt % N	0.69	(R/S) - decimal point blinks after pressing; item #1 displayed

1. Dry stoichiometric moles flue gas/lb fuel = 0.4453.
(One may proceed to items 9, 17, or 18 by pressing (f)(A), (E), or entering MW and pressing (B), respectively.)

*Input wt % H_2O in fuel (0 if none) 0.26

(C)	2.	Moles H_2O in flue gas/lb fuel	0.0546
(R/S)	3.	Total moles of flue gas (stoichiometric)/lb fuel	0.4998
(R/S)	4.	Dry volume/wet volume	0.8908
(R/S)	5.	Volume % H_2O in flue gas	10.92
(R/S)	6.	Volume % CO_2, dry in flue gas	16.09
(R/S)	7.	SO_2 (ppm by vol.), dry at stoichiometric	707.5
(R/S)	8.	NO (ppm by vol.), dry at stoichiometric	1106.8
(f)(A)	9.	Stoichiometric air/fuel ratio (lb air/lb fuel)	13.668

(Before items 10-16 may be determined, items 1-9 must be completed.)

(D) → 20.95 displayed

		*Input measured vol. % O_2 for O_2 correction	1	1.11	3	4	5
(R/S)	10.	$\frac{\text{Gas moles at \% } O_2}{\text{Gas moles, stoic.}} = \frac{20.95}{20.95 - \%\ O_2}$ =	1.05	1.167	1.236	1.314
(R/S)	11.	Dry moles flue gas/lb fuel at % O_2	0.468	0.520	0.550	0.585
(R/S)	12.	Vol. % CO_2, dry at % O_2	15.33	13.79	13.02	12.25
(R/S)	13.	SO_2 (ppm by vol.) dry at % O_2	673.7	606.2	572.4	538.6
(R/S)	14.	NO (ppm by vol.) dry at % O_2	1053.4	947.8	895.0	842.0
(R/S)	15.	Vol. % H_2O at % O_2	10.45	9.50	9.02	8.53
(R/S) (decimal pt. blinks)	16.	Percent Excess Air	473	15.77	22.27	29.58

(RCL)(2)(E) 17. Converts item 1 to SCF dry flue gas at stoich/10^6 Btu = 9339.93

Item 18.

a. *Input MW, (B), program calculates K (lb/10^6 Btu = ppm/K)
(MW = 46 for NOx, CO = 28, HC = 16, SOx = 64)

1. *Input measured ppm at 3% O_2, dry, (R/S), program calculates lb/10^6 Btu.
2. (Optional) No input, (R/S), program converts lb/10^6 Btu → ng/J
3. Repeat steps (1) and (2) as necessary.

b. *Enter next value of MW, complete step (a) followed by steps (1), (2), and (3). Repeat for all species desired.

	MW	K for lb/10^6 Btu	ppm@3% O_2	lb/10^3 BTU	ng/J
NOx	46	771.68	947.8	1.228	528.14
CO	28	1267.76	100	0.079	33.92
HC	16	2218.58	100	0.045	19.38
SOx	64	554.65	606.2	1.093	469.97

*Indicates input is required

Data Sheet 6015-19
Revised 7/6/78

KVB 5807-842

Tenneco Oil
A Tenneco Company

P. O. Box 9909
Bakersfield, California 93309
(805) 832-9010

September 15, 1978

KBV, Inc.
17332 Irvine Blvd.
Tustin, CA 92680

Attention: Mr. Frank D. Ducey

RE: Flue Gas Emission Tests on Kendon Steam Generator #43 Located near Taft, CA on Sec. 35, T32S/R23E, MDB&M

Gentlemen:

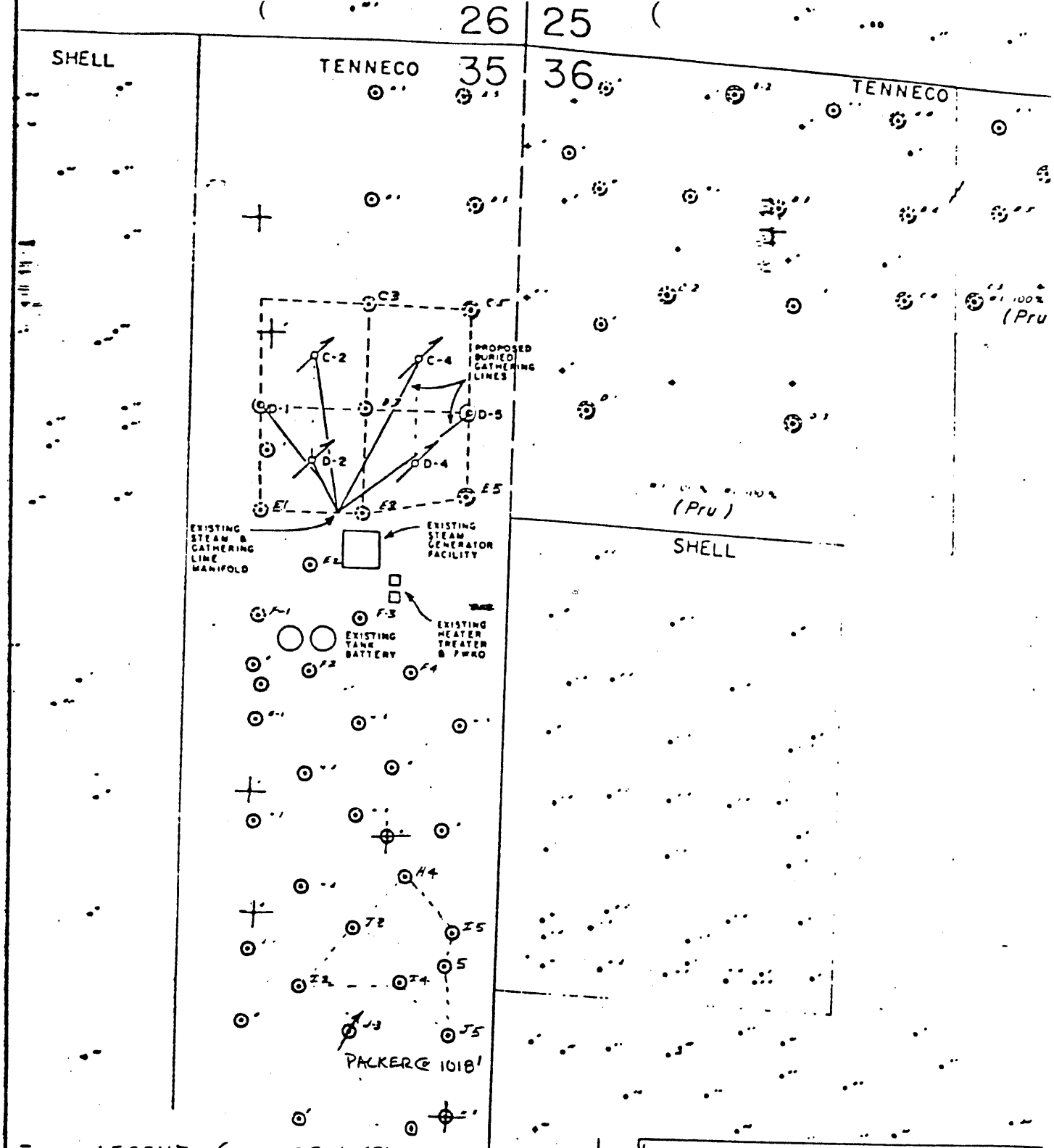
The information that you requested is attached. Figure 1 shows the steam drive project for the Kendon Lease. The steam generator data and reservoir characteristics are also listed on pages 3 and 4, respectively.

Sincerely,

H. W. Swan
Environmental Safety Coordinator

HWS/LKB:bme
Attachments

KVB 5807-842



LEGEND (7-21-78 LKB)

NON-PRODUCER

STEAM INJECTION WELL

PRODUCING WELL

--- INDICATES STEAM PATTERN

TENNECO OIL COMPANY
PACIFIC COAST DIVISION
KENDON LEASE

PILOT STEAM DRIVE PROJECT

FIGURE 1

BY: F. D. GRAY
DRAWN BY Paulson
DATE 9-13-76
REVISED
SCALE 1" = 400
BAKERSFIELD, CALIFORNIA

KVB 5807-842

NAME: Thermotics Steam Generator DATE: July 27, 1978

LOCATION: California, Kendon Lease Steam Generator #43

OPERATING COMPANY: Tenneco Oil Company

STEAM GENERATOR DATA

Equipment Specs. - Boiler

Manufacturer: Thermotics, Inc.
Installation Date: January, 1977
Firebox Rated Duty (MMBTU/Hr): 50
Radiation Heating Surface (Sq. Ft): 1990
Economizer (Convection Section) Heating Surface (Sq. Ft): 5884
Total Heating Space of Boiler (Water Walls) (Sq. Ft): 7874
Convection Section Size (Physical Dimensions): L = 11' - 3 13/16", W = 6'-6 3/4", H = 9'-8 1/4"

Equipment Specs. - Burner

Manufacturer: North American
Installation Date: January, 1977
Number of Burners: One
Type of Burner: 5131G-CR-62.5 (Crude Fuel Only)
Total Burner Rated Duty (MMBTU/Hr) = 62.5 (Max.), 50 (Normal Operation)

Maintenance Data

Method of Cleaning Burners: Nozzle cleaned with a solvent (more cleaning required during winter months)
Method of Cleaning Convection Section: High pressure water hose
Time Period between Burner Cleanings: As needed.
Time Period between Convection Section Cleanings: Approximately 3 months
Date of Last Convection Section Cleaning: July 11, 1978

Additional Note:

A stack was added to steam generator for testing procedures. This stack is not part of generator under normal operations.

RESERVOIR CHARACTERISTICS (KENDON) DATE: July 27, 1978

Zone of Four Northern Injection Wells: Upper Monarch (1050'-1150')
Zone of One Southern Injection Well: Intermediate (1300'-1500')
Average Crude Oil Production Rate:

Average BOPD (Kendon Lease): 620
Average BOPD (8 Northern Steam Drive Wells): 125
Average BOPD (7 Southern Steam Drive Wells): 185

Crude API Gravity: 11°
Steam Drive: See Attached Figure 1
Porosity of Formation (Monarch): 30%
Permeability of Formation (Monarch): 3000 MD (Approx.)
Steam Flow Rate: 75 GPM (Water Intake into Generator)

Average MCF/D, Steam Rate:

Well C-2: 141,000
Well C-4: 147,000
Well D-2: 157,000
Well D-4: 156,000
Well J-3: 1,237,000

TENNECO OIL Test 1.

Test 1 PARTICULATE EMISSION CALCULATIONS

Test No. T-1 Date 7/25/78 Location 25 mile Hill Engr. J. M. R. Bynum

Unit No. 43 Fuel Crude Sampling Train and Method JOY

Pitot Factor, Fs .835 Barometric Pressure, P_{bar} (STO 0) 29.98 in. Hg

Tot. Liquid Collected, V_{lc} (STO 1) 121 ml Total Particulate, M_n (STO 2) 312.8 m gm

Velocity Head, ΔP (STO 3) ____ iwg Stack Temp., Ts (STO 4) 565 °F Stack Area, As (STO 5) 7.07 ft^2

Sample Volume, Vm (STO 6) 53.67 ft^3 Stack Press., Psg (STO 7) -.21 iwg Excess O_2, XO_2 % (STO 8) 4.0 %

Orifice Press. Diff., H (STO 9) .85 iwg Stack Gas Sp. Gravity, Gs (STO A) [29.07]/1.004 n.d.

Sample Time, θ (STO B) 44 min Nozzle Dia., Dn (STO C) 5/16 in. Meter Temp., T_m (STO D) 120 °F

Select F_e	Oil (A)	Gas (B)	Coal (C)	Other:
SC Feet/10^4 Btu	92.2	87.4	98.2	(E)

Press (E) if meter is not temperature compensated.

1. Sample Gas Volume $Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)\frac{520}{460+T_m}(.898)$ 48.39 SCF } 54.13
2. Water Vapor $Vw_{std} = 0.0474\ V_{lc}$ 5.74 SCF
3. Moisture Content Bwo = Eq. 2/(Eq. 1 + Eq. 2) $\frac{5.74}{54.03}$ .106 N.D.
4. Concentration a. $C = 0.0154\ Mn/Vm_{std}$ 0.0995 grains/DSCF
   b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$ 1.425×10^{-5} lb/DSCF
   c. C = Eq. 4b x 16.018×10^3 0.228 grams/DSCM
5. Abs. Stack Press. $Ps = P_{bar} \times 13.6 \pm Psg$ 408 in. w abs.
6. Stack Gas Speed at Sample Point $Vs = 174\ Fs \sqrt{\Delta PTs}\sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$ 3103 ft/min
7. Stack Gas Flow Rate @ 70°F a. Qsw = Eq. 6 x As x $\frac{530}{Ts} \times \frac{Ps}{407}$ 11,131 WSCF/min
   b. Qsd = Eq. 7a x (1. - Eq. 3) 9951 DSCF/min
8. Material Flow Ms = Eq. 7b x Eq. 4b x 60 8.526 lb/hr
9. XO_2 factor $XO_2f = 2090/(20.9 - XO_2\%)$ 123.7 N.D.
10. Emission a. E = Eq. 4b x Fe x Eq. 9 .163 lb/MMBtu
    b. E = Eq. 4c x Fm x Eq. 9 x 1000 ____ ng/joule
11. % Isokinetic $I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$ 104 % Overall *

Calc. based on stack gas flow rates

*If calculating by hand:
1) Convert T_s and T_m to °R
2) Multiply EQ 1 by $530/T_m$(°R) if meter not temperature compensated.
3) $F_m = 2.684 \times 10^{-5} \times F_e$

* Multi Point Sampling. For Individual sample points see attached sheet

Data Sheet 6002-4
Revised 2/15/78

KVB 5807-842

Temmeco Test 1 — Particulates

① Based on Velocity Traverse sheet
Could not use pitot with probe

Joy Train - Economiser Outlet

LOCATION
UNIT 43 FUEL Oil
OPERATORS Joe Marks
Hill 25

TEST NUMBER	T 1 02 4%72578
DATE	7/25/78
AMBIENT TEMPERATURE, °F	105 20%RH
METER VOL. (START/END)	8226.03 / 8289.70

Page 1 of 2

Fuel Analysis (% By Weight)

C = H = S = O =
N = CO_2 = H_2O =
ASH = INERT =
DENSITY = HHV =

Nomograph Setup

P_{meter} = 30 C =
P_{stack} = 30 T_{stack} = 565
T_{meter} = 120 ΔP =
$\Delta H_@$ = Noz (Ideal) = "
Noz (Actual) = 5/16
% H_2O = 10 ▼ =

Imp.	Vol. (End)		Vol. (Start)		ΔVol. (ml)
#1	240	−	150	=	90
#2	172	−	150	=	22
#3	0	−	0	=	0
				Total	112
#4 (Silica Gel)	g (End) 806	−	g (Start) 797	=	Δ grams 9
				Total Vol. H_2O	121 ml

Filter# 102
Reeve Angel 934 AH

Particulate Wts

Filter ____ mg
Acetone ____ mg
Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. ~~In. Hg Gauge~~ in. H_2O	Barometric Pressure
					0.835	−.21	29.98

TEST RESULTS

Test Averages:
ΔP_s = .45 T_{stack} = 565 °F
ΔH = .85 T_{meter} = 120 °F
Sample Vol. = 5367 Ft^3

Sample Point	Time	① METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter* out	Meter* in	O_2, %	Vac.
9	1525	.42	1.1	8236.03	565		300	130	110	110	110		4½
9	3.2	"	.95	~~8240.10~~			310	140	65	110	110		
9	5	"	.85	8240.10			"	"	"	"	"		3½
9	8	"	.85	8243.4			350	140	65	115	115		3½
9	12	"	.85	8246.90			"	"	"	"	"		"
11	12.1	.47	.85				330	145	75	"	"		3½
11	15	"		8248.61			"	"	"	"	"		"
11	19	"	.85	8253			350	145	75	115	120		"
11	24	"		8256.52			"	"	"	"	"		"
K	24.1	.45	.85										
"	28.6	"	.85	8261.50			"	"	"	"	"		"
"	32	"	"	8264.70			"	"	"	"	"		"
"	36	"	"	8268.00									
14	36.1	.47	"										
"	39	"	"	8270.29			340	150	65	130	125		3½
"	44	"	"	8275.42			360	"	"	"	"		"
Average													

From Velocity Traverse

continued

Thermocouple out of well

Percent O_2 = ____
$MW_{stack\ gas}$ = ____ (~28)
Velocity = ____ ft/sec
Total Sample Time = ____ min.
ISOKINETICS = ____ %

Particulate Emissions

____ lbs/10^6 BTU

COMMENTS:
Dry Gas Meter not Temp. Comp.
Leak Rate 0.03 cfm
9
11
R
14
16
Δp .45 52 ft/sec
.84 cfm ~11 H_2O

085

KVB 5807-842

continuation

Tenneco Test 1

Particulates

Joy Train

page 2

LOCATION Hill 25
UNIT 43 FUEL 271
OPERATORS [illegible]

TEST NUMBER	T1 O_2 4%
DATE	7/25/78
AMBIENT TEMPERATURE, °F	105 · 26% RH
METER VOL. (START/END)	/

Page 2 Of 2

Fuel Analysis (% By Weight)

C = H = S = O =

N = CO_2 = H_2O =

ASH = INERT =

DENSITY = HHV =

Nomograph Setup

P_{meter} = C =

P_{stack} = T_{stack} =

T_{meter} = ΔP =

$\Delta H_@$ = Noz (Ideal) =

% H_2O = Noz (Actual) =

▼ =

Imp.	Vol. (End)		Vol. (Start)		ΔVol. (ml)
#1		−		=	
#2		−		=	
#3		−		=	
			Total		
#4 (Silica Gel)	g (End)	−	g (Start)	=	Δ grams
			Total Vol. H_2O		ml

Filter#

Particulate Wts

Filter ____ mg

Acetone ____ mg

Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In.Hg-Gauge	Barometric Pressure
							29.98

TEST RESULTS

Test Averages:

ΔP_s = ____ T_{stack} = ____ °F

ΔH = ____ T_{meter} = ____ °F

Sample Vol. = ____ Ft^3

Sample Point	Time	METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter out	Meter in	O_2, %	Vac.
14	48	.47	.75	8278.90	565		360	240	65	125	125		3½
16	48.1	.44	.75		"		360	280	70	125	125		3½
"	52	"	"	8282.48	"		"	"	"	"	"		3½
"	58	"	"	8288	"		"	300		125	125		3½
"	60	"		8289.70	"		"	"	"	"	"		3½
				8236.03									
			Net	53.67									
Average													

Percent O_2 = ____

$MW_{stack\ gas}$ = ____ (~28)

Velocity = ____ ft/sec

Total Sample Time = ____ min.

ISOKINETICS = ____ %

Particulate Emissions

____ lbs/10^6 BTU

COMMENTS:

KVB 5807-842

086

TENNECO KENDON TEST #1

CALCULATION OF ISOKINETIC SAMPLING RATES

Tenneco Oil Particulates

Kendon Lease; Hill 25

Test No. 1 Joy Train 7/23/78

5.74 acf H_2O

point

9

8236.03 - 8236.9

$$\%I = \frac{\overset{10.87\,acf}{14077 \times 1025 \times (9.94 + 1.18)}}{12 \times 408 \times 3015 \times .3125^2} = 111$$

$\Delta P = .42$
$\Delta H = .92$
$T_M = 571°R$

11

8236.9 - 8236.52

$$\%I = \frac{\overset{9.62\,acf}{14077 \times 1025 \times (8.71 + 1.03)}}{12 \times 408 \times 3189 \times .3125^2} = 92$$

$\Delta P = .47$
$\Delta H = .85$
$T_M = 576°R$

R

8236.52 - 8268.0

$$\%I = \frac{\overset{11.48}{14077 \times 1025 \times (10.36 + 1.23)}}{12 \times 408 \times 3120 \times .3125^2} = 112$$

$\Delta P = .45$
$\Delta H = .85$
$T_M = 578°R$

14

8268.0 - 8278.90

$$\%I = \frac{\overset{10.9\,acf}{14077 \times 1025 \times (9.67 + 1.15)}}{12 \times 408 \times 3189 \times .3125^2} = 102$$

$\Delta P = .47$
$\Delta H = .85$
$T_M = 588°R$

16

8278.9 - 8289.7

$$\%I = \frac{\overset{10.8\,acf}{14077 \times 1025 \times (9.63 + 1.15)}}{12 \times 408 \times 3086 \times .3125^2} = 105$$

$\Delta P = .44$
$\Delta H = .85$
$T_M = 585°R$

Total Av. 104.4% isokinetics

KVB 5807-842

KVB

Sample Code T1 02N 7-25-78

Firm and Unit Thermetics — 43 w/Stack

Test No. T1 02N

Page

Sampling Station outlet of Stack

Date 7-25-78

Nipples 4"

Stack −0.22 "H_2O GAS VELOCITY DATA

Air T 97° 26% RH

Static Stack Wg. .22 in. H_2O ΔP

Point	Time Start 13:00	Test 1 Vel.Head In. H_2O	Test 1 Temp. °F	Test 1 Vel. Ft/Sec.	Test 1 aft. Vel.Head In.H_2O	Test 1 aft. Temp. °F	Test 1 aft. Vel. Ft/Sec.	Test No.5 7-26-78 Vel.Head In.H_2O	Test No.5 Temp. °F	Test No.5 Vel. Ft/Sec.
1		.47	565	61.6	.47	565	61.6	.38	575	57.5
2		.46		63.8	.41		62.3	.40		59.6
3		.40		58.7	.40		58.7	.35		55.7
4		.40		58.7	.36		57.2	.32		52.8
R		.45		62.3	.40		58.7	.43		59.0
5		.40		58.7	.38		57.2	.38		57.5
6		.38		57.2	.38		57.2	.32		52.8
7		.44		61.6	.45		62.3	.38		57.5
8		.50		65.7	.50		65.7	.45		62.3
9		.42		60.2	.42		60.2	.32		52.5
10		.54		68.2	.48		67.0	.48		64.6
11		.47		63.7	.52		67.0	.50		66.8
12		.48		64.3	.47		64.3	.44		61.2
R		.45		62.3	.45		62.3	.42		60.5
13		.47		63.7	.48		64.3	.45		62.6
14		.47		63.7	.48		65.0	.46		62.3
15		.46		63.0	.49		65.0	.45		62.3
16		.44		61.6	.41		61.6	.40		57.0
Finish			565			565			575	59.6

5 1/8"
7 3/4
11.0
15 3/4
22
28 1/4
33.0
36 1/4
38 7/8

A. Average Velocity (Traverse) Ft/Sec 62.13

B. Av. Velocity (Ref. Point) Ft/Sec

C. Flue Factor A/B Test 1 T-1 .835 Test 2 T-5

D. Pitot Correction Factor

E. Gas Density Correction Factor .994 .998

F. Corrected Vel., AxDxE, Ft/Sec 51.6 49.5

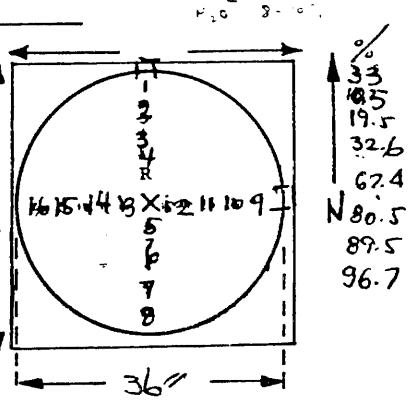
or BxCxDxE, Ft/Sec

G. Area of Flue, Sq. Ft. 7.07

H. Average Flue Temp., °F 565

I. Flow Rate, FxGx60, CFM 21880 20,984

J. Flow Rate, 520 x J/(H+460), SCFM 11,104 10,542



9/76

KVB 5807-842

KVB

Sample Code Ten. 102N 72578

Firm and Unit Tenneco Kendall Tuft

Test No. T102N Page

Sampling Station Stack outlet #43 Thermotics 50 MM Btw Steam generator Date 7-25-78

WATER VAPOR AND GAS DENSITY CALCULATIONS

Percent Water Vapor in Gases

A. Gas Pressure at Meter, In. Hg (Absolute)

B. Vapor Pressure of Water at Impinger Temp., In.Hg

C. Volume of Metered Gas, Cu. Ft.

D. Volume of Water Vapor Metered, BxC/A, Cu.Ft.

E. Volume of Water Vapor Condensed, Cu.Ft.*

F. Total Volume of Water Vapor in Gas Sample, D+E, Cu.Ft.

G. Total Volume of Gas Sample, C+E, Cu.Ft.

H. % Water Vapor in Sampled Gas, 100 x F/G

* See D on sampling train data sheet

Gas Density Correction Factor

Fyrite Air 20.9 12:45 13:30 16:30 Calc.

Component	Volume Percent		X Moisture Collection	X Mol.Wt.=	Weight Per Mole Wet Basis
Water	8.9%	8.9	1.0 .106	18.0	1.602 1.91
CarbonDioxide	13 Dry Basis	13	12.9 12.5 .894 .911	44.0	5.21 5.07
CarbonMonoxide	35 Dry Basis	35	35 35 ppm .894 .911	28.0	—
Oxygen	4.0 Dry Basis	4.0	4.0 .894 .911	32.0	1.17 1.14
Nitrogen + Inerts	83.0 Dry Basis	83.1	83.5 .894 .911	28.2	23.2 20.95

B = .264 x 83 - (17) = 4.91

28 - 9.824

Average Molecular Weight 29.38 29.07

J. Density of Gas Referred to Air = $\frac{\text{Av.Mol.Wt.}}{28.95}$ = not 1.004

K. Gas Density Correction Factor = $\sqrt{\frac{1.00}{J}}$ = .994 .998

9/76

KVB

Sample Code TiO_2 4% 72578

Firm and Unit Tenneco Kendall #43 stack no Scrubber 50MMBHC Thermotics

Test No. 1

Page G-

Date 7-25-78

GRAB AND BAG SAMPLE RESULTS
HYDROCARBONS, ALDEHYDES

Barometer 29.98

SAMPLE STATION	Sample Type and Sampling Time	Components	ppm Dry Basis	ppm Stack Conditions	Grains/SCF Stack Conditions	LBS/HR Loss
Location Tenneco Stack	PDS 2000ml BC 14:55 Bottles 15:00 NOx (230)	No. 1				
		No. 2				
		No. 3				
Temp., °F 105		No. 4				
Humidity, % 23						
Location Tenneco ~~105~~ stack	HC 14:45 total HC methane non-methane	16 250ml				
		1 250ml				
Temp., °F 105						
Humidity, % 23	Background 14:45	2 250ml				
Location						
Temp., °F						
Humidity, %						

KVB 5807-842

PARTICULATE EMISSION CALCULATIONS Test 2 T-5

Test No. TENNECO Date 7/26/78 Location 25 Mile Hill Engr. J.M.

Unit No. T-5 43 Fuel Crude Sampling Train and Method JOY CARB

Pitot Factor, Fs .835 Barometric Pressure, P_{bar} 29.95 (STO 0) in. Hg

Tot. Liquid Collected, V_{lc} 91 (STO 1) ml Total Particulate, M_n 167.3 (STO 2) m gm

Velocity Head, Av. ΔP 0.407 (STO 3) iwg Stack Temp., Ts 575 (STO 4) °F Stack Area, As 7.07 (STO 5) ft^2

Sample Volume, Vm 40.35 (STO 6) ft^3 Stack Press., Psg -.22 (STO 7) iwg Excess O_2, XO_2% 4.5 (STO 8) %

Orifice Press. Diff., H .72 (STO 9) iwg Stack Gas Sp. Gravity, Gs 1.005 (29.09) (STO A) n.d.

Sample Time, θ 43 (STO B) min Nozzle Dia., Dn 5/16 (STO C) in. Meter Temp., T_m 108 (STO D) °F

Select Fe	Oil (A)	Gas (B)	Coal (C)	Other:
SC Feet/10^4 Btu	92.2	87.4	98.2	(D)

Press (E) if meter is not temperature compensated.

1. Sample Gas Volume $Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)\left(\frac{520}{Tm}\right)$ 29.93 .915 568°R — 36.92 ~~36.98~~ SCF * } 41.23
2. Water Vapor $Vw_{std} = 0.0474\ V_{lc}$ — 4.31 SCF
3. Moisture Content Bwo = Eq. 2/(Eq. 1 + Eq. 2) — .105 N.D.
4. Concentration a. $C = 0.0154\ Mn/Vm_{std}$ — 0.07 (0.0698) grains/DSCF
   b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$ — 9.99×10^{-6} lb/DSCF
   c. C = Eq. 4b x 16.018×10^3 — 0.160 grams/DSCM
5. Abs. Stack Press. $Ps = (P_{bar} \times 13.6) \pm Psg$ — 407 in. w abs.
6. Stack Gas Speed at sample points $Vs = 174\ Fs\ \sqrt{\Delta PTs}\ \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$ — 2976 ft/min*
7. Stack Gas Flow Rate @ 70°F a. Qsw = ~~Eq. 6~~ Comb. Calc. x As x $\frac{\cancel{530}\ 520}{Ts} \times \frac{Ps}{407}$ — 10,570 WSCF/min
   b. Qsd = Eq. 7a x (1. - Eq. 3) — 9460 DSCF/min
8. Material Flow Ms = Eq. 7b x Eq. 4b x 60 — 5.67 lb/hr
9. XO_2 factor $XO_2f = 2090/(20.9 - XO_2\%)$ — 127.43 N.D.
10. Emission a. E = Eq. 4b x Fe x Eq. 9 — lb/MMBtu
    b. E = Eq. 4c x Fm x Eq. 9 x 1000 — ng/joule
11. % Isokinetic $I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$ — 99 % overall *

*If calculating by hand:
1) Convert T_s and T_m to °R
2) Multiply EQ 1 by $530/T_m$(°R) if meter not temperature compensated.
3) $F_m = 2.684 \times 10^{-5} \times F_e$

Data Sheet 6002-4
Revised 2/15/78

* Multi point Sampling
See attached sheets for individual Sample Points

KVB 5807-842

Tenneco Kendon — Particulates No 2 Test

Leak Rate 0.02 cfm

LOCATION Hill 25
UNIT 45 FUEL oil
OPERATORS C.M.
Test #5 Normal + O_2

TEST NUMBER	T-5 O_2 N
DATE	11/26/79
AMBIENT TEMPERATURE, °F	43°F 20°RH
METER VOL. (START/END)	/

Page 1 of 2

Fuel Analysis (% By Weight)

C = H = S = O =
N = CO_2 = H_2O =
ASH = INERT =
DENSITY = HHV =

Nomograph Setup

P_{meter} = 29.9 C =
P_{stack} = T_{stack} = 575
T_{meter} = 120 ΔP = .7
$\Delta H_@$ = Noz (Ideal) =
$\%\ H_2O$ = 10 Noz (Actual) = 5/16"

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1	220	150	70
#2	164	150	14
#3	0	0	—
		Total	84

#4 (Silica Gel)	g (End)	g (Start)	Δ grams
	751	744	7

Total Vol. H_2O 91 ml

Filter# 103

Particulate Wts
Filter ____ mg
Acetone ____ mg
Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. ~~In. Hg Gauge~~	Barometric Pressure
		91			.835	.22 "H_2O	29.95

TEST RESULTS

Test Averages:
ΔPs = ____ Tstack = 575 °F
ΔH = ____ Tmeter = 108 °F
Sample Vol. = 435 Ft^3

Sample Point	Time	METER CONDITIONS ΔPs	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter In	Meter Out	O_2, %	Vac.
9	1145	.32	.80	8269.28	575		320	220	70	100	100		3
"	4	"	.80	8293.4	"		340	220	65	105	103		3
"	6	"	.70		"		"	"	"	"	"		"
"	9	"	.70	8322.4	"		350	260	65	"	"		2½
"	12	"	.70	8349.8	"		"	"	"	"	"		"
11	13.3	.50	.75	8360.80	"		"	"	"	"	"		1½
"		Probe	probe	To filter	Change								"
		Start	Imp	2 To Be	Replace		2	hr	for	27	minutes		
"	16	.50	.72	8303	"		340	220	65	"	"		2½
"	20	.50	.72	8306.3	"		340	250	65	103	110		"
"	24	.50	.72	8309.38	"		"	"	"	"	"		"
A	24.3	.49	.70		"		320	260	65	110	111		"
R	29	.49	.70	8313.5	"		"	"	"	"	"		"
R	36	"	"	8318.9	"		"	"	"	"	"		"
14	36.4	.46	.70		"		350	"	"	110	113		"
14	43	.46		8324.5	"		"	"	"	"	"		"
Average													

Percent O_2 = ____
MW stack gas = ____ (~28)
Velocity = ____ ft/sec
Total Sample Time = ____ min.
ISOKINETICS = see screen sheet

Particulate Emissions

____ lbs/10^6 BTU

COMMENTS:

11:9 .80
" .84 Q not using ITA
" .81 by multiple Probe
" .82 Q ΔPs barometer
" .80 reading by traverse
next

continued

092
KVB 5807-842

continuation

TENNECO Kendon - Particulates No 2 Test

Particulates Page 2

LOCATION Tenneco Test 2
UNIT _____ FUEL _____
OPERATORS Joy train

TEST NUMBER	T-5
DATE	7/26/78
AMBIENT TEMPERATURE, °F	
METER VOL. (START/END)	/

Page 2 Of 2

Fuel Analysis (% By Weight)

C = H = S = O =
N = CO_2 = H_2O =
ASH = INERT =
DENSITY = HHV =

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
$\Delta H_@$ = Noz (Ideal) =
% H_2O = Noz (Actual) =
Y =

Imp.	Vol. (End)	Vol. (Start)	ΔVol. (ml)
#1			
#2			
#3			
		Total	
#4 (Silica Gel)	g (End)	g (Start)	Δ grams
		Total Vol. H_2O	ml

Filter# _____

Particulate Wts
Filter _____ mg
Acetone _____ mg
Total _____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In.Hg-Gauge	Barometric Pressure

Sample Point	Time	METER CONDITIONS ΔP	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
14	48	416	.7	8328.45	575	@	350	280	60	115 120		2½
16	48.1		.7	~~8330.23~~								
16	50.3		.7	8330.23	"		"	"	"	"		2½
				Nat Train	o.f.f							
				Broke glass	cause:	with	recycle	Train				
										108 Av.		
				~~8330.23~~								
				8284.88								
				~~4035~~								
Average												

TEST RESULTS

Test Averages:
ΔP_s = _____ T_{stack} = _____ °F
ΔH = _____ T_{meter} = _____ °F
Sample Vol. = _____ Ft^3
Percent O_2 = _____
$MW_{stack\ gas}$ = _____ (~28)
Velocity = _____ ft/sec
Total Sample Time = _____ min.
ISOKINETICS = _____ %

Particulate Emissions
_____ lbs/10^6 BTU

COMMENTS:

093

KVB 5807-842

TENNECO KENDON TEST #2

CALCULATION OF ISOKINETIC SAMPLING RATES

Tenneco Particulates

Tenneco T-5 Test No. 2

Joy Train 7/26/78 Test No. ~~5~~

4.31 scf H_2O

point

9.92 acf

9 $I = \frac{14077 \times 1035 \times (9.17 + 1.07)}{12 \times 407 \times 2881 \times .3125^2}$ $\Delta P = .38$ $\Delta H = .74$ $T_M = 564°R$

$= 109\%$

9.59 acf

11 $I = \frac{14077 \times 1035 \times (8.84 + 1.03)}{12 \times 407 \times 3305 \times .3125^2}$ $\Delta P = .50$ $\Delta H = .73$ $T_M = 565°R$

8299.8 - 8309.39 $= 91\%$

9.51 acf

R $I = \frac{14077 \times 1035 \times (8.69 + 1.01)}{12 \times 407 \times 3101 \times .3125^2}$ $\Delta P = .44$ $\Delta H = .70$ $T_M = 580°R$

8309.39 - 8318.9 $= 96\%$

9.55

14 $I = \frac{14077 \times 1035 \times (8.67 + 1.01)}{12 \times 407 \times 3170 \times .3125^2}$ $\Delta P = .46$ $\Delta H = .70$ $T_M = 574°R$

8318.9 - 8328.45 $= 93\%$

1.28

16 $I = \frac{14077 \times 1035 \times (1.61 + .19)}{2.2 \times 407 \times 2881 \times .3125^2}$ $\Delta P = .38$ $\Delta H = .7$ $T_M = 578°R$

8328.45 - 8330.23 $= 104\%$

98.6% Av Isokinetics

KVB 5807-842

Tennecco KVB Normal O_2 No. 2 Test

Sample Code T 5 O_2 4% 7-26-78

Firm and Unit Tennecco Kewaton 43 Thermotics 50 mm Btu

T-5

Test No. O_2 Normal

Page

Sampling Station Stack base center

Date 7-26-78

WATER VAPOR AND GAS DENSITY CALCULATIONS

Percent Water Vapor in Gases

A. Gas Pressure at Meter, In. Hg (Absolute) _____

B. Vapor Pressure of Water at Impinger Temp., In.Hg _____

C. Volume of Metered Gas, Cu. Ft. _____

D. Volume of Water Vapor Metered, BXC/A, Cu.Ft. _____

E. Volume of Water Vapor Condensed, Cu.Ft.* _____

F. Total Volume of Water Vapor in Gas Sample, D+E, Cu.Ft. _____

G. Total Volume of Gas Sample, C+E, Cu.Ft. _____

H. % Water Vapor in Sampled Gas, 100 x F/G _____

* See D on sampling train data sheet

Gas Density Correction Factor

Component	Volume Percent (Dry Basis)	Moisture Collection	Mol.Wt.	Weight Per Mole Wet Basis
Water ~~8.9~~ 11.15	0.105	1.0	18.0	~~1.89~~ 1.89
Carbon Dioxide Fyrite	12.8 Dry Basis .128	.895 ~~.917~~	44.0	~~5.16~~ 5.04
Carbon Monoxide	37 ppm Dry Basis		28.0	
Oxygen Fyrite	4.5 Dry Basis 0.045	.895 ~~.917~~	32.0	~~1.32~~ 1.29
Nitrogen + Inerts	82.7 Dry Basis 0.827	.895 ~~.917~~	28.2	21.39 20.87

$28 = 2([.264 \times 82.7] - [12.8 + 4.5]) = 9.1$ (17.3) Average Molecular Weight ~~24.36~~ 29.09

J. Density of Gas Referred to Air = $\frac{\text{Av.Mol.Wt.}}{28.95}$ = ~~1.01~~ 1.005

K. Gas Density Correction Factor = $\sqrt{\frac{1.00}{J}}$ = ~~0.995~~ 0.998

9/76

TENNECO Hendon No. 2 Test, Particulates

Sample Code T5 O_2 4% 7-26-78

Firm Name and Unit Tenneco 43 Thermatics Steam gen.

Test No. T-5

Page D-2

Sampling Station Stack of unit

Date 7-26-78

SPOT MONITORING DATA BY DRAEGER OR TLV SNIFFER

11:45 - 12:15 T 98°F 20%RH

INSTRUMENT USED	FUNCTIONAL DATA	COMPOUND NAME	CONCENTRATION		
			ppm	Grs/SCF	Lbs/Hour
Draeger	1 x	SO_2	460		
	5 x	SO_2	450		
	2 x	NO_x	300		
	1 x	NO_x	250		
	10	NO_2	< 2		
	10	~~Formald.~~ HCN	< 1		
	5		Neg		
Fyrite 4	repeats	O_2	4.5%		

9/76

KVB 5807-842

TENNECO KENDON

SUMMARY OF RESULTS OF SO_2 - SO_3 DETERMINATIONS BY METHOD 8

SUMMARY SOx DATA

LOCATION TEST	DATE	SO_3 ppm	$C_{H_2SO_4}$ lb/ft³		SO_2 ppm	C_{SO_2} As SO_2 lb/ft³	
TENECO HILL #25							
OUTLET	7-25	21	5.52×10^{-6}	Test 1	468	7.9×10^{-5}	Test 1
OUTLET	7-26	21	5.52×10^{-6}	Test 2	465	7.84×10^{-5}	Test 2

TENNECO KENDON

METHOD 8 DETERMINATION OF SO_2 AND SO_3 (H_2SO_4) TESTS 1 AND 2

TENECO KENDON LEASE Test No. 1 7-25-78

HILL 25 UNIT #3

OUTLET OF UNIT

SAMPLE SIZE = 25.23 CF

METER TEMP = 530 °R

STACK = 565 °F

B.P. = 29.98 "Hg

ΔH = 1.2 "H_2O

H_2O CONDENSATE = 40.2 ml

SAMPLE VOL IN SCF = $25.23 \times 17.71 \times \frac{29.98 + \frac{1.2}{13.6}}{530} = 25.35$

VOL H_2O VAPOR = $.0474 \times 40.2 =$

% H_2O $= \frac{1.90}{25.35+1.90} \times 100 = 7.0\%$

SO_3

TOTAL VOL = 547 ml

ALIQUOT = 1 ml

ml $Ba(ClO_4)_2$ = (5.4, 5.4, 5.5) = 5.4 ml

N $Ba(ClO_4)_2$ = .0098

ml Blank = .1 ml

SO_2 ppm = $(5.4-.1) \times .0098 \times \frac{547}{1} \times .03203 \times \frac{13040}{25.35} = 468$ ppm

C_{SO_2} lb/ft^3 = $7.05 \times 10^{-5} \times (5.4-.1) \times .0098 \times \frac{547}{25.35} = 7.9 \times 10^{-5}$

TENECO OUTLET 7-25-78

SO_3

TOTAL VOL = 228 ml

ALIQUOT = 25 ml

ml $Ba(ClO_4)_2$ = (15.1, 15.0, 14.9) = 15.0 ml

N $Ba(ClO_4)_2$ = .0098

ml Blank = .1 ml

$SO_3 = (15.0 - .1) \times .0098 \times .04 \times \frac{222}{25} \times \frac{10,400}{25.35} = 21$ ppm

$C_{H_2SO_4}$ lb/ft³ = $1.09 \times 10^{-4} \times (15.0 - .1) \times .0098 \times \frac{\frac{222}{35}}{25.35} = 5.52 \times 10^{-6}$ lb/ft³

TENECO KENDON LEASE Test No. 2. 7-26-78

HILL #25 UNIT #43

OUTLET OF UNIT

SAMPLE SIZE = 24.47 CF

METER TEMP = 530 °R

STACK TEMP = 575 °F

B.P. = 29.95 "Hg

ΔH = 1.1 "H_2O

H_2O CONDENSATE = 44.6 ml

SAMPLE VOL AT SCF = $24.47 \times 17.71 \times \frac{29.95 + \frac{1.1}{13.6}}{530} = 24.55$

VOL H_2O VAPOR = .0474 × 44.6 = 2.11

% $H_2O = 100 \times \frac{2.11}{24.55 + 2.11} = 7.9\%$

TENECO UNIT #43 HILL #25 7-26-78

SO_3

TOTAL VOL = 298 ml

ALIQUOT = 10 ml

ml $Ba(ClO_4)_2$ = 4.3, 4.4, 4.6 = 4.4 ml

N $Ba(ClO_4)_2$ = .0098

ml Blank = .1 ml

SO_3 ppm $= (4.4-.1) \times .0098 \times \frac{298}{10} \times .04 \times \frac{10400}{24.55} = 21$ ppm

$C_{H_2SO_4}$ lb/ft^3 $= 1.08 \times 10^{-4} \times (4.4-.1) \times .0098 \times \frac{\frac{298}{10}}{24.55} = 5.52 \times 10^{-6}$ lb/ft^3

SO_2

TOTAL VOL = 593 ml

ALIQUOT = 1 ml

ml $Ba(ClO_4)_2$ = 4.8, 4.8, 4.8 = 4.8 ml.

N $Ba(ClO_4)_2$ = .0098

ml Blank = .1 ml

$SO_2 = (4.8-.1) \times .0098 \times \frac{593}{1} \times .03203 \times \frac{13070}{24.55} = 465$ ppm

$C_{SO_2} = 7.05 \times 10^{-5} \times (4.8-.1) \times .0098 \times \frac{593}{24.55} = 7.84 \times 10^{-5}$

TENNECO TEST 1 & 2, TITRATIONS

Tenneco SO_x 7-25 & 7-26

#1

SO_2 total Vol 547 ml ~~aliquot~~ aliquot 1 ml

A 5.4 ml
B 5.4 ml } 5.4 ml.
C 5.5 ml.

SO_3 total Volume 222 ml aliquot 25 ml.

A ~~12 ml~~ 15.1 ml
B 15.0 ml } 15.0 ml.
C 14.9 ml

#2

SO_2 total Volume 593 ml aliquot 1 ml.

A 4.8 ml
B 4.8 ml } 4.8 ml
C 4.8 ml

SO_3 total Volume 298 ml aliquot 10 ml

A 4.3
B 4.4 } 4.4
C 4.6

Method 8 test 1 (SO_x)

LOCATION TENNECO OUTLET TAFT
UNIT 43 FUEL OIL
OPERATORS [illegible]
SO_x HILL #25 KENDAN LEASE

TEST NUMBER 1
DATE SO_x - 1 7-25-78
AMBIENT TEMPERATURE, °F 105°F
METER VOL. (START/END) 5685.34 / 5710.57

Page ____ Of ____

Fuel Analysis (% By Weight)

C = H = S = O =
N = CO_2 = H_2O =
ASH = INERT =
DENSITY = HHV =

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
$\Delta H_@$ = Noz (Ideal) =
% H_2O = Noz (Actual) =
▼ =

Imp.	Vol. (End)		Vol. (Start)		ΔVol. (ml)
#1	64	−	100	=	−36
#2	142	−	100	=	42
#3	124	−	100	=	24
				Total	30
#4 (Silica Gel)	g (End) 208.2	−	g (Start) 200	=	Δ grams 8.2
				Total Vol. H_2O	40.2 ml

Filter# ____

Particulate Wts

Filter ____ mg
Acetone ____ mg
Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In.Hg-Gauge	Barometric Pressure
SINGLE POINT	—	40.2	—	—	—	—	29.98

TEST RESULTS

Test Averages:
ΔP_s = — T_{stack} = 567 °F
ΔH = 1.2 T_{meter} = 128 °F
Sample Vol. = 25.23 Ft^3

Sample Point	Time	METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
	1630		1.2	5685.34	565				90	125	4.0	11
	1638		1.2	5692.2	565				80	130		11
END	1700			5710.57								

Average Meter is temp. compensated.

Percent O_2 = 4.0
$MW_{stack\ gas}$ = ____ (~28)
Velocity = ____ ft/sec
Total Sample Time = ____ min.
ISOKINETICS = ____ %

Particulate Emissions

____ lbs/10^6 BTU

COMMENTS:
63.6

LEAK RATE < .01 CFM

KVB 5807-842

Method 8, Test 2

LOCATION TENNECO
UNIT 43 FUEL O/C
OPERATORS Fuel
SOx method #8

TEST NUMBER	T-2-43
DATE	7-26-78
AMBIENT TEMPERATURE, °F	105
METER VOL. (START/END)	5732.28/5756.75

Page ____ Of ____

Fuel Analysis (% By Weight)

C = H = S = O =
N = CO_2 = H_2O =
ASH = INERT =
DENSITY = HHV =

Nomograph Setup

P_{meter} = C =
P_{stack} = T_{stack} =
T_{meter} = ΔP =
$\Delta H_@$ = Noz (Ideal) =
% H_2O = Noz (Actual) =

Imp.	Vol. (End)		Vol. (Start)		ΔVol. (ml)
#1	64	−	100	=	-36
#2	142	−	100	=	42
#3	130	−	100	=	30
			Total		36

#4 (Silica Gel)	g (End)		g (Start)		Δ grams
	208.6	−	200	=	8.6

Total Vol. H_2O 44.6 ml

Filter# ____

Particulate Wts
Filter ____ mg
Acetone ____ mg
Total ____ mg

Sampling Time Per Point, Min.	Particulate Wt., mg	Condensate Vol., ml	Fuel Flow gal/hr	Load MW	C_{pitot}	Stack Press. In.Hg-Gauge	Barometric Pressure
SINGLE POINT NORTH DUCT	—	44.6	—	—	—	—	29.95

TEST RESULTS

Test Averages:
ΔP_s = — T_{stack} = 575 °F
ΔH = 1.1 T_{meter} = 111 °F use 530°R METER TEMP COMP
Sample Vol. = 24.47 ft^3

Sample Point	Time	METER CONDITIONS ΔP_s	ΔH	Meter Reading	TEMPERATURES, °F Stack	Probe	Oven	Impingers In	Impingers Out	Meter	O_2, %	Vac.
WEST START	1141		1.2	5732.28	575	—	—	—	80	105		11
	1152		1.1	5741.0		—	—	—	90	108		12
END	1211		1.1	5756.75		—	—	—	95	120		
Average												

Meter is temp. compensated

Percent O_2 = ____
$MW_{stack\ gas}$ = ____ (~28)
Velocity = ____ ft/sec

Total Sample Time = ____ min.

ISOKINETICS = ____ %

Particulate Emissions

____ lbs/10^6 BTU

COMMENTS:
LEAK RATE < .01 CFM.

103

KVB 5807-842

KVB

Sample Code T-2 O_2: 1.5% 7 26 78 Low O_2

Firm and Unit Tenneco 43 Thermotics

Test No. T-2 O_2 Page

Sampling Station Stack base Low O_2 Date 7-26-78

WATER VAPOR AND GAS DENSITY CALCULATIONS

Percent Water Vapor in Gases

Gas Pressure at Meter, In. Hg (Absolute)

Vapor Pressure of Water at Impinger Temp., In.Hg

Volume of Metered Gas, Cu. Ft.

Volume of Water Vapor Metered, BxC/A, Cu.Ft.

Volume of Water Vapor Condensed, Cu.Ft.*

Total Volume of Water Vapor in Gas Sample, D+E, Cu.Ft.

Total Volume of Gas Sample, C+E, Cu.Ft.

% Water Vapor in Sampled Gas, 100 x F/G

See D on sampling train data sheet

Gas Density Correction Factor

Component	Volume Percent (Fyrite 14:15)	Moisture Collection	Mol.Wt.	Weight Per Mole Wet Basis
Water	12.9	1.0	18.0	2.32
CarbonDioxide	13.5 Dry Basis	.871	44.0	5.17
CarbonMonoxide	35 PPM Dry Basis	.871	28.0	—
Oxygen	1.5 Dry Basis	.871	32.0	0.42
Nitrogen + Inerts	85.0 Dry Basis	.871	28.2	20.88
B = .264 x 85 − 15 = 7.44 x 2 = 14.88			Average Molecular Weight	28.78

Density of Gas Referred to Air = $\frac{\text{Av.Mol.Wt.}}{28.95}$ = 0.994

Gas Density Correction Factor = $\sqrt{\frac{1.00}{J}}$ = 1.003

KVB

Sample Code T-3 O_2 3% Medium 7-26-78

Firm and Unit Tenneco 43 Thermotics

Test No. T-3 Page

Sampling Station Base of Stack Medium O_2 Date 7-26-78

WATER VAPOR AND GAS DENSITY CALCULATIONS

Percent Water Vapor in Gases

A. Gas Pressure at Meter, In. Hg (Absolute)

B. Vapor Pressure of Water at Impinger Temp., In.Hg

C. Volume of Metered Gas, Cu. Ft.

D. Volume of Water Vapor Metered, BxC/A, Cu.Ft.

E. Volume of Water Vapor Condensed, Cu.Ft.*

F. Total Volume of Water Vapor in Gas Sample, D+E, Cu.Ft.

G. Total Volume of Gas Sample, C+E, Cu.Ft.

H. % Water Vapor in Sampled Gas, 100 x F/G

* See D on sampling train data sheet

Gas Density Correction Factor

Component	Volume Percent	X Moisture Collection	X Mol.Wt. =	Weight Per Mole Wet Basis
Water	10.8	1.0	18.0	1.94
CarbonDioxide	13.1 Dry Basis	.892	44.0	5.14
CarbonMonoxide	30 ppm Dry Basis		28.0	
Oxygen	3.0 Dry Basis	.892	32.0	.86
Nitrogen + Inerts	83.9 Dry Basis	.892	28.2	21.10
$\{.264 \times 83.9 - (16.1)\} 2 = 12.1$			Average Molecular Weight	29.00

J. Density of Gas Referred to Air = $\frac{\text{Av.Mol.Wt.}}{28.95}$ = 1.003

K. Gas Density Correction Factor = $\sqrt{\frac{1.00}{J}}$ = .998

KVB

Sample Code T-4 HiO_2 7-26-78

Firm and Unit Tenneco Kendon base 50 mm Btu thermothics

Test No. T-4 Page

Sampling Station Base of Stable outlet Date 7-26-78

WATER VAPOR AND GAS DENSITY CALCULATIONS

Percent Water Vapor in Gases

A. Gas Pressure at Meter, In. Hg (Absolute)

B. Vapor Pressure of Water at Impinger Temp., In.Hg

C. Volume of Metered Gas, Cu. Ft.

D. Volume of Water Vapor Metered, BxC/A, Cu.Ft.

E. Volume of Water Vapor Condensed, Cu.Ft.*

F. Total Volume of Water Vapor in Gas Sample, D+E, Cu.Ft.

G. Total Volume of Gas Sample, C+E, Cu.Ft.

H. % Water Vapor in Sampled Gas, 100 x F/G

* See D on sampling train data sheet

Gas Density Correction Factor

Component	Volume Percent	X Moisture Collection	X Mol.Wt. = Weight Per Mole Wet Basis
Water	11.3 (calculated)	1.0	18.0 — 2.03
CarbonDioxide	11.25 Dry Basis	.887	44.0 — 4.39
CarbonMonoxide	25 ppm. Dry Basis		28.0
Oxygen	4.6 Dry Basis	.887	32.0 — 1.31
Nitrogen + Inerts	84.15 Dry Basis	.887	28.2 — 21.05
		Average Molecular Weight	28.78

$\%H_2O = \frac{200B}{1.00+2B}$ $2B = (.264 \cdot 84.15 - 15.85)$ $2B = 6.373$ $= 11.29\% H_2O$

J. Density of Gas Referred to Air = $\frac{\text{Av.Mol.Wt.}}{28.95}$ = .994

K. Gas Density Correction Factor = $\sqrt{\frac{1.00}{J}}$ = 1.003

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KVB

Sample Code T-2-3-4 7-26-78

Firm and Unit Tenneco

Test No. T-2,3,4

Page 2

Date 7-26-78

GRAB AND BAG SAMPLE RESULTS
HYDROCARBONS, ALDEHYDES

SAMPLE STATION	Sample Type and Sampling Time	Components	ppm Dry Basis	ppm Stack Conditions	Grains/SCF Stack Conditions	LBS/HR Loss
Location T-2 Low O_2	PDS	11				
	Low O_2 PDS	12				
Temp., °F 98	% 2.3%					
	14:30 HC	# 10 - 500				
Humidity, % 2c	HC	# 100 - 500				
Location T-3 Med O_2	PDS	13 - 2000				
	Med. O_2 PDS	14 - 2000				
Temp., lower F	% 3%					
	15:00					
Humidity, %	HC	101 - 500				
	HC	22 - 500				
Location T-4 Hi O_2	T-4 PDS	16 - 2000				
	O_2 % PDS	15 - 2000				
Temp., °F	PDS					
	16:00 HC	4 - 250				
Humidity, %	HC	102 - 250				

KVB

Sample Code T-5 7-26-78

Firm and Unit Tenneco Unit 43 Thermatics
Reuedon Lease

T-5

Test No. _____

Page _____

Date 7-26-78

GRAB AND BAG SAMPLE RESULTS
HYDROCARBONS, ALDEHYDES

SAMPLE STATION	Sample Type and Sampling Time	Components	ppm Dry Basis	ppm Stack Conditions	Grains/SCF Stack Conditions	LBS/HR Loss
Location Stack O_2 4% Test T-5	T-5 NOx PDS	#17 2000 ml				
		18 "				
Temp. °F 98	Normal O_2 4% 11:25	19 "				
		20 "				
	HC	104 250				
Humidity, % 20		103 250				
	Background	3 250				
	11:30					
Location						
Temp., °F						
Humidity, %						
Location						
Temp., °F						
Humidity,						

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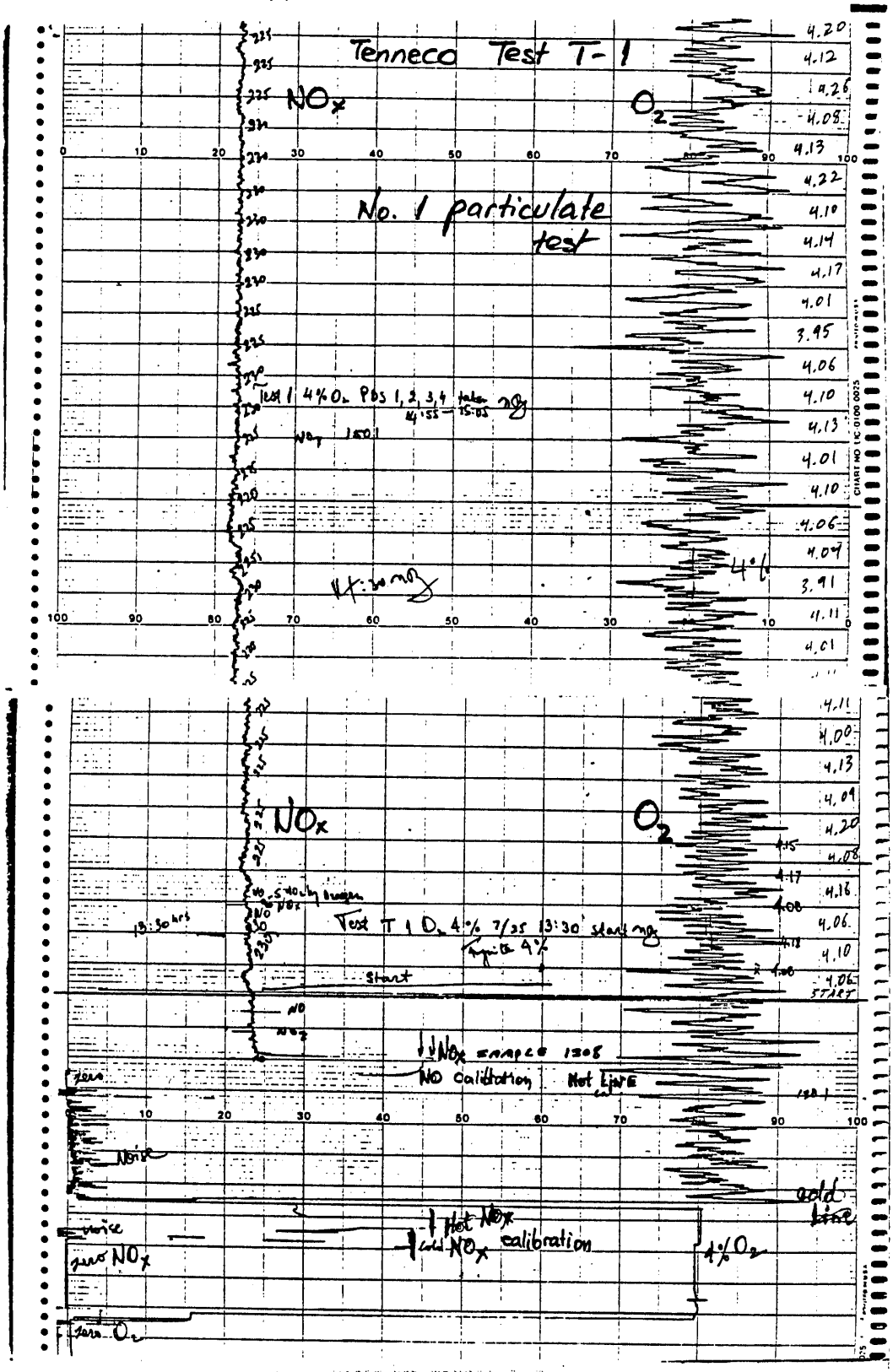
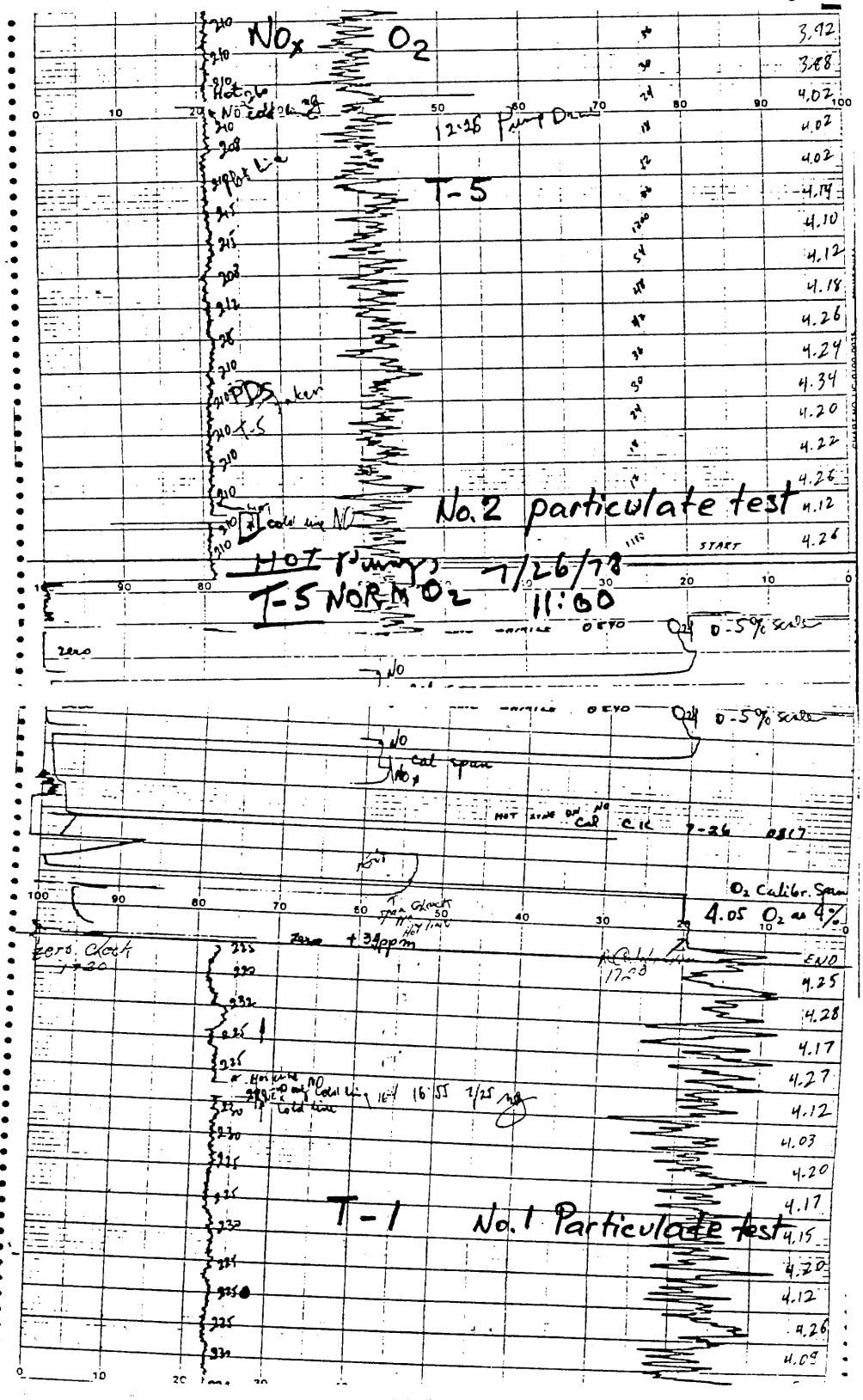
TENNECO KENDON

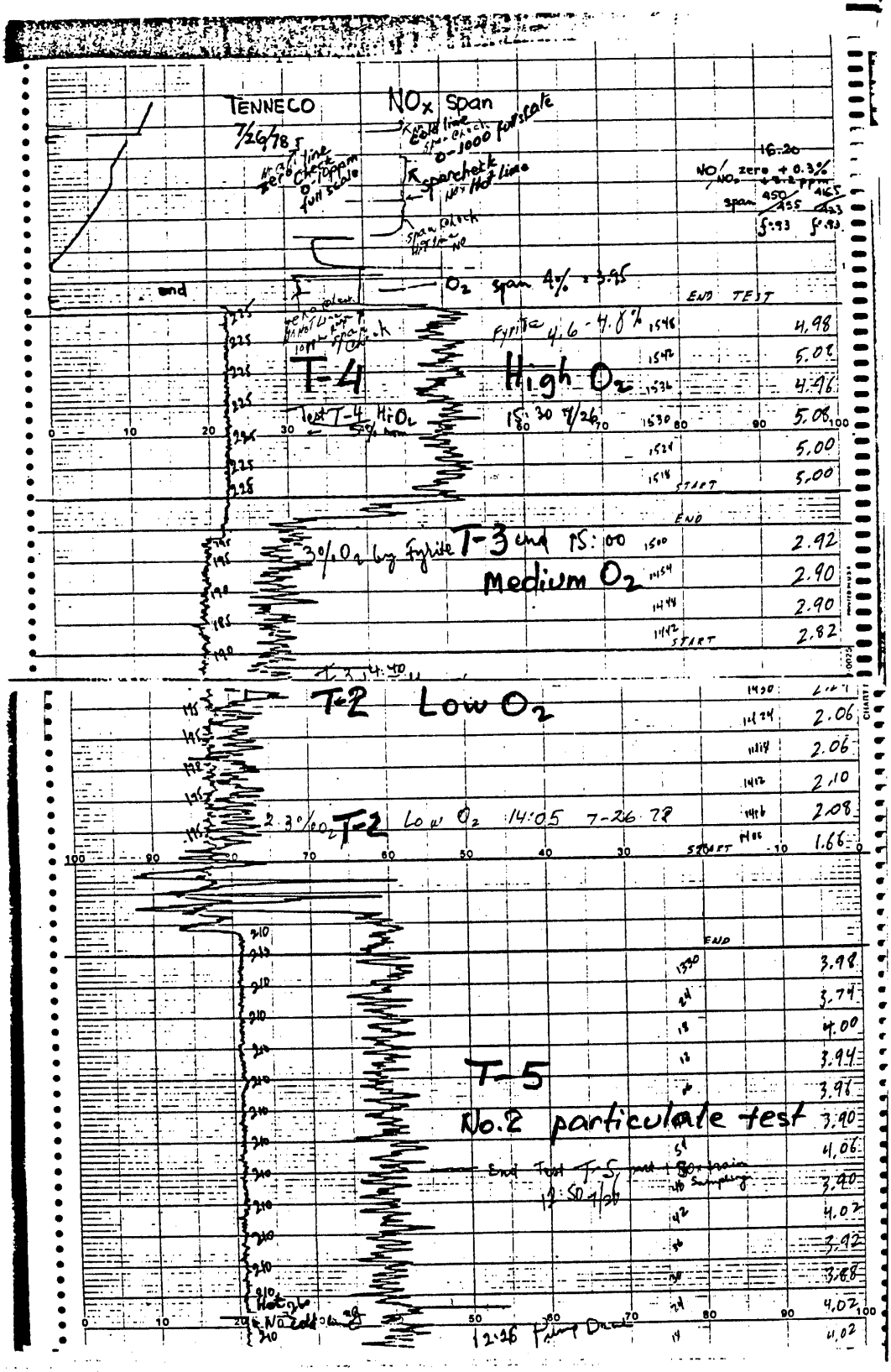
INSTRUMENT RECORDED DATA ON NO_x AND O_2

(Speed: 10 Centimeter Per Hour)

$NO_x - O_2$
Page 1 of 3




NOx
O2
T-5
No. 2 particulate test
HOT pumps 7/26/78
T-5 NOR-M O2 11:60
T-1
No. 1 Particulate test


TENNECO
7/26/78
NOx Span
Cold line
Span check
0-1000 full scale
Hot line
zero check
0-10ppm
full scale
Span check
Hot line
NO
16:20
NO/NOx zero + 0.3%
span 450/455 4165/423
f:.93 f:.93
end
O2 span 4% = 3.95
END TEST
Fyrite 4.6 - 4.8%
T-4
High O2
Test T-4 HiO2
15:30 7/26
4.98
5.08
4.96
5.08
5.00
5.00
START
END
3% O2 by Fyrite
T-3 end 15:00
Medium O2
2.92
2.90
2.90
2.82
START
T-2 Low O2
2.06
2.06
2.10
2.08
1.66
2.3% O2
T-2 Low O2 14:05 7-26-78
START
END
3.98
3.74
4.00
3.94
3.96
3.90
4.06
3.90
4.02
3.92
3.88
4.02
4.02
T-5
No.2 particulate test
End Test T-5
12:50 7/26
12:26 Pump Down

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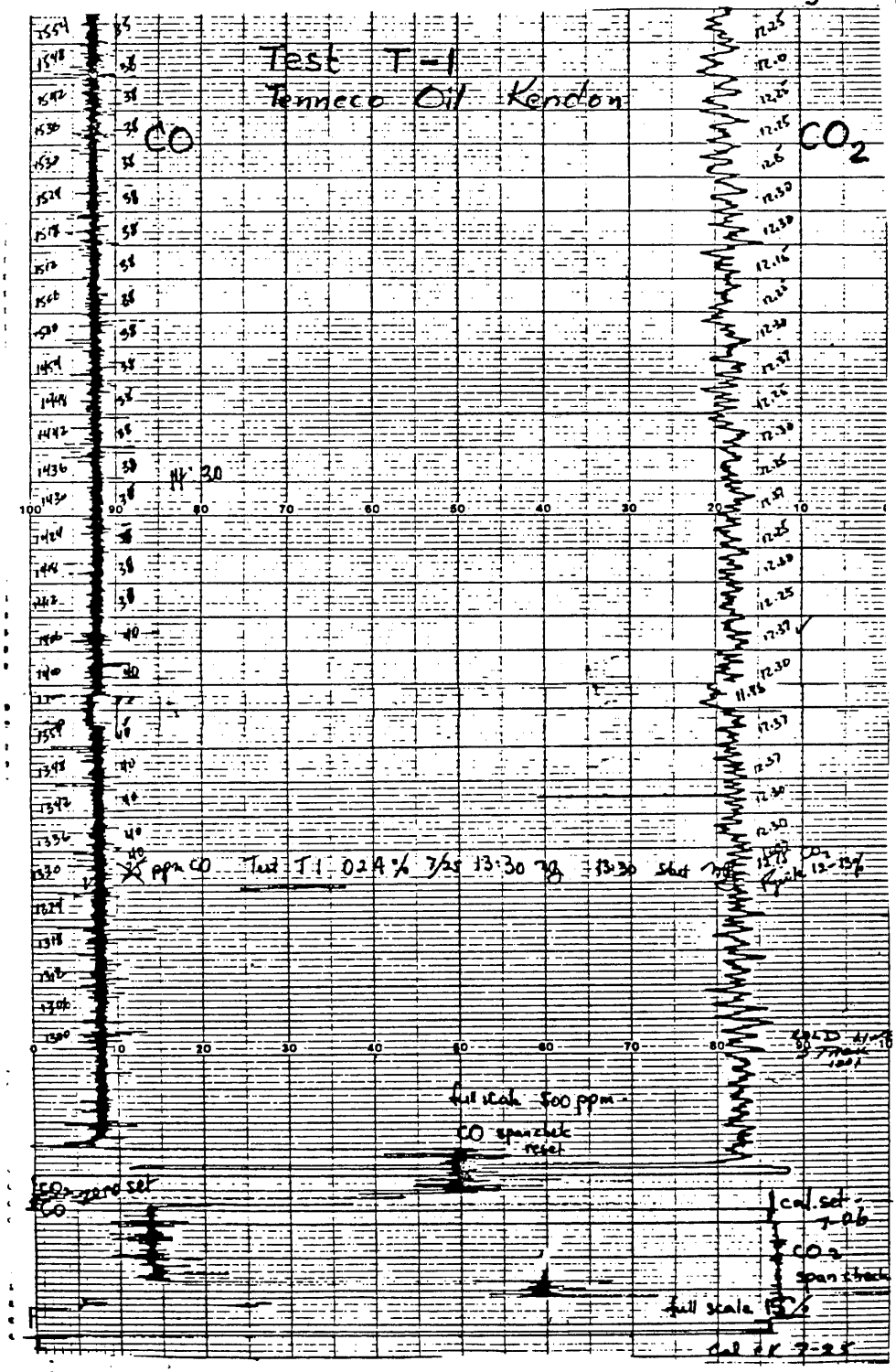
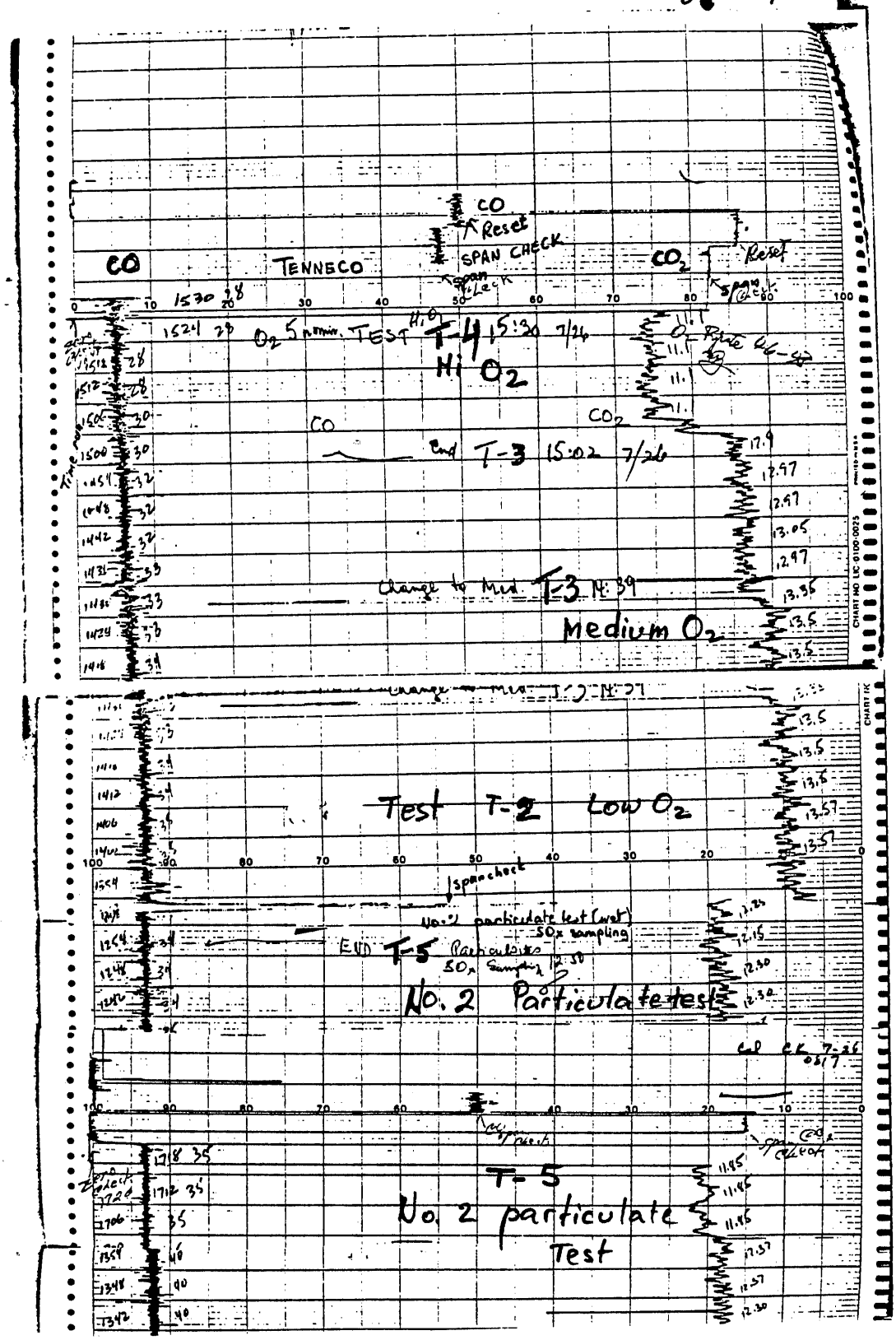
TENNECO KENDON

INSTRUMENT RECORDED DATA ON CO AND CO_2 $CO-CO_2$

(Speed: 10 Centimer Per Hour) Page 1 of 2



KVB 5807-842

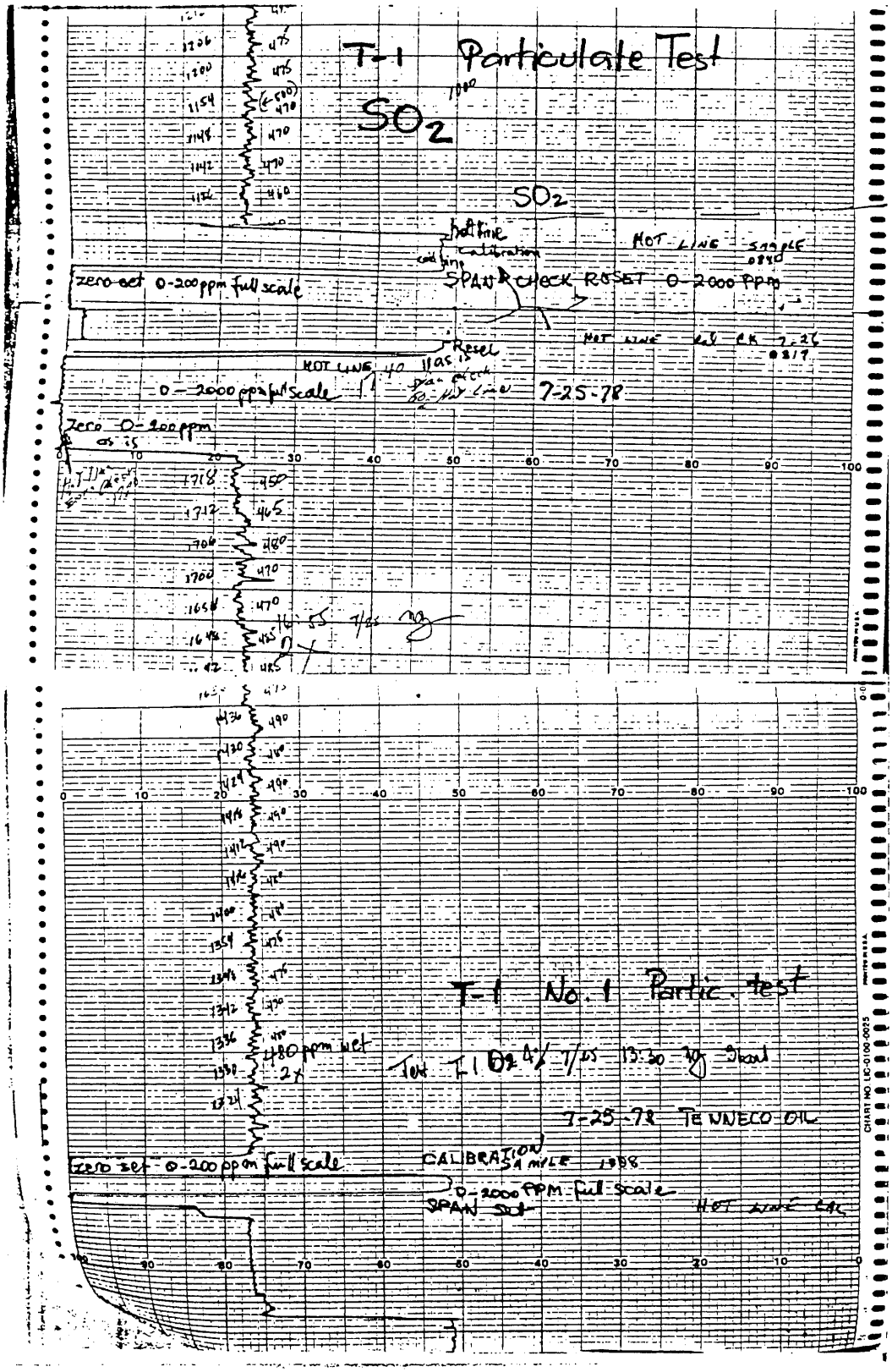

CO
Reset
SPAN CHECK
TENNECO
CO_2
Reset
O_2 5 min. TEST
T-4 15:30 7/26
Hi O_2
CO
CO_2
End T-3 15:02 7/26
Change to Mid T-3 14:39
Medium O_2
Test T-2 Low O_2
span check
No. 2 particulate test (wet)
SOx sampling
END T-5 Particulates
SOx Sampling
No. 2 Particulate test
T-5
No. 2 particulate
Test

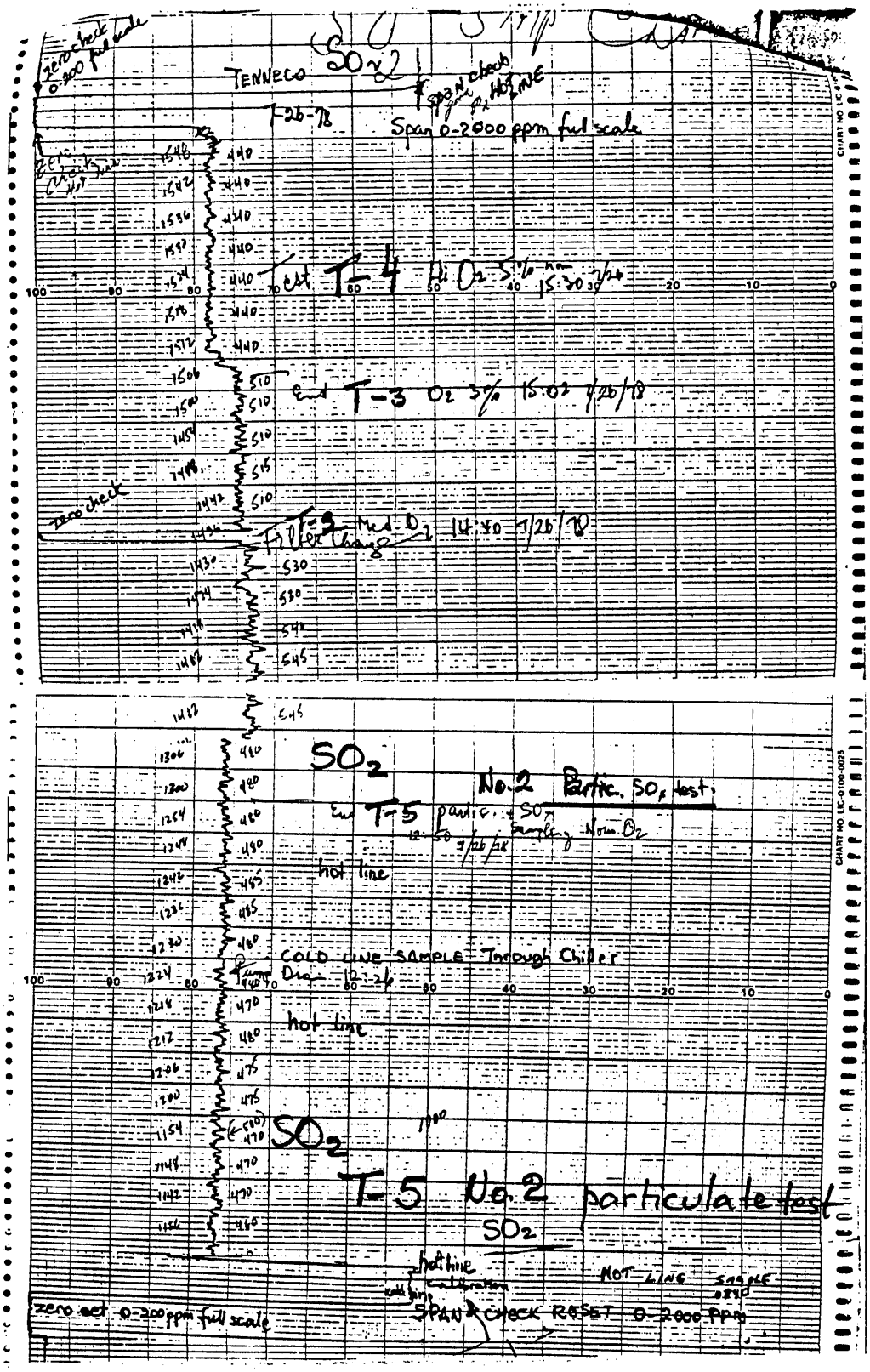
KVB 5807-842

TENNECO KENDON

INSTRUMENT RECORDED DATA ON SO_2

(Speed: 10 Centimer Per Hour)




zero check 0-200 full scale
TENNECO SO2
7-26-78
Span 0-2000 ppm full scale
Test T-4 Hi O2 5% nom 15:30 7/26
End T-3 O2 3% 15:02 7/26/78
zero check
T-3 Med O2 14:40 7/26/78
Filter Change
SO2
No. 2 Partic. SO2 test
End T-5 partic. + SO2 Sampling Nom O2
hot line
COLD LINE SAMPLE Through Chiller
hot line
SO2
T-5 No. 2 particulate test
SO2
hot line
NOT LINE SAMPLE
zero set 0-200 ppm full scale
SPAN CHECK RESET 0-2000 PPM

KVB 5807-842