Background Report Reference

AP-42 Section Number: 12.20

Background Chapter: 4

Reference Number: 66

Title: Report of Air Pollution Source Testing At Building No. 5 Scrubbers

Douglas Aircraft Company

January 1990

ENCLOSURE 5 - REFERENCE E DOUGLAS AIRCRAFT BLDG 5, SCRUBI 5 HA7-6

ELECTROPLATING

REF. 4-66

On page 1 of this report under the methodology section, tl of detection of two analytical techniques are described: for hexavalent chromium is 0.01 microgram per liter and t for total chromium is 10 micrograms per liter. Ten micrograms per liter is equal to 1 microgram per 100 milliliters, and this was the detection level on the diphenylcarbazide method that we used for

hexavalent chromium early in our testing program. The hex chrome analysis at 0.01 micrograms per liter equals 0.001 micrograms per 100 milliliters, or 1000 times more sensitive. A call to Peter Ghrose revealed that the methods used are ICPCR for hex chrome and AAGF for total chromium. The detection limit for the total chromium should be 1 microgram per liter rather than 10 micrograms per liter.

The same problem exists with this report as with the others with respect to hex chrome versus total chromium. The ratio varies from 0.2% to 92.5%.

This is probably insignificant, but page 10 of thje report shows the % changeof the samples with respect to time. The hexavalent chrome samples gained when a second analysis was performed(+12.6% and 83.4%) sOne of the total chrome samples stayed the same while the other lost 1.6%

During the testing, there were two flow conditions: low and high. Low flow conditions existed most of the time. The high flow was about 10 times the low flow, but lasted only for a short time. Runs for high flow lasted about 20 to 30 minutes while low flow runs were about 8 hours long.

This report gives a good example of what will probably happen when anodizers are tested and the hex chrome numbers are used for compliance. Here we have ICPCR analysis for hex chrome and AAGF for total chrome. To calculate efficiencies for the control devices, the total chromium numbers should be used.

interferences; at concentrations above 200 μg/L, calcium's effect is constant and eliminates the effect of phosphate. Calcium nitrate is therefore added to ensure a known constant effect. Other matrix modifiers recommended by the instrument manufacturer may also be suitable. Nitrogen should not be used as the purge gas due to cyanide band interference. Background correction may be required because of possible significant levels of nonspecific absorption and scattering at the 357.9 nm analytical wavelength. Zeeman or Smith-Hieftje background correction is recommended to correct for interferences due to high levels of dissolved solids in the alkaline impinger solutions.

2.5 ICP Interferences.

2.5.1 Spectral Interferences. Spectral interferences are caused by: (1) overlap of a spectral line from another element; (2) unresolved overlap of molecular band spectra; (3) background contribution from continuous or recombination phenomena; and (4) stray light from the line emission of high-concentration elements. Spectral overlap may be compensated for by computer correcting the raw data after monitoring and measuring the interfering element. At the 267.72 nm Cr analytical wavelength, iron, manganese and uranium are potential interfering elements. Background and stray light interferences can usually be compensated for by a background correction adjacent to the analytical line. Unresolved overlap requires the selection of an alternative chromium wavelength. Consult the manufacturer's operation manual for interference correction procedures.

2.5.2 Physical Interferences. Samples containing high levels of dissolved solids may cause significant inaccuracies due to salt buildup at the nebulizer and torch tips. This problem can be controlled by diluting the sample or providing for extended rinse times between sample analyses. It is also recommended that standards be prepared in the same matrix as the samples (i.e., 0.1 N NaOH).

2.5.3 Chemical Interferences. These include molecular compound formation, ionization effects and solute vaporization effects, and are usually not significant in ICP, especially if the standards and samples are matrix matched.

3. Apparatus - Sampling

Enclosure 5
Reference E

This report uses two analytical techniques that are not clearly identified. They were from SCAQMD Method 205.1 but what each is specifically is difficult to determine from the report given the analytical technique is not included in the lab results in the report Appendix give total chromium by ICPMS and Hex Chromium by EPA 7196/IC. Furthermore, the hex chrome analysis is ~~###~~ 1000 times more sensitive than the total chromium method. When the laboratory hex chromium results are ratioed with the laboratory total chrome results, the percent hex chrome varies from 92.5% for a high to a low of 0.2%.

Page 10 of the report shows the % change of the sample with respect to time. The Hexavalent chrome sample grind when a second analysis was performed (+12.6% and 83.4%). One of the total chrome samples stayed the same while the other lost 1.6%.

During testing, there was a low flow condition (the majority of the time) and a high flow condition. High flow was about 10 times the low flow. The high flow runs were from 20 to 30 minutes long. The low flow runs were about 8 hours long.

~~On this test, the hex chrome number should be used to determine efficiency~~

ENCLOSURE 5
REFERENCE E

REPORT OF AIR POLLUTION SOURCE TESTING AT BUILDING NO. 5 SCRUBBERS (HA7-5, HA7-6) DOUGLAS AIRCRAFT COMPANY LONG BEACH, CALIFORNIA

Submitted to:

DOUGLAS AIRCRAFT COMPANY
10833 Valley View
Cypress, California 90630

Submitted on:

January 12, 1990

Submitted by:

ENGINEERING-SCIENCE, INC.
75 N. Fair Oaks Avenue
Pasadena, California 91103
P.O. Box 7107

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Rolando Rosario
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ES ENGINEERING-SCIENCE

1.

E

REPORT OF AIR POLLUTION SOURCE TESTING AT BUILDING NO. 5 SCRUBBERS (HA7-5, HA7-6) DOUGLAS AIRCRAFT COMPANY LONG BEACH, CALIFORNIA

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REPORT OF AIR POLLUTION SOURCE TESTING AT BUILDING NO. 5 SCRUBBERS (HA7-5, HA7-6) DOUGLAS AIRCRAFT COMPANY LONG BEACH, CALIFORNIA

INTRODUCTION

On November 21-22, 1989 Engineering-Science (ES), Pasadena conducted air pollution source testing on a pair of Harrington, vertical packed type, scrubbers at Douglas Aircraft Company (DAC) facilities at Long Beach, California. Tank 5DA-07 (Anodize) was tested at the exhaust outlets of the two scrubbers designated HA7-5 and HA7-6. Two tests runs, each with two loads per run, were conducted at two different operating conditions. Personnel from DAC monitored the operating conditions, amperage usage, and parts processed.

The ES testing team was comprised of Messrs. Mike Edwards (Team Leader), Dennis Bautista, Dwight Wieman, Anthony King, Senen Karikitan, and Rolando Rosario. The DAC coordinating team was comprised of Messrs. John Houghton, Robert Tomko, Charles Austin, and Stefan Schurter. ~~Mr. Merrill Hickman was the observer for the SCAQMD.~~

METHODOLOGY

The testing procedures have been developed to meet the SCAQMD requirements for chromium plating processes. Chromium emissions as hexavalent chromium and as total chromium were determined in accordance with SCAQMD Method 205.1. Limits of detection were 0.01 microgram per liter for hexavalent chromium and 10 microgram per liter for total chromium.

Velocity and Moisture Determination

are these reversed ?

The sampling ports were located in accordance with EPA Method 1. The two ports were oriented 90° to each other, and a sampling and velocity traverse of 12 points were conducted through each port. The gas stream flow rate in fpm and exhaust temperatures at each traverse point was determined using a TSI Model 8350 air velocity meter. Carbon dioxide (CO_2) and oxygen (O_2) used in determining the molecular weight of the exhaust gases were determined by Fyrite analysis of integrated Tedlar bag samples. Moisture contents were determined gravimetrically by the weight gain of the impinger train sets in accordance with EPA Method 4.

Cyclonic flow checks were conducted in accordance with EPA Reference Method 1 guidelines. Cyclonic flow was verified by rotating the air velocity meter pitot tip so that the planes of the face openings of the tube were perpendicular to the stack cross-sectional plane. This is known as the "0 degree reference" position. A zero reading should be obtained from the hot wire anemometer. If the anemometer did not read zero, the tube was rotated up to a 90° yaw angle or until a zero reading was obtained. The angle of rotation from the initial position was recorded to the nearest degree. The source was considered free of cyclonic flow since the average angle of rotation was less than 10° for the 24-point traverse.

The variation in the stack gas flows required nozzles of two different sizes in order to maintain isokinetics. Since changing nozzles invalidates a test, two sample trains were operated in each stack. The first train had a one (1") inch diameter nozzle and the second had a quarter (1/4") inch nozzle. When the tank lids were opened the sample train equipped with the smaller nozzle was operated to accommodate the high flow conditions, when the hoods were closed the sample train with the larger nozzle was turned on and the train with the smaller nozzle was turned off.

For Tank No. 7 a 480 minute run was conducted on low flow conditions, high flow conditions were sampled as they occurred. Process operations were coincident with the sampling runs to ensure that batches were not processed during port changes. A minimum sample volume of 200 dry standard cubic feet was targeted for each scrubber exhaust.

Hexavalent Chromium and Total Chromium

SCAQMD Method 205.1 was used to collect wet impingement samples from the scrubber outlets. All sample train components were constructed of glass or teflon and cleaned before each test using 1:1 nitric acid followed by a rinse with 0.02 sodium bicarbonate to a neutral pH.

Sample recovery was accomplished using minimal amounts of 0.02 N sodium bicarbonate to minimize sample dilution. The probe rinse was recovered and composited with the catch and rinse of the impingers. The filter was recovered and included with the composite. The composite sample for each train was submitted to West Coast Analytical Laboratories (WCAS), Santa Fe Springs California for hexavalent and total chromium analyses. A blank sample was submitted and only ES laboratory numbers were used to identify the samples.

Process Data Requirements

During the test program, records were maintained for documentation of the test conditions. The recording ammeter and ammeter strip chart were operating throughout the program. Personnel from DAC monitored and recorded the ampere usage, the numbers and description of the parts in each rack.

QUALITY ASSURANCE

Field Quality Assurance

Prior to and at the conclusion of field sampling, the meter box dry gas meter and orifice were calibrated against a wet test meter. The results of orifice calibration was expressed as the delta H@ at various pressure drops (in inches of water), as specified in EPA publication APTD-0576. The dry gas meter accuracy was expressed as gamma (Y) and was determined as the ratio between the meter box dry gas meter and the wet test meter.

Impinger and meter temperatures were monitored using a type-K thermocouple connected to an Omega Model 601 digital readout. A calibrated air velocity meter (TSI Model 8350) was used for flowrate and stack temperature measurements.

At the conclusion of each test run the sampling train was leak checked at a vacuum equal to or greater than the highest vacuum observed during the test runs. The sampling train was considered leak free since the leak rate was less than 0.02 CFM or 4% of the average sample rate.

At the beginning of field testing programs, a probe wash and flexible line wash were obtained and identified as field blanks. The probe wash technique, all sampling and recovery reagents, sample containers and sample handling used for the test runs were identical to those used to obtain the field blanks.

Laboratory Quality Assurance

WCAS has its own laboratory quality assurance program applied to the samples for analysis. ES applied its own laboratory quality assurance program to ensure that the trains and reagents used for the test program conform or exceed testing guidelines.

Calibration Procedures

The calibration procedures were specific to each analytical procedure. Standards were prepared from the highest grade reagents available, using procedures specified in the methods.

Internal Quality Control Checks

Internal quality control checks were made by using blanks (prepared by ES), by the use of internal standards common to each laboratory, and by the use of replicate determinations.

SAMPLE CUSTODY

A specific Chain-of-Custody procedure was used for this project. The elements of this plan include:

- Train component identification
- Sample identification
- Sample labels

- Documentation
- Chain of custody forms

The sequence of activities concerned with sample custody together with identification and tracking procedures are described below:

1. Sample train prepared by the laboratory including filter holders, impingers, and other sampling equipment identified by tags and codes.
2. Sample train issued to test team and the master log filled out. Sample I.D. number stickers issued according to test identification code.
3. Train returned to recovery area when a valid sample was obtained. Sample train accompanied by all field data sheets.
4. Recovery team recovered samples using appropriate containers, affixed sample I.D. labels to sample containers, to master log, to field data sheet, and to train recovery sheet.
5. All samples returned to ES Pasadena laboratory with Chain-of-Custody form.
6. Samples transferred or shipped to appropriate laboratory with Chain-of-Custody form.
7. Samples examined at each transfer point for integrity (broken containers, loss in liquid, seal, identity).

Upon completing the required analysis, the analyst returned the Chain-of Custody form along with results to ES. All samples were accounted for by the ES Laboratory Supervisor and Project Manager. Each laboratory identified the samples in its own laboratory notebooks by the ES I.D. number as well as any internal identification. Notebooks are retained by each laboratory according to usual laboratory practices.

RESULTS

Tables 1 to 6 represent the results of the testing program. Additional supporting data are contained in the Appendix.

Table 1

Summary of Chromium Emissions

Douglas Aircraft Company
Long Beach, California

Tank 5DA-07

November 21-22, 1989

Parameter	HA7-5	HA7-6	TANK 5DA-07
Condition 1			
Ampere-hours	NA[1]	NA	10,666[2]
Hexavalent Chromium			
mg/day	738	9,062	9,800
mg/amp-hr	NA	NA	0.306
Total Chromium			
mg/day	620	10,093	14,713
Condition 2	11.9%	89.8%	66.6%
Ampere-hours	NA	NA	6,445[2]
Hexavalent Chromium			
mg/day	5.9	86.5	92.4
mg/amp-hr	NA	NA	0.005
Total Chromium			
mg/day	23.7	5,232	5,469
	24.9%	1.7%	1.7%

1 NA, not applicable

2 2 loads per test ≈ 6 loads daily

Hi XROM "MASSFLO-

RUN NUMBER RUN
HA 7-5

VOL MTR STD ?
13.9210000 RUN
STACK DSCFM ?
2.00000000 CLX
39,396.00000 RUN
FRONT 1/2 MG ?
.0010100 RUN
SACK 1/2 MG ?
.0070000 RUN

F GR/DSCF = 0.0000911
F MG/MMM = 0.0025621
F LB/HR = 0.0903772
F KG/HR = 0.0001711

B GR/DSCF = 0.6000078
B MG/MMM = 0.0177572
B LB/HR = 0.0026144
B KG/HR = 0.0011859

Table 2

Summary of Chromium Emissions

Douglas Aircraft Company
Long Beach, California

Condition 1 HA 7-5

November 21, 1989

Parameter	Low Flow	High Flow
Sampling Time (min)	468	20
Metered Volume (ft^3) (DSCF)	411.655	13.921
Flow Rate		
Velocity (fps)	2.77	25.07
DSCFM	4,382	39,306
Sample Volume (l)	0.795	0.700
Hexavalent Chromium		
Conc. (ug/l)	48.93	1.43
Mass (ug)	38.9	1.0
mg/day	571.84	166.63
Total Chromium		
Conc (ug/l)	53	≤ 10
Mass (ug)	42.14	ND[1]
mg/day	619.47	NA[2]

1 ND, not detectable

2 NA, not applicable

92.3% Cr^{+6}

14.3%

```
RUN NUMBER                                  XROOM "MASSFLO"
HA 7-5                                  RUN
VOL MTR STD ?                           RUN
          411.6550
STACK DSCFM ?                           RUN
        4,382.0000
FRONT 1/2 MG ?                          RUN
            .0360
BACK 1/2 MG ?                           RUN
            .042135

F  GR/DSCF = 1.4245E-6
F  MG/MMM = 0.0033
F  LB/HR = 0.0001
F  KG/HR = 2.4270E-5

B  GR/DSCF = 1.5795E-6
B  MG/MMM = 0.0036
B  LB/HR = 0.0001
B  KG/HR = 2.6911E-5
```

SAMPLING SUMMARY SHEET

PLANT _____ LOCATION _____

SAMPLED SOURCE _____

Run	Date	N_p	(3) Y_m	(4) ΔH	(5) P Bar.	(6) V_m	(7) T_m	(8) V_m Std.	(9) %	(10) P_{st}	17 P_s	(18) T_s	(19) VP	(20) V_w	21 $V_{w_{gas}}$	22 %M	23 M_d

Run	(24) CO_2	(25) O_2	26 N_2	(27) CO	(28) ___	29 MW_d	30 MW	(31) $C_p\sqrt{\Delta P_s(T_s + 460)}$	(32)	(33) T_t	(34) D_n	35 V_s	(36) D_s	(37) Area	38 ACFM	(39) DSCFM	40 %I

$$V_m \text{ Std.} = Y_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$MW_d = \%CO_2 \times .44 + (\%O_2 \times .32) + (\%CO + \%N_2) \times .28 + \left(\%\text{Other} \times \frac{\text{Mol. wt.}}{100}\right)$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_t \times P_s \times M_d \times A_n}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orfice Pressure Drop, inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP, DSCF[a]

% = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, inches H_2O

P_s = Stack Gas Pressure, inches Hg.

T_s = Average Stack Temperature, °F

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volume of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

$\%CO_2$ = Volume % Dry

$\%O_2$ = Volume % Dry

$\%N_2$ = Volume % Dry

%CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T_s + 460)}$ Is determined by averaging the square root of the product of the velocity head (P) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a] Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg.

[b] Standard Conditions @ 68°F. 29.92 in. Hg.

SUMMARY OF EMISSIONS

PLANT Douglas Aircraft LOCATION Long Beach, California

SAMPLED SOURCE Bldg #5 Scrubbers HA7-5 & HA7-6

	RUN	DATE	(1) V_m Std.	(2) DSCFM	FRONT HALF MILLIGRAMS PROBE	CYCLONE	FILTER	(3) Hex TOTAL	(4) Total BACK HALF	5 FRONT + BACK TOTAL
Lo	Cond 1 HA 7-5	21Nov89	411.655	4382				038.90	042.135	
Hi		21Nov89	13.921	39,306				001.001	007.00	
Lo	Cond 1 HA 7-6	21Nov89	359.395	6261				373.95	421.6	
Hi		21Nov89	13.115	62575				000.3486	008.3	

CONCENTRATIONS

	RUN	(6) Hex FRONT HALF Gr/DSCF	(7) Mg/M³	(8) Lb/Hr	(9) Kg/Hr	(10) Total BACK HALF Gr/DSCF	(17) Mg/M³	(18) Lb/Hr	(19) Kg/Hr	(20) TOTAL Gr/DSCF	(21) Mg/M³	(22) Lb/Hr	(23) Kg/Hr
Lo		.000326	~~.002337~~	~~5.48X10⁻⁵~~	5.35×10^{-5}		.003443	5.65×10^{-5}					
Hi			.00256	3.77×10^{-4}		ND→	.01776	2.61×10^{-3}					
Lo			.03871	9.08×10^{-4}			.04143	9.72×10^{-4}					
Hi			.000939	2.20×10^{-4}		ND→	.02235	5.24×10^{-3}					

Remarks: Note following samples are ND (non-detect) or < minimum detection limit (<10)

HA 7-5 High Flow (Total Cr)

HA 7-6 High Flow (Total Cr)

SUMMARY OF EMISSIONS

PLANT Douglas Aircraft LOCATION Long Beach, California

SAMPLED SOURCE

	RUN	DATE	V_m Std. (1)	DSCFM (2)
Lo	2-HA 7-5	22 Nov 89	408.230	4206 ~~41855~~
Hi:	2-HA 7-5	22 Nov 89	26.485	41855
Lo	2-HA 7-6	22 Nov 89	314.632	5897
Hi:	2HA 7-6	22 Nov 89	19.194	56954

FRONT HALF MILLIGRAMS				Total (4)	5
PROBE	CYCLONE	FILTER	Hex (3) ~~TOTAL~~	~~BACK HALF~~	FRONT + BACK TOTAL
			005.5 *	017.05	
			000.0372	006.20 *	
			002.0093	.127.8	
			000.1288	008 7.28	

Total CONCENTRATIONS

Hex

FRONT HALF					BACK HALF				TOTAL			
RUN	Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr	Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr	Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr
		.000476	7.5×10^{-6}			.001475	2.32×10^{-5}					
		.000050	7.8×10^{-6}			.008267	1.296×10^{-3}					
		.000226	5.0×10^{-6}			.01434	3.17×10^{-4}					
		.000237	5.06×10^{-5}			.01339	2.86×10^{-3}					
	6	7	8	9	10	17	18	19	20	21	22	23

Remarks: Note following samples are ND (non-detect) or < min. detection limit (< 10)

* HA 7-5 Low Flow Hex Chrome

* HA 7-5 High Flow Total Cr

SAMPLING SUMMARY SHEET

PLANT _____ LOCATION _____

SAMPLED SOURCE _____

Run	Date	N_p	(3) Y_m	(4) ΔH	(5) P Bar.	(6) V_m	(7) T_m	(8) V_m Std.	(9) %	(10) P_{st}	17 P_s	(18) T_s	(19) VP	(20) V_w	21 $V_{w_{gas}}$	22 %M	23 M_d

Run	(24) CO_2	(25) O_2	26 N_2	(27) CO	(28) ___	29 MW_d	30 MW	(31) $C_p\sqrt{\Delta P_s(T_s + 460)}$	(32) T_t	(33) D_n	34 V_s	(35) D_s	(36) Area	(37) ACFM	38 DSCFM	39 %I

$$V_m \text{ Std.} = Y_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$MW_d = \%CO_2 \times .44 + (\%O_2 \times .32) + (\%CO + \%N_2) \times .28 + \left(\%\text{Other} \times \frac{\text{Mol. wt.}}{100}\right)$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_t \times P_s \times M_d \times A_n}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orfice Pressure Drop, inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP, DSCF[a]

% = Per Cent other gas removed before Dry Gas Meter

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P_s = Stack Gas Pressure, Inches Hg.

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V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volumn of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

$\%CO_2$ = Volume % Dry

$\%O_2$ = Volume % Dry

$\%N_2$ = Volume % Dry

%CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T_s + 460)}$ Is determined by averaging the square root of the product of the velocity head (P) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a] Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg.

[b] Standard Conditions @ 68°F. 29.92 in. Hg.

Table 3

Summary of Chromium Emissions

Douglas Aircraft Company
Long Beach, California

Condition 1 HA-7-6

November 21, 1989

Parameter	Low Flow	High Flow
Sampling time (min)	480	23
Metered Volume (ft^3) (DSCF)	359.395	13.115
Flow Rate		
Velocity (fps)	2.24	22.36
DSCFM	6,261	62,575
Sample Volume (l)	0.680	0.830
Hexavalent Chromium		
Conc. (ug/l)	549.93	0.42
Mass (ug)	373.95	0.35
mg/day	8,956.02	109.96
Total Chromium		
Conc. (ug/l)	620	<10
Mass (ug)	421.6	ND[1]
mg/day	10,092.72	NA[2]

[1] ND, not detectable

[2] NA, not applicable

88.7% Cr^{+6}

4.2%

HA 7-6 Lo Flow

```
XROM "MASSFLO"
RUN NUMBER                    RUN
HA 7-6
VOL MTR STD ?
      359.3950000             RUN
STACK DSCFM ?
    6,261.0000000             RUN
FRONT 1/2 MG ?
      .3939000                RUN
BACK 1/2 MG ?
      .4216000                RUN
F GR/DSCF = 0.0000016
F MG/MMM = 0.0037094
F LB/HR = 0.0009878
F KG/HR = 0.0004118
B GR/DSCF = 0.0000013
B MG/MMM = 0.0014262
B LB/HR = 0.0009715
B KG/HR = 0.0004407
```

HA 7-6 Hi

```
XROM "MASSFLO"
RUN NUMBER                    RUN
HA 7-6
VOL MTR STD ?
      13.1150000              RUN
STACK DSCFM ?
    62,575.0000000            RUN
FRONT 1/2 MG ?
      .0003486                RUN
BACK 1/2 MG ?
      .0003000                RUN
F GR/DSCF = 0.0000004
F MG/MMM = 0.0009387
F LB/HR = 0.0022200
F KG/HR = 0.0000998
B GR/DSCF = 0.0000998
B MG/MMM = 0.0223489
B LB/HR = 0.0052383
B KG/HR = 0.0023761
```

01/11/90-JMB

Table 4

Summary of Chromium Emissions

Douglas Aircraft Company
Long Beach, California

Condition 2 HA-7-5

November 22, 1989

Parameter	Low Flow	High Flow
Sampling time (min)	480	33
Metered Volume (ft^3) (DSCF)	408.230	26.485
Flow Rate		
(Velocity (fps)	2.62	26.22
DSCFM	4,206	41,855
Sample Volume (l)	0.550	0.620
Hexavalent Chromium		
Conc. (ug/l)	<0.10	0.06
Mass (ug)	ND[1]	0.04
mg/day	NA[2]	5.86
Total Chromium		
Conc. (ug/l)	31	<10
Mass (ug)	17.05	ND[1]
mg/day	236.69	NA[2]

32.3%

0.6%

1 ND, not detectable

2 NA, not applicable

```
XROM "MASSFLO"
RUN NUMBER          RUN
7-5
VOL MTR STD ?
     408.2300000    RUN
STACK DSCFM ?
    4,206.0000000   RUN
FRONT 1/2 MG ?
          .0055000  RUN
BACK 1/2 MG ?
          .0170500  RUN

F  GR/DSCF = 0.0000002
F  MG/MMM = 0.0004758
F  LB/HR = 0.0000025
F  KG/HR = 0.0000034

B  GR/DSCF = 0.0005006
B  MG/MMM = 0.0014749
B  LB/HR = 0.0000332
B  KG/HR = 0.0000151

R/DSCF = 2.1675442E-8
MG/MMM = 0.0004496
_B/HR = 0.0000078
KG/HR = 0.0000035

R/DSCF = 0.0000026
MG/MMM = 0.0022468
_B/HR = 0.0012990
KG/HR = 0.0005895
```

```
XROM "MASSFLO"
RUN NUMBER          RUN
7-5
VOL MTR STD ?
      26.4850000    RUN
STACK DSCFM ?
    41,855.000000   RUN
FRONT 1/2 MG ?
          .0000372  RUN
BACK 1/2 MG ?
          .0062000  RUN
```

R 460

Table 5

Summary of Chromium Emissions

Douglas Aircraft Company
Long Beach, California

Condition 2 HA-7-6

November 22, 1989

Parameter	Low Flow	High Flow
Sampling time (min)	484	32
Metered Volume (ft^3)	314.632	19.194
Flow Rate		
Velocity (fps)	2.09	20.89
DSCFM	5,897	56,954
Sample Volume (l)	0.710	0.560
Hexavalent Chromium		
Conc. (ug/l)	2.83	0.23
Mass (ug)	2.01	0.13
mg/day	50.88	35.36
Total Chromium		
Conc. (ug/l)	180	13
Mass (ug)	127.8	7.28
mg/day	3235.32	1996.83
	1.6%	1.8%

```
XROM "MASSFLO"
RUN NUMBER                    RUN
   7-6
VOL MTR STD ?
      314.6320000             RUN
STACK DSCFM ?
      5,897.000000            RUN
FRONT 1/2 MG ?
          .0020093            RUN
BACK 1/2 MG ?
          .1270000            RUN
F  GR/DSCF = 0.0000001
F  MG/MMM = 0.0002255
F  LB/HR = 0.0000050
F  KG/HR = 0.0000023

B  GR/DSCF = 0.0000063
B  MG/MMM = 0.0143442
B  LB/HR = 0.0003168
B  KG/HR = 0.0001437
```

```
XROM "MASSF
RUN NUMBER
HA 7-6
VOL MTR STD ?
      19.1940000
STACK DSCFM ?
      56,954.00000
FRONT 1/2 MG ?
          .0001288
BACK 1/2 MG ?
          .0072800

F  GR/DSCF = 0.0000
F  MG/MMM = 0.00023
F  LB/HR = 0.000052
F  KG/HR = 0.000023

B  GR/DSCF = 0.0001
B  MG/MMM = 0.0133
B  LB/HR = 0.00295
B  KG/HR = 0.00129
```

01/11/90-JMB

Table 6

Sample Retention Time Check

Douglas Aircraft Company
Long Beach, California

November 21-22, 1989

Sample #	Initial Analysis 11-28-89	Analysis Re-run 12-5-89	% Change
Total Chromium			
891161	620	610	-1.6
891166	180	180	0
Detection Limit	10	10	NA[1]
Hexavalent Chromium			
891161	550	620	+12.6
891166	2.9	6.3	+83.4
Detection Limit	0.01	1.0	NA

[1] NA, not applicable

APPENDIX A

Condition 1 HA7-5, HA 7-6

891159

RUN 1

Engineering-Science, Pasadena, California

Plant: DAC LONG BEACH
Source: HA 7-5 LOW FLOW
Date: 11-21-89
Run: 7-5 LOW FLOW
Standard Temp = 60 deg F Standard Press = 29.92 in Hg

FLOW DATA

STACK DIAMETER (inches)	72.00
STACK CROSS-SECTIONAL AREA (sq feet)	28.27
BAROMETRIC PRESSURE (inches Hg)	29.00
OXYGEN CONTENT (%)	21.0
CARBON DIOXIDE CONTENT (%)	0.0
MOISTURE CONTENT (%)	1.9
STACK TEMPERATURE (deg F)	71
STACK STATIC PRESSURE (inches water)	0.00
DRY STACK GAS MOLECULAR WEIGHT	28.84
VELOCITY PRESSURE (sq rt inches water)	0.04
PITOT TUBE CORRECTION FACTOR	0.99
VELOCITY (ft per sec)	2.77
EXHAUST GAS FLOW RATE (ACFM)	4,707
EXHAUST GAS FLOW RATE (DSCFM)	4,382

SAMPLING DATA

DRY GAS VOLUME SAMPLED (DCF)	438.422
DRY GAS VOLUME SAMPLED (DSCF)	411.655
DRY GAS METER TEMPERATURE (deg F)	86
DRY GAS METER GAMMA	1.01
AVERAGE ORIFICE PRESSURE (inches water)	2.80
TOTAL RUN TIME (min)	468
NOZZLE DIAMETER (inches)	1.003
ISOKINETIC (%)	103.5

LABORATORY DATA

MOISTURE RECOVERED (mls)		172.70
~~PARTIC FROM NOZ, PROBE & WASHES~~	(mg)	38899.00
PARTICULATE FROM FILTER (mg)		0.00
~~PARTICULATE FROM IMPINGERS~~	(mg)	34185.00

0.038829 kg × 10⁻⁶

PARTICULATE DATA

~~FRONT HALF~~	(gr/DSCF)		1.4580
	(gr/ACF)		1.3575
	(lb/hr)	0.024	54.78
~~BACK HALF~~	(gr/DSCF)		1.2814
	(gr/ACF)		1.1929
	(lb/hr)	0.021 g/hr	48.14
TOTAL	(gr/DSCF)		2.7394
	(gr/ACF)		2.5504
	(lb/hr)	0.0459	102.93

891160
RUN 1

Engineering-Science, Pasadena, California

Plant: DAC LONG BEACH
Source: HA 7-5 HIGH
Date: 11-21-89
Run: 1 7-5 HIGH
Standard Temp = 60 deg F Standard Press = 29.92 in Hg

FLOW DATA

STACK DIAMETER (inches)	72.00
STACK CROSS-SECTIONAL AREA (sq feet)	28.27
BAROMETRIC PRESSURE (inches Hg)	29.00
OXYGEN CONTENT (%)	21.0
CARBON DIOXIDE CONTENT (%)	0.0
MOISTURE CONTENT (%) SATURATED	2.6
STACK TEMPERATURE (deg F)	71
STACK STATIC PRESSURE (inches water)	0.00
DRY STACK GAS MOLECULAR WEIGHT	28.84
VELOCITY PRESSURE (sq rt inches water)	0.37
PITOT TUBE CORRECTION FACTOR	0.99
VELOCITY (ft per sec)	25.07
EXHAUST GAS FLOW RATE (ACFM)	42,536
EXHAUST GAS FLOW RATE (DSCFM)	39,306

SAMPLING DATA

DRY GAS VOLUME SAMPLED (DCF)	15.219
DRY GAS VOLUME SAMPLED (DSCF)	13.921
DRY GAS METER TEMPERATURE (deg F)	78
DRY GAS METER GAMMA	0.97
AVERAGE ORIFICE PRESSURE (inches water)	2.60
TOTAL RUN TIME (min)	20
NOZZLE DIAMETER (inches)	0.312
ISOKINETIC (%)	94.1

LABORATORY DATA

MOISTURE RECOVERED (mls)		9.80
~~PARTIC. FROM NOZ., PROBE & WASHES~~ (mg)		~~349.00~~
PARTICULATE FROM FILTER (mg)		0.00
~~PARTICULATE FROM IMPINGERS~~ (mg)		8500.00

PARTICULATE DATA

~~FRONT HALF~~	(gr/DSCF)	0.3868
	(gr/ACF)	0.3575
	(lb/hr)	130.37
~~BACK HALF~~	(gr/DSCF)	9.1997
	(gr/ACF)	8.5013
	(lb/hr)	3100.50
TOTAL	(gr/DSCF)	9.5866
	(gr/ACF)	8.8587
	(lb/hr)	3230.87

101
≤ 7500
X10^6
373.97
≤ 3104.88
RR

891161

RUN1

Engineering-Science, Pasadena, California

Plant: DAC LONG BEACH
Source: HA 7-6 LOW FLOW
Date: 11-21-89
Run: 1 7-6 LOW
Standard Temp = 60 deg F Standard Press = 29.92 in Hg

FLOW DATA

STACK DIAMETER (inches)	96.00
STACK CROSS-SECTIONAL AREA (sq feet)	50.26
BAROMETRIC PRESSURE (inches Hg)	29.00
OXYGEN CONTENT (%)	21.0
CARBON DIOXIDE CONTENT (%)	0.0
MOISTURE CONTENT (%)	2.0
STACK TEMPERATURE (deg F)	72
STACK STATIC PRESSURE (inches water)	0.00
DRY STACK GAS MOLECULAR WEIGHT	28.84
VELOCITY PRESSURE (sq rt inches water)	0.03
PITOT TUBE CORRECTION FACTOR	0.99
VELOCITY (ft per sec)	2.24
EXHAUST GAS FLOW RATE (ACFM)	6,742
EXHAUST GAS FLOW RATE (DSCFM)	6,261

SAMPLING DATA

DRY GAS VOLUME SAMPLED (DCF)	376.986
DRY GAS VOLUME SAMPLED (DSCF)	359.395
DRY GAS METER TEMPERATURE (deg F)	77
DRY GAS METER GAMMA	1.01
AVERAGE ORIFICE PRESSURE (inches water)	2.24
TOTAL RUN TIME (min)	480
NOZZLE DIAMETER (inches)	1.003
ISOKINETIC (%)	109.6

LABORATORY DATA

MOISTURE RECOVERED (mls)	155.70
~~PARTIC. FROM NOZ., PROBE & WASHES~~ (mg)	~~373952.00~~
PARTICULATE FROM FILTER (mg)	0.00
~~PARTICULATE FROM IMPINGERS~~ (mg)	~~421600.00~~ 41988

PARTICULATE DATA

~~FRONT HALF~~	(gr/DSCF)		16.0550
	(gr/ACF)		14.9099
	(lb/hr)	0.391	861.93
~~BACK HALF~~	(gr/DSCF)		18.1007
	(gr/ACF)		16.8097
	(lb/hr)		~~971.75~~ 35.05
TOTAL	(gr/DSCF)		34.1557
	(gr/ACF)		31.7196
	(lb/hr)		1833.68

X10 6 AP

RR

891161V

RUN 1

Engineering-Science, Pasadena, California

Plant:
Source:
Date: 1-7-6 #16A
Run:
Standard Temp = 60 deg F Standard Press = 29.92 in Hg

FLOW DATA

STACK DIAMETER (inches)	96.00
STACK CROSS-SECTIONAL AREA (sq feet)	50.26
BAROMETRIC PRESSURE (inches Hg)	29.00
OXYGEN CONTENT (%)	21.0
CARBON DIOXIDE CONTENT (%)	0.0
MOISTURE CONTENT (%)	2.0
STACK TEMPERATURE (deg F)	72
STACK STATIC PRESSURE (inches water)	0.00
DRY STACK GAS MOLECULAR WEIGHT	28.84
VELOCITY PRESSURE (sq rt inches water)	0.33
PITOT TUBE CORRECTION FACTOR	0.99
VELOCITY (ft per sec)	22.36
EXHAUST GAS FLOW RATE (ACFM)	67,431
EXHAUST GAS FLOW RATE (DSCFM)	62,575

SAMPLING DATA

DRY GAS VOLUME SAMPLED (DCF)	13.839
DRY GAS VOLUME SAMPLED (DSCF)	13.115
DRY GAS METER TEMPERATURE (deg F)	72
DRY GAS METER GAMMA	0.99
AVERAGE ORIFICE PRESSURE (inches water)	2.50
TOTAL RUN TIME (min)	23
NOZZLE DIAMETER (inches)	0.313
ISOKINETIC (%)	100.8

LABORATORY DATA

MOISTURE RECOVERED (mls)	5.90
~~PARTIC. FROM NOZ., PROBE & WASHES~~ (mg)	1001.00
PARTICULATE FROM FILTER (mg)	0.00
~~PARTICULATE FROM~~ IMPINGERS (mg)	7000.00

PARTICULATE DATA

~~FRONT HALF~~	(gr/DSCF)	1.1777
	(gr/ACF)	1.0929
	(lb/hr)	631.87
~~BACK HALF~~	(gr/DSCF)	8.2357
	(gr/ACF)	7.6425
	(lb/hr)	4418.67
TOTAL	(gr/DSCF)	9.4134
	(gr/ACF)	8.7354
	(lb/hr)	5050.54

3479 ≤ 8300 X10-6

≤ 6772.6

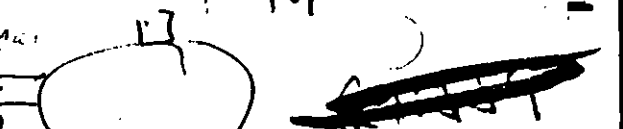
ES ENGINEERING-SCIENCE COMPANIES

K = 847.76

ΔP × K = ΔH

K = 1598.1

FIELD DATA



PAGE 1 OF 3

Plant DAC
Date 11-21-89
Test Site Bldg 5
Run Number 1-1
Operator SK/RW

Ambient Temp
Barometer
Stack Pressure
Stack H2O %
Stack Dia

Meter ΔH@ .71
Meter Gamma 1.01
Meter Box # 1.024
Nozzle Diameter .251 / .255
Probe Length /

Probe Mat'l
Filter Number
Samp Box #
PRE LEAK
POST LEAK

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm) 177.278	VELOCITY HEAD (delta p) PPM /	ORIFICE PRESSURE (delta H, "H2O) Desired	Actual	TEMPERATURES STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	PUMP VAC. "Hg
A1	0	1354	177.278	200 = .0045	4.0	4.0	75	84	79	44	NA	4
2	20	1416	193.3	185 = .0030	3.2	3.2	75	94	85	44		4
3	40	1436	215.6	185 = .0020	3.2	3.2	75	91	85	44		4
4	60	1456	231.7	185 = .0025	3.2	3.2	75	91	85	44		<4
5	80	1516	259.6	190 = .0025	4.0	4.0	74	99	89	44		4
6	100	1536	281.1	180 = .0025	3.2	3.2	73	95	87	44		4
7	120	1556	293.1	170 = .0014	2.8	2.9	72	91	82	43		4
8	140	1616	310.2	180 = .002	3.20	3.2	72	94	86	44		4
9	160	1636	331.2	185 = .0025	4.0	4.0	70	98	86	44		5
10	180	1656	354.0	170 = .001	2.8	2.9	70	89	82	43		4
11	200	1716	374.2	180 = .002	3.2	3.2	69	87	81	43		4
12	220	1736	389.5	180 = .002	3.2	3.2	70	91	82	44		4
	240 (248)	1756	410.2	170 = .001	2.8	2.9	70	93	84	44		4
			PORT CHANGE					0				
AVERAGE /SUM												

ES ENGINEERING-SCIENCE COMPANIES

Plant INC
Date 11-21-89
POST LEAK RATE

Run Number 2
Operator

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O)		TEMPERATURES					PUMP VAC. "Hg
					Desired	Actual	STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	
B1	00	1900	410.✓	13V 0.0011	1.96	1.8	71					
	9	1909	417.1	STV								
	11	1914	420,3	13V 0.0011	START			86	78			2
2	20	1925	429.6									
3	280	1945	452.4	stop	—	TAN NUT						
	~~330~~	~~2010~~		START	—							
~~4~~		~~2020~~										
3	280	2018	457.5	150 0014 START	2,24	2,24	71	85	78			2
4	300	2038	471,7	150 0014	2.24	2.24	70	87	79			3
5	320	2058	489.6	120 0011	1,60	1.60	70	83	76			2
6	340	2118	505,5	150 0014	2,24	2,24	69	87	79			3
7	360	2138	524.6	155 0015	2,40	2.40	67	87	79			3
8	380	2158	539,1	160 0016	2.60	2.60	67	88	79			3
9	400	2218	557.8	150 0014	2,3	2.3	65	84	78			3
10	420	2238	572,2	145 0013	2,1	2,1	69	88	80			3
11	440	2258	596,8	155 0015	2,4	2,4	69	84	77			5
AVERAGE /SUM							71					

Sta. 06

#A7-5 Blue

ES ENGINEERING-SCIENCE COMPANIES

Plant DAC
Date 11-27-89
POST LEAK RATE

Run Number 2
Operator

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O)		TEMPERATURES					PUMP VAC.
					Desired	Actual	STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	"Hg
	~~72~~											
12	460	2318	610.70	155 .1015	2.4	2.4	69	84	78			5
				$\sqrt{\Delta p}$								
AVERAGE /SUM	468		44.4	0.637		2.4	71	82.4	87			

71 2.404

FS 891159

ENGINEERING-SCIENCE, INC.

TRAIN RECOVERY SHEET

DATE 11-21-89

RUN# BLUE HA7-5 METHOD 205.1

FACILITY DAC

TYPE CHROMIUM

TECHNICIAN RO

IMP. SOLUTION $NaHCO_3$

	SOLUTION	VOL. (ml)	DESCRIPTION
NOZZLE-PROBE RINSE			/
UMBILICAL RINSE			/

		FINAL (g)ml	INITIAL (g)ml	NET (g)ml
IMPINGER # 1		155	100ml	55
IMPINGER # 2		125	100ml	25
IMPINGER # 3		11	0	11
IMPINGER #				
DESCRIPTION				
IMPINGER RINSE				

		FINAL (g)	INITIAL (g)	
SILICA GEL (DESCRIPTION)	ALL USED	904.2	822.5	81.7
FILTER# (DESCRIPTION)	TEFLON HA 7-5 BLUE	TOTAL MOISTURE		

FIELD BLANKS

~~161.7~~ (g)

11

172.7

DISPOSITION/COMMENTS

ES ENGINEERING-SCIENCE COMPANIES

FIELD DATA

ΔP x K = ΔH

Run #1

PAGE ___ OF ___

Plant _____
Date _____
Test Site _____
Run Number #1
Operator _____

Ambient Temp _____
Barometer _____
Stack Pressure _____
Stack H2O % _____
Stack Dia _____

Meter ΔH@ _____
Meter Gamma _____
Meter Box # _____
Nozzle Diameter 0.312
Probe Length _____

Probe Mat'l _____
Filter Number _____
Samp Box # _____
PRE LEAK _____
POST LEAK _____

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H; "H2O)		TEMPERATURES					PUMP VAC. "Hg
					Desired	Actual	STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	
1	0	1347	419.114	0.14								
(6)	6	1353	419.180	950								
(5) 3	-	1356	421.85	0.1						1501		
(4) 4	6	1409	426.0									7
(4) 5		1413 20.44	4269	0.14 Adj.						1550		
(4)	4	2018	429,325	Stop								7
AVERAGE /SUM	20		15,219	0.34								

891160

ENGINEERING-SCIENCE, INC.

TRAIN RECOVERY SHEET

DATE 11-21-89 (21 RS)

RUN# Red (7-5) METHOD 205.1

FACILITY DAC

TYPE Chromium

TECHNICIAN J.B.

IMP. SOLUTION Sodium Bicarbc

	SOLUTION	VOL. (ml)	DESCRIPTION
NOZZLE-PROBE RINSE			✓
UMBILICAL RINSE			✓

		FINAL (g)/ml.	INITIAL (g)/ml.	NET (g)
IMPINGER # 1	Sodium Bicarbonate	104 ml.	100 ml.	↓
IMPINGER # 2	Sodium Bicarbonate	101 ml.	100 ml.	1
IMPINGER # 3	EMPTY	1 ml.	0 ml.	1
IMPINGER #				
DESCRIPTION				
IMPINGER RINSE				

		FINAL (g)	INITIAL (g)	
SILICA GEL (DESCRIPTION)	½ used	806.8	803.0	3.8
FILTER# (DESCRIPTION)	TEFLON	TOTAL MOISTURE		9.8 (g)

FIELD BLANKS

DISPOSITION/COMMENTS

K = 1,826 ΔP × K = ΔH

ES ENGINEERING-SCIENCE COMPANIES

FIELD DATA

PAGE 1 OF 3

Plant DAC
Date 11/21/84
Test Site HA-76
Run Number 1
Operator [illegible]

Ambient Temp 75 °F
Barometer
Stack Pressure
Stack H2O % 2%
Stack Dia

Meter ΔH@ 1.970
Meter Gamma 1.001
Meter Box # Alw #2
Nozzle Diameter 0.245 → 0.245
Probe Length

Probe Mat'l
Filter Number
Samp Box #
PRE LEAK 0.016 @ 8" Hg
POST LEAK 0.015 @ 10" Hg

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O) Desired	Actual	TEMPERATURES STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	PUMP VAC. "Hg
1	0	1343	331.562	0.0010	1.83	1.8	68	77				8
2	5	1348	340.014	0.0010	1.83	1.8	SCRP	FUK		HF		
3	✓ 5	1353	340.014	0.0010	1.83	1.8	STNG	FUK		LF		
4	20	1408	352.2	0.0009	1.64	1.6	77	78				6
5	40	1428	366.2	0.0022	4.02	4	77	79				11
6	60	1448	387.2	0.0025	4.57	4.6		80				12.5
7	65	1453	392.472				stop for HF					12.5
8	69	1457	392.472	0.0025	4.57	4.6	start for LF		80			12.5
5	80	1508	405.1	0.0026	4.75	4.8	75		80			13
6	100	1524	428.6	0.0023	4.20	4.2	76		80			16.5
7	120	1548	450.8	0.0021	3.84	3.8	74		80			11
8	140	1608	471.9	0.0021	3.84	3.8	74		80			11
9	160	1628	495.5	0.0010	1.83	1.8	74	84				10
10	180	1648	517.7	0.0010	1.83	1.8	72	83				10
AVERAGE /SUM												

ES ENGINEERING-SCIENCE COMPANIES

K = 1,826 HD 7-6

Blue (low flow)

Plant DNC
Date 11/7/86
POST LEAK RATE 0.015 @ 10 "Hg

Page V of 3
Run Number 1
Operator DSB/MA

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O)		TEMPERATURES					PUMP VAC. "Hg
					Desired	Actual	STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	
11	20	1708 1728	540.4	1.20 0.0009	1.64	1.6	70	80				6.5
V	20	1728 1748	540.5	1.26 0.0010	1.83	1.8	72	80				
	240	1748	554.899		port change							
AVERAGE /SUM												

HA7-6 Blue

ES ENGINEERING-SCIENCE COMPANIES

Plant DAC
Date 11-21-89
POST LEAK RATE

Page 1 of 3
Run Number #1
Operator DSW

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O)		TEMPERATURES					PUMP VAC. "Hg
					Desired	Actual	STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	
B 1	240	1900	554.899	117	1.28	1.3	71	7	2	43	NA	5
	255	1915	560.0	117	1.28	1.3	71	7	2	43		5
2	260	1925	564.9	120	1.46	1.5	71	7	2	44		5
3	280	1945	586.9	133	2.01	2.0	71	7	6	44		5
4	300	2005	593.6	127	1.83	1.8	71	7	6	44		5
	308	2013	599.249	122	1.83	1.8	70	7	4	43		5
5	320	2029	609.3	117	1.28	1.3	70	7	4	43		5
6	340	2049	620.3	117	1.28	1.3	68	7	4	44		5
7	360	2109	633.3	112	0.91	0.9	72	7	5	43		5
8	380	2129	643.3	151	2.56	2.6	71	7	4	43		6
9	400	2149	659.7	125	1.83	1.8	69	7	4	43		6
10	420	2209	674.8	118	1.46	1.5	69	7	4	44		5
11	440	2229	686.4	110	1.10	1.1	69	7	4	44		4
12	460	2249	697.5	110	1.10	1.1	69	7	4	43		4
	480	2309	708.584			end	stop	run	#1			
AVERAGE /SUM	480		376.984	0.033		1.4	71.6	96.1 - 77				

ENGINEERING-SCIENCE, INC.

TRAIN RECOVERY SHEET

DATE 11-21-89 RJ

RUN# HA-75 Blue METHOD 205.1

FACILITY DAC

TYPE Chromium

TECHNICIAN J.B.

IMP. SOLUTION Sodium Bicarbonate

	SOLUTION	VOL. (ml)	DESCRIPTION
NOZZLE-PROBE RINSE			✓
UMBILICAL RINSE			✓

		FINAL (g) ml.	INITIAL (g) ml.	NET (g)
IMPINGER # 1	Sodium Bicarbonate	166 ml.	100 ml.	66
IMPINGER # 2	Sodium Bicarbonate	104 ml.	100 "	4
IMPINGER # 3	EMPTY	7 ml.	0 "	7
IMPINGER #				
DESCRIPTION				
IMPINGER RINSE		-		

		FINAL (g)	INITIAL (g)	
SILICA GEL (DESCRIPTION)	all used up	947.5	868.8	78.7

FILTER# (DESCRIPTION) TEFLON

TOTAL MOISTURE 157 (g)

FIELD BLANKS

DISPOSITION/COMMENTS

ES ENGINEERING-SCIENCE COMPANIES

$K = 3.51$ (14.9) $\Delta P \times K = \Delta H$

Red Top (high / low)

SIDE

FIELD DATA

PAGE 1 OF ___

Plant DAC
Date 11/21/89
Test Site HA-76
Run Number 1
Operator DHP

Ambient Temp 75°F
Barometer 29.0
Stack Pressure ___
Stack H2O % 2%
Stack Dia ___

Meter ΔH@ 1.629
Meter Gamma 0.994
Meter Box # std #2
Nozzle Diameter 1.028
Probe Length ___

Probe Mat'l ___
Filter Number ___
Samp Box # ___
PRE LEAK 0.00 @ 10"Hg
POST LEAK ___

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H; "H2O) Desired	ORIFICE PRESSURE (delta H; "H2O) Actual	TEMPERATURES STACK (Ts)	TEMPERATURES METER INLET	TEMPERATURES METER OUT	TEMPERATURES IMPINGER	TEMPERATURES FILTER	PUMP VAC. "Hg
TP 1	0	1348	323.213	.1	1.35	1.45	74	65				7
5	5	1353	327.969	.06		stop	for	CF				
7	5	1453	327.969	.15	1.53	1.53 start	77	for HF	73			1
4	9	1457	329.814			stop	79	for LF				
Sump B15	9	1910	329.814			stop	for	HF				
5 6	5	1915	333.678	.15							1670.0	
3 7	8	2013	337.052									
				√Δp								
AVERAGE /SUM	17		13.839	0.33		2.5						

ENGINEERING-SCIENCE, INC.

TRAIN RECOVERY SHEET

DATE 11-21-89 RUN # HA-7-6 Red METHOD 205.1

FACILITY DAC TYPE Chrome

TECHNICIAN J.B. IMP. SOLUTION Sodium Bicarbonate

	SOLUTION	VOL. (ml)	DESCRIPTION
NOZZLE-PROBE RINSE			✓
UMBILICAL RINSE			✓

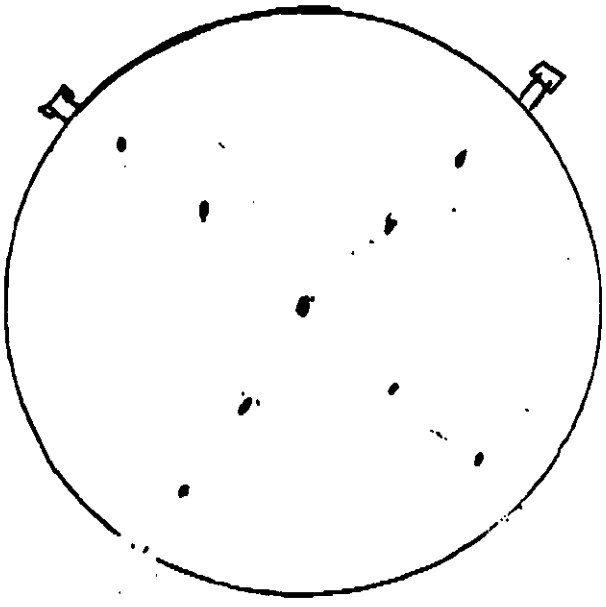
		FINAL (g)ml	INITIAL (g)ml	NET (g)m
IMPINGER # 1	Sodium Bi Carbonate	107 ml.	100 ml.	7
IMPINGER # 2	Sodium Bicarbonate	99 "	100 "	
IMPINGER # 3	Empty	0 "	0 "	
IMPINGER #				
DESCRIPTION				
IMPINGER RINSE				

		FINAL (g)	INITIAL (g)	
SILICA GEL (DESCRIPTION)		897.0	892.1	4.9
FILTER # (DESCRIPTION) TEFLON		TOTAL MOISTURE		5.9 (g)

FIELD BLANKS

DISPOSITION/COMMENTS

HA 7-5- 6 FT DUCT DIA $\frac{\pi(6^2)}{4} = 28.27'$



11/21/89 FLOW RATE

ACTUAL 440 GPM

REQUIRED 440 GPM

LID OPEN

$\frac{47812}{28.27} = 1691$ FT/MIN TARGET

LID CLOSED

$\frac{5200}{28.27} = 184$ FT/MIN. TARGET

	OPEN LID	@ CLOSED LID
VELOCITY	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
AVG		AVG.

TRANSITION LAG

1691 FT/MIN T AVG = 184 FT/MIN

~~1691 (10%) = 1521.9 FT/MIN~~ LIDS OPEN

~~184 (10%) = 165.6 FT/MIN~~ LIDS CLOSED

FT/MIN	CFM
1670 =	47210
1490 =	42122
1442 =	40765
1187 =	33556
41 =	1159
235 =	6643
156 =	4381
173 =	4890

ENGINEERING SCIENCE

Pasadena, California

PRELIMINARY VELOCITY TRAVERSE DATA

Plant DAC Date 11-21-84

Location HA 7-5 Stack I.D. 72"

Barometric Pressure _____ Static Pres _____

Operators MG/TK (OPEN)

TRAVERSE POINT NUMBER	VELOCITY HEAD	STACK TEMP.	CYCLONIC FLOW ANGLE
1	~~315~~ 1242	~~65~~ 62	
2	~~315~~ 1273	"	
3	~~327~~ 1284	"	
4	~~307~~ 1326	~~65~~ 62	
5	~~297~~ 1151	"	
6	~~285~~ 1106	"	
7	~~306~~ 1191	~~65~~ 62	
8	1315	"	
9	1337	"	
10	1353	"	
11	1335	"	
12	1354	~~65~~ 62	
	~~X~~ 1252		
AVERAGE			

TRAVERSE POINT NUMBER	VELOCITY HEAD	STACK TEMP.	CYCLONIC FLOW ANGLE
1	1241	62	
2	1313	"	
3	1274	"	
4	1351	"	
5	1287	"	
6	1190	62	
7	1330	"	
8	1299	"	
9	1341	"	
10	1402	"	
11	1451	"	
12	1423	62	
AVERAGE			

ENGINEERING SCIENCE

Pasadena, California

PRELIMINARY VELOCITY TRAVERSE DATA

Plant [illegible] Date [illegible]

Location [illegible] +1.7-7-5 Stack I.D. [illegible]

Barometric Pressure _____ Static Pres _____

Operators HE/TK CLCFC

TRAVERSE POINT NUMBER	VELOCITY HEAD	STACK TEMP.	CYCLONIC FLOW ANGLE
1	273		
2	194		
3	277		
4	330		
5	290		
6	220		
7	265		
8	250		
9	327		
10	320		
11	328		
12	305		
AVERAGE			

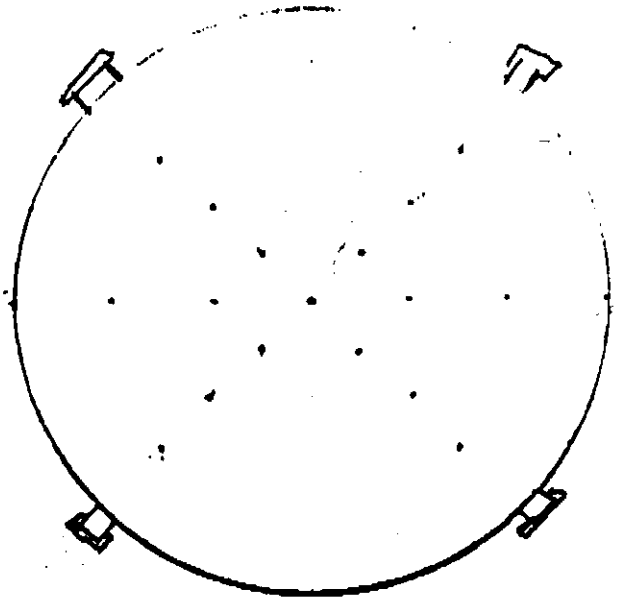
TRAVERSE POINT NUMBER	VELOCITY HEAD	STACK TEMP.	CYCLONIC FLOW ANGLE
1	[illegible]		
2	326		
3	342		
4	321		
5	257		
6	326		
7	[illegible]		
8	192		
9	209		
10	[illegible]		
11	202		
12	210		
AVERAGE			

HA 7-6 8 FT Duct Dia.

$\frac{\pi(8^2)}{4} = 50.26$

Lid OPEN.

$\frac{81563}{50.76} = 1623$ FT/MIN



11/21/89
Flow Rate

310 CPM
330 CPM } ACTUAL

REQUIRED 365 6PM

Lid Open

$\frac{85663}{50.26} = 1623$ FT/MIN = 1704

Lid Closed

$\frac{5200}{50.26} = 103$ FT/MIN

100 ft

	Open Lid	Closed Lid
velocity	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8
Avg =		

Theoretical Avg 1623 FT/MIN

TAvg = 103 FT/MIN.

11/21/89

TURNED MOTOR RPM

DOWN 10%

~~1623 (10%) = 1460 FT/MIN~~ LIDS OPEN

103 (10%) = ~~92.7 FT/MIN~~ LIDS CLOSED

1396 = 70,162 CFM

1212 = 60,915 CFM

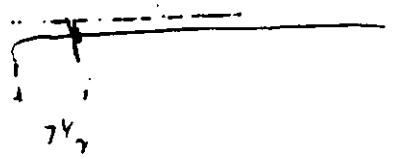
~~221~~
188
155

98 FT/MIN = 4925 CFM

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT LMC
DATE 11-21-89
SAMPLING LOCATION SCRUBBER #7-5, 7-6
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) 78"
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) 6"
STACK I.D., (DISTANCE A - DISTANCE B) (7-5) 72" ~~(7-6) 72~~
NEAREST UPSTREAM DISTURBANCE > 2
NEAREST DOWNSTREAM DISTURBANCE > 8
CALCULATOR TK / RM

(6" nipple)



SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	% FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	2.1	72"	1.51 ≈ 1 1/2"	6"	7 1/2"
2	6.7		4.82 = 4 7/8"		10 7/8"
3	11.8		8.50 = 8 1/2"		14 1/2"
4	17.7		12.74 = 12 3/4"		18 3/4"
5	25.0		18 = 18"		24"
6	35.6		25.63 = 25 3/4"		31 3/4"
7	64.4		46.37 = 46 3/8		52 3/8"
8	75.0		54 = 54"		60"
9	82.3		59.26 = 59 1/4"		65 1/4"
10	88.2		63.50 = 63 1/2"		69 1/2"
11	93.3		67.18 = 67 1/8"		~~67 1/8~~ 71 1/8"
12	97.9		70.49 = 70 1/2"		70 1/2"
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

ENGINEERING SCIENCE

Pasadena, California

PRELIMINARY VELOCITY TRAVERSE DATA

Plant DAC Date 11-21-[illegible]

Location SCRUBBER 7-6 Stack I.D.

Barometric Pressure Static Pres

Operators

TRAVERSE POINT NUMBER	VELOCITY HEAD	STACK TEMP.	CYCLONIC FLOW ANGLE
1	144		
2	172		
3	251		
4	158		
5	205		
6	2EC		
7	246		
8	25C		
9	2C2		
10	26C		
11	240		
12	24E		
AVERAGE			

TRAVERSE POINT NUMBER	VELOCITY HEAD	STACK TEMP.	CYCLONIC FLOW ANGLE
1	3C7		
2	36C		
3	3E2		
4	37C		
5	3C9		
6	355		
7	3C1		
8	37E		
9	390		
10	355		
11	2 77		
12	3C1		
AVERAGE			

1.

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT DAC
DATE 11-21-89
SAMPLING LOCATION SCRUBBER 7-C
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) 96
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) 6
STACK I.D., (DISTANCE A - DISTANCE B) 96
NEAREST UPSTREAM DISTURBANCE
NEAREST DOWNSTREAM DISTURBANCE
CALCULATOR

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	2.1	96	2.02 = 2"	6"	8"
2	6.7		6.43 = 6 1/2"		12 1/2"
3	11.8		11.33 = 11 3/8"		17 3/8"
4	17.7		16.99 = 17"		23"
5	25.0		24 = 24"		30"
6	35.6		34.18 = 34 1/8"		40 1/8"
7	64.4		61.82 = 61 7/8"		67 7/8"
8	75.0		72 = 72"		78"
9	82.3		79.01 = 79"		85"
10	88.2		84.67 = 84 5/8"		90 5/8"
11	93.3		89.57 = 89 5/8"		95 5/8"
12	97.9		93.98 = 94"		100"

ENGINEERING SCIENCE

Pasadena, California

PRELIMINARY VELOCITY TRAVERSE DATA

Plant ~~[illegible]~~ DAC Date 11/21/89

Location HA. 76 Stack I.D.

Barometric Pressure Static Pres ∠0.001

Operators BB (3) YMD PCT

TRAVERSE POINT NUMBER	VELOCITY HEAD	STACK TEMP.	CYCLONIC FLOW ANGLE
1	.115	77	
2	.120	75	
3	75	74	
(1) ~~4~~	37	71	
F ~~4~~	1780	70	
~~5~~	~~.095~~	70	
~~6~~	89	68	
~~7~~	115	72	
~~8~~	151	71	
~~9~~	125	69	
~~10~~	118	69	
~~11~~	105	69	
12	117	68	
AVERAGE			

TRAVERSE POINT NUMBER	VELOCITY HEAD	STACK TEMP.	CYCLONIC FLOW ANGLE
AVERAGE			

(1) high

ENGINEERING SCIENCE

Pasadena, California

PRELIMINARY VELOCITY TRAVERSE DATA

Plant DAC Date 11/21/89

Location _____ Stack I.D. _____

Barometric Pressure _____ Static Pres _____

Operators _____

TRAVERSE POINT NUMBER	VELOCITY HEAD	STACK TEMP.	CYCLONIC FLOW ANGLE
1	1695	184	120
2	1721	800	134
3	1725	184	128
4	1660	185	120
5	1600	185	100
6	1590	140	98
7	1691	131	102
8	1621	120	100
9	1251	129	82
10	1400	143	87
11	1620	118	45
12	1039	126	55
		(155 AVG)	
1	1572	11 1201	11 1231
2	1689	12 1226	12 1215
3	1685	1 1535	1 1496
4	1660	2 1559	2 1681
5	1639	3 1200	3 1674
6	1443	4 1252	4 1680
7	1401	5 992	5 1490
8	1224	6 936	6 1399
9	1008	7 950	7 1296
10	999	8 1092	8 1302
AVERAGE		9 1025	9 1390
		10 1108	10 1129

TRAVERSE POINT NUMBER	VELOCITY HEAD	STACK TEMP.	CYCLONIC FLOW ANGLE
1	1554	320	209
2	1520	354	203
3	1540	311	205
4	1300	316	220
5	1320	309	223
6	1250	307	209
7	1100	278	189
8	970	222	187
9	1009	284	150
10	907	315	143
11	980	257	157
12	960	294	161
	1212 AVG		(184 AVG)
1	1092	9 1300	5 1707
2	1778	10 1370	6 1535
3	1702	11 1539	7 1386
4	1690	12 1310	8 1607
5	1576	1 1955	9 1607
6	1481	2 2002	10 1570
7	1292	3 1841	11 1501
8	1346	4 1750	12 1470
AVERAGE		7-5	

ENGINEERING-SCIENCE

Client _____ Job No. _____ Sheet ___ of ___

Subject _____ By _____ Date _____

_____ Checked _____ Rev. _____

11-21-84

7-6

	High	Low
209	1550	184
20	1528	200
20	1540	184
22	1360	185
22	1320	185
20	1280	140
19	1180	131
17	990	120
20	1009	139
17	907	143
17	980	118
11	960	126
188	1212	1755

72.4

1975

APPENDIX B

Condition 2 HA 7-5, HA 7-6

891164

RUN V

Engineering-Science, Pasadena, California

Plant: DAC LONG BEACH
Source: HA 7-5 LOW
Date: 11-22-89
Run: 2 7-5-UW
Standard Temp = 60 deg F Standard Press = 29.92 in Hg

FLOW DATA

STACK DIAMETER (inches)	72.00
STACK CROSS-SECTIONAL AREA (sq feet)	28.27
BAROMETRIC PRESSURE (inches Hg)	29.20
OXYGEN CONTENT (%)	21.0
CARBON DIOXIDE CONTENT (%)	0.0
MOISTURE CONTENT (%)	1.7
STACK TEMPERATURE (deg F)	67
STACK STATIC PRESSURE (inches water)	0.00
DRY STACK GAS MOLECULAR WEIGHT	28.84
VELOCITY PRESSURE (sq rt inches water)	0.04
PITOT TUBE CORRECTION FACTOR	0.99
VELOCITY (ft per sec)	2.62
EXHAUST GAS FLOW RATE (ACFM)	4,443
EXHAUST GAS FLOW RATE (DSCFM)	4,206

SAMPLING DATA

DRY GAS VOLUME SAMPLED (DCF)	425.597
DRY GAS VOLUME SAMPLED (DSCF)	408.230
DRY GAS METER TEMPERATURE (deg F)	78
DRY GAS METER GAMMA	1.01
AVERAGE ORIFICE PRESSURE (inches water)	2.70
TOTAL RUN TIME (min)	480
NOZZLE DIAMETER (inches)	1.003
ISOKINETIC (%)	104.2

LABORATORY DATA

MOISTURE RECOVERED (mls)	152.10
~~PARTIC. FROM NOZ., PROBE & WASHES~~ (mg)	39.00
PARTICULATE FROM FILTER (mg)	0.00
~~PARTICULATE FROM IMPINGERS~~ (mg)	≤ 11550.00

PARTICULATE DATA

~~FRONT~~ HALF	(gr/DSCF)	0.0015
	(gr/ACF)	0.0014
	(lb/hr)	0.05
~~BACK~~ HALF	(gr/DSCF)	0.4366
	(gr/ACF)	0.4132
	(lb/hr)	≤ 15.74
TOTAL	(gr/DSCF)	0.4380
	(gr/ACF)	0.4146
	(lb/hr)	15.80

$\times 10^{-6}$

891163
RUN ✓

Engineering-Science, Pasadena, California

Plant: DAC LONG BEACH
Source: HA- 7-5
Date: HIGH
Run: 2 7/7 HIGH
Standard Temp = 60 deg F Standard Press = 29.92 in Hg

FLOW DATA

STACK DIAMETER (inches)	72.00
STACK CROSS-SECTIONAL AREA (sq feet)	28.27
BAROMETRIC PRESSURE (inches Hg)	29.20
OXYGEN CONTENT (%)	21.0
CARBON DIOXIDE CONTENT (%)	0.0
MOISTURE CONTENT (%) SATURATED	2.3
STACK TEMPERATURE (deg F)	67
STACK STATIC PRESSURE (inches water)	0.00
DRY STACK GAS MOLECULAR WEIGHT	28.84
VELOCITY PRESSURE (sq rt inches water)	0.39
PITOT TUBE CORRECTION FACTOR	0.99
VELOCITY (ft per sec)	26.22
EXHAUST GAS FLOW RATE (ACFM)	44,482
EXHAUST GAS FLOW RATE (DSCFM)	41,855

SAMPLING DATA

DRY GAS VOLUME SAMPLED (DCF)	28.337
DRY GAS VOLUME SAMPLED (DSCF)	26.485
DRY GAS METER TEMPERATURE (deg F)	70
DRY GAS METER GAMMA	0.97
AVERAGE ORIFICE PRESSURE (inches water)	2.50
TOTAL RUN TIME (min)	33 ✓
NOZZLE DIAMETER (inches)	0.313 ?
ISOKINETIC (%)	101.8 ?

LABORATORY DATA

MOISTURE RECOVERED (mls)	18.10
~~PARTIC FROM NOZ..~~ PROBE & WASHES (mg) ✓	37.00
PARTICULATE FROM FILTER (mg)	0.00
~~PARTICULATE FROM~~ IMPINGERS (mg)	≤ 6200.00

PARTICULATE DATA

~~FRONT~~ HALF	(gr/DSCF)	0.0216
	(gr/ACF)	0.0203
	(lb/hr)	7.74
~~BACK~~ HALF	(gr/DSCF)	3.6121
	(gr/ACF)	3.3988
	(lb/hr)	≤ 1296.30
TOTAL	(gr/DSCF)	3.6336
	(gr/ACF)	3.4190
	(lb/hr)	1304.03

CW CT CW CT

X10⁻⁶ ≤

891166
RUN V

Engineering-Science, Pasadena, California

Plant: DAC LONG BEACH
Source: HA- 7-6 LOW
Date: 11-22-89
Run: 2 - 7-6 LOW
Standard Temp = 60 deg F Standard Press = 29.92 in Hg

FLOW DATA

STACK DIAMETER (inches)	96.00
STACK CROSS-SECTIONAL AREA (sq feet)	50.26
BAROMETRIC PRESSURE (inches Hg)	29.20
OXYGEN CONTENT (%)	21.0
CARBON DIOXIDE CONTENT (%)	0.0
MOISTURE CONTENT (%)	2.3
STACK TEMPERATURE (deg F)	70
STACK STATIC PRESSURE (inches water)	0.00
DRY STACK GAS MOLECULAR WEIGHT	28.84
VELOCITY PRESSURE (sq rt inches water)	0.03
PITOT TUBE CORRECTION FACTOR	0.99
VELOCITY (ft per sec)	2.09
EXHAUST GAS FLOW RATE (ACFM)	6,304
EXHAUST GAS FLOW RATE (DSCFM)	5,897

SAMPLING DATA

DRY GAS VOLUME SAMPLED (DCF)	335.358
DRY GAS VOLUME SAMPLED (DSCF)	314.632
DRY GAS METER TEMPERATURE (deg F)	80
DRY GAS METER GAMMA	0.99
AVERAGE ORIFICE PRESSURE (inches water)	1.72
TOTAL RUN TIME (min)	484
NOZZLE DIAMETER (inches)	1.003
ISOKINETIC (%)	101.0

LABORATORY DATA

MOISTURE RECOVERED (mls)	160.20
~~PARTIC. FROM NOZ.~~ PROBE & WASHES (mg)	2009.00
PARTICULATE FROM FILTER (mg)	0.00
~~PARTICULATE FROM IMP~~INGERS (mg)	%120700.00

PARTICULATE DATA

~~FRONT HALF~~	(gr/DSCF)	0.0985
	(gr/ACF)	0.0922
	(lb/hr)	4.98
~~BACK HALF~~	(gr/DSCF)	5.9193
	(gr/ACF)	5.5367
	(lb/hr)	299.27
TOTAL	(gr/DSCF)	6.0178
	(gr/ACF)	5.6289
	(lb/hr)	304.25

X10-6

89116T

RUN ✓

Engineering-Science, Pasadena, California

Plant: DAC LONG BEACH
Source: HA 7-6 HIGH
Date: 11-22-89
Run: 2 7-6 HIGH FLOW
Standard Temp = 60 deg F Standard Press = 29.92 in Hg

FLOW DATA

STACK DIAMETER (inches)	96.00
STACK CROSS-SECTIONAL AREA (sq feet)	50.26
BAROMETRIC PRESSURE (inches Hg)	29.20
OXYGEN CONTENT (%)	21.0
CARBON DIOXIDE CONTENT (%)	0.0
MOISTURE CONTENT (%) SATURATED	2.5
STACK TEMPERATURE (deg F)	69
STACK STATIC PRESSURE (inches water)	0.00
DRY STACK GAS MOLECULAR WEIGHT	28.84
VELOCITY PRESSURE (sq rt inches water)	0.31
PITOT TUBE CORRECTION FACTOR	0.99
VELOCITY (ft per sec)	20.89
EXHAUST GAS FLOW RATE (ACFM)	62,997
EXHAUST GAS FLOW RATE (DSCFM)	58,954

SAMPLING DATA

DRY GAS VOLUME SAMPLED (DCF)	20.229
DRY GAS VOLUME SAMPLED (DSCF)	19.194
DRY GAS METER TEMPERATURE (deg F)	75
DRY GAS METER GAMMA	0.99
AVERAGE ORIFICE PRESSURE (inches water)	2.50
TOTAL RUN TIME (min)	32
NOZZLE DIAMETER (inches)	0.312
ISOKINETIC (%)	96.1

LABORATORY DATA

MOISTURE RECOVERED (mls)	11.70
PARTIC. FROM NOZ., PROBE & WASHES (mg)	~~128.00~~
PARTICULATE FROM FILTER (mg)	0.00
PARTICULATE FROM IMPINGERS (mg)	1680.00

PARTICULATE DATA

FRONT HALF	(gr/DSCF)	0.1029
	(gr/ACF)	0.0963
	(lb/hr)	~~52.01~~ → 52.91
BACK HALF	(gr/DSCF)	1.3506
	(gr/ACF)	1.2639
	(lb/hr)	682.69
TOTAL	(gr/DSCF)	1.4535
	(gr/ACF)	1.3602
	(lb/hr)	734.70

$\times 10^{-6}$

Filling 2:10
Waiting for PH - by adjustment by DAC

BLUE N RUN #2

K = 1,5956

ES ENGINEERING-SCIENCE COMPANIES

FIELD DATA

PAGE 1 OF 3

Plant DAC
Date 11-21-89
Test Site
Run Number 2
Operator SE, AA, WW

Ambient Temp
Barometer
Stack Pressure
Stack H2O % 2
Stack Dia

Meter ΔH@ 1.74
Meter Gamma 1.01
Meter Box # BLUE N
Nozzle Diameter 1.0079 PR
Probe Length

Probe Mat'l
Filter Number
Samp Box #
PRE LEAK
POST LEAK

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H; "H2O) Desired	ORIFICE PRESSURE (delta H; "H2O) Actual	TEMPERATURES STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	PUMP VAC. "Hg/67
1	0	~~2445~~ 0120	616.505	167, 0018	2.90	2.9	70	72 75	72	40	WNL	7
~~2~~	~~20 0125~~		634.6	167, 0018	2.9	2.9	70	74	70	42		6
~~3~~	~~40 0125~~	STOP	645.4									
		0135	646.3 STOP	179, 0019	3.0	3.0	70	74	70	42		6
2	20	0121	654.1	161, 0016	2.5	2.5	70	74	70	42		6
3	40	0131	657.9	171, 0018	2.9	2.9	68	83	75	42		6
4	60	0151	678.5	166, 0017	2.7	2.7	68	83	76	42		6
5	80	0211	696.4	173, 0019	3.0	3.0	68	84	77	42	STOP	7
~~6~~	~~100 0231~~ 3		697.0	176 ST			~~63~~			0214 HF 0218 HF	STOP	
		0218	697.0	176, 0019	3.0	3.0	63	84	77	42		7
6	100 11	0245	716.0	170 0.0018	2.88	2.9	68	84	77	45		7
7	120	0255	734.9	170 0.0018	2.88	2.9	68	84	77	48		7
8	140	0315	752.1	175, 0014	3.0	3.0	68	84	77	48		7
9	160	0335	7733	151, 0015	2.40	2.40	68	84	77	48		7
AVERAGE /SUM												

BLUE

ES ENGINEERING-SCIENCE COMPANIES

Plant PAC
Date 11/29/89
POST LEAK RATE

Page 2 of 3
Run Number 2
Operator BM, SF

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O)		TEMPERATURES					PUMP VAC.
					Desired	Actual	STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	"Hg
10	180	0355	7921	146 .0014	2.3	2.3	68	83	77	48		7
11	200	0415	8084	170 .0018	2.9	2.9	68	83	77	48		7
12	220	0435	8268	155 .0015	2.4	2.4	65	82	76	48		7
	2400	0455	845.106	155 .0015	2.4		STOP					
				PORT CHANGE								
1	240	0545	846.103	147 .0014	2.3	2.3	67	80	73	48		5
	~~260~~	~~0605~~	~~865~~									
	11	0617	855.8	STOP FOR DF								
	9	0603		START FOR LF								
2	260	0605	865.3	180 .0020	3.2	3.2	65	77	71	48		6
~~3~~	~~280~~	~~0625~~	~~865.3~~	180 .0020	3.2	3.2	65	77	71	48		6
3	280	0625	876.8	150 .0014	2.2	2.2	66	79	71	48		5
4	300	0645	891.7	160 .0016	~~2.5~~ 2.6	2.6	67	79	72	48		5
~~5~~	~~320~~	0703	907.7	START DF								
		0709	..	STOP LF					~~73~~			
5	320	0709	918.6	155 .0015	2.4	2.4	67	77	73	48		5
AVERAGE /SUM												

ES ENGINEERING-SCIENCE COMPANIES

Blue
HA 7-5 LOW Run #2

Plant DAC
Date 11-22-89
POST LEAK RATE

Page 3 of 3
Run Number 2
Operator

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O)		TEMPERATURES					PUMP VAC. "Hg
					Desired	Actual	STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	
~~6~~ ~~340~~		0729		START	H2							
		0729		STOP	HF							
6	340	0736	923.7	150 .0014	2.24	2.24	67	78	72	48		5
7	360	0756	939.0	165 .0017	2.72	2.7	68	80	73	48		5
8	380	0816	964.5	165 .0017	2.72	2.7	68	80	73	48		5
9	400	0836	977.9	165 .0017	2.72	2.7	68	80	73	50		6
10	420	0856	994.2	155 .0015	2.4	2.4	67	80	74	50		6
11	440	0916	012.6	165 .0017	2.72	2.7	67	80	74	50		5
12	460	0936	035.6	165 .0017	2.72	2.7	66	81	74	50		5
	480	0956	052.02	165 .0017	2.72	2.7	67	80	74	60		5
										ΔH =	1.5	
										ΔP =	0.039	
										C_T =	≤ 11,550	
AVERAGE /SUM	480		485.597	0.034		2.7	67	77.7				

89 1164

ENGINEERING-SCIENCE, INC.

TRAIN RECOVERY SHEET

DATE 11-22-89 RUN# 2 (BLUE MA-75) METHOD 205-1

FACILITY OAC TYPE Chromium

TECHNICIAN RS IMP. SOLUTION $NaHCO_3$

	SOLUTION	VOL. (ml)	DESCRIPTION
NOZZLE-PROBE RINSE			/
UMBILICAL RINSE			/

		FINAL (g)ml	INITIAL (g)m	NET (g)
IMPINGER # 1		175	100	75
IMPINGER # 2		100	100	0
IMPINGER # 3		0	0	0
IMPINGER #				
DESCRIPTION				
IMPINGER RINSE				

		FINAL (g)	INITIAL (g)	
SILICA GEL (DESCRIPTION)	All USED	853.9	776.8	77.1
FILTER# (DESCRIPTION)	TEFLON	TOTAL MOISTURE		

152.1 (g)

FIELD BLANKS

DISPOSITION/COMMENTS

16 2 1.5 2 Ref #1 V M

ES ENGINEERING-SCIENCE COMPANIES

FIELD DATA

0.97

PAGE 1 OF 1

Plant DAC
Date 11-21-84
Test Site
Run Number #2
Operator GE/RR/DRD

Ambient Temp
Barometer
Stack Pressure
Stack H2O %
Stack Dia

Meter ΔH@ 2.00
Meter Gamma 0.97
Meter Box # RED 1
Nozzle Diameter .1024
Probe Length

0.31 RR

Probe Mat'l
Filter Number
Samp Box #
PRE LEAK
POST LEAK

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O) Desired	Actual	TEMPERATURES STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	PUMP VAC. "Hg
			~~446.505~~									
1		2959	429.108		START							
17	15	01/6	442.9		STOP							
2	5	0215	443.2		START							
3		0218	4460		STOP							
			PORT	CHANGE								
3		0556	446.094		START					1550 FPM		
7	7	0603	451.533		STOP					~~1800 FPM~~		
4		0703	451.534		START					1800 FPM		
6	6	0709	457.445		STOP							
		~~0713~~ 4			~~START~~							Hg
										C_w = 0.037		
										C_T = ≤0.010		
AVERAGE /SUM	33		18.337				67	70				

891163

ENGINEERING-SCIENCE, INC.

TRAIN RECOVERY SHEET

DATE 11-22-89

RUN# 2 (RED HA-75) METHOD 205-1

FACILITY OAC

TYPE Chromium

TECHNICIAN RS

IMP. SOLUTION $NaHCO_3$

	SOLUTION	VOL. (ml)	DESCRIPTION
NOZZLE-PROBE RINSE			✓
UMBILICAL RINSE			✓

		FINAL (g) ml	INITIAL (g) ml	NET (g)
IMPINGER # 1		110	100	10
IMPINGER # 2		100	100	0
IMPINGER # 3		0	0	0
IMPINGER #				
DESCRIPTION				
IMPINGER RINSE				

		FINAL (g)	INITIAL (g)	
SILICA GEL (DESCRIPTION)	½ USED	771.4	763.3	8.1
FILTER# (DESCRIPTION)	TEFLON	TOTAL MOISTURE		

18.1 (g) ✓

FIELD BLANKS

DISPOSITION/COMMENTS

K = 3.51

Req. (Hg.) 1700, 1650

ENGINEERING-SCIENCE COMPANIES

FIELD DATA

PAGE 1 OF ___

Plant DAC
Date 11/21/89
Test Site HA (7-6)
Run Number 2
Operator [illegible]

Ambient Temp 55 F
Barometer ___
Stack Pressure ___
Stack H2O % 2
Stack Dia ___

Meter ΔH@ 1.629
Meter Gamma 0.994
Meter Box # unit #2
Nozzle Diameter 0.245 .315
Probe Length ___

Probe Mat'l ___
Filter Number ___
Samp Box # ___
PRE LEAK ___
POST LEAK ___

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O) Desired	ORIFICE PRESSURE (delta H, "H2O) Actual	TEMPERATURES STACK (Ts)	TEMPERATURES METER INLET	TEMPERATURES METER OUT	TEMPERATURES IMPINGER	TEMPERATURES FILTER	PUMP VAC. "Hg
			350.424									
1	0	~~1457~~	~~346.424~~	~~1650~~	2.5	2.5	69	71		60		3
2	17	0114	360.025		...stop for LF →			(Rack broke)	was	~~stuck~~ - too long !!!		
	17	214	360.025		2.5	2.5				stop for HF		
	~~0~~	~~2147~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~				1700	~~[illegible]~~		
3½	20½	0417½	362.595		stop for LF		69		(97)			
	27.5	0555	362.555		stop for LF							
4		601	370.715		stop for LF		68		1635			
			RR									
6												
5½										CV 6	0.178	
										CV 1	1.680	
AVERAGE /SUM			10.791	.316		2.5	69	75				

891165

ENGINEERING-SCIENCE, INC.

TRAIN RECOVERY SHEET HA76 RED

DATE 11-22-89 RUN# 2 METHOD 205.1

FACILITY DAC TYPE Chromium

TECHNICIAN RS IMP. SOLUTION $NaHCO_3$

	SOLUTION	VOL. (ml)	DESCRIPTION
NOZZLE-PROBE RINSE			/
UMBILICAL RINSE			/

		FINAL ~~(g)~~ ml	INITIAL ~~(g)~~ ml	NET (g)
IMPINGER # 1		105	100	5
IMPINGER # 2		100	100	0
IMPINGER # 3		0	0	0
IMPINGER #				
DESCRIPTION				
IMPINGER RINSE				

		FINAL (g)	INITIAL (g)	
SILICA GEL (DESCRIPTION)	1/6 USED	804.6	797.9	6.7
FILTER# (DESCRIPTION)	TEFLON	TOTAL MOISTURE		11.7 (g)

FIELD BLANKS

DISPOSITION/COMMENTS

K = 1,826

ΔP × K = ΔH

Blue (L.)

AGA 7-6 [redacted]

ES ENGINEERING-SCIENCE COMPANIES

FIELD DATA

PAGE 1 OF 4

Plant DAC
Date 11/21/89
Test Site HA 76
Run Number 2
Operator [redacted]

Ambient Temp 55 °F
Barometer
Stack Pressure
Stack H2O % 2
Stack Dia

Meter ΔH@ 1.970
Meter Gamma 1.001
Meter Box #
Nozzle Diameter .228 (S/S)
Probe Length

Probe Mat'l
Filter Number 2
Samp Box #
PRE LEAK
POST LEAK

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O) Desired	Actual	TEMPERATURES STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	PUMP VAC. "Hg
1	0	2443	717.870	115 0.0010	1.83	1.8	69	80		60	ND	7.5
	14	2457	728.371		stop for HE							
	14	0144	728.371	0.0010	1.83 start	1.8 for LA	69	80		60		7.5
2	20	0120	732.3	139 0.0010	1.83	1.8	68	79		61		8
3	40	0140	746.8	124 0.0010	1.83	1.8	68	80		61		8
4	60	0200	761.4	117 0.0009	1.64	1.6	70	80		61		7.5
	14	0214	771.780	STOP FOR	HIGH	FLOW						
		0217	START	LOW	FLOW	0.00[illegible]						
5	80	0223	775.7	110 0.0008	1.46	1.5	70	80		60		7
6	100	0243	788.2	130 0.0011	2.01	2.0	69	80		61		8
7	120	0303	803.3	115 0.0009	1.64	1.6	68	80		61		7.5
8	140	0323	817.3	127 0.0010	1.87	1.8	72	80		61		7.5
9	160	0343	832.1	0.0008	1.46	1.5	71	80		61		8
10	180	0403	847.6	0.0010	1.83	1.8	71	80		61		8
AVERAGE /SUM												

K = 1,82#/.1

Blue (Low)

Blue (High)

AgA 7-b [redacted]

ES ENGINEERING-SCIENCE COMPANIES

Plant DAC
Date 11/21/89
POST LEAK RATE

Page 2 of 4
Run Number #2
Operator [illegible]

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H, "H2O)		TEMPERATURES					PUMP VAC. "Hg
					Desired	Actual	STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	
11	200	0433	859.0	0.0007	1.28	1.3	74	82		60		8
12	220	0443	872.2	0.0010	1.83	1.8	75	82		61		8
	240	0503	886.738		port change							
1	260	0545			1.83	1.8	73	82		45		
AVERAGE /SUM												

A 2-7-6 K = 1,826

Blue (low)

ES ENGINEERING-SCIENCE COMPANIES

FIELD DATA

[redacted]

Plant DAC
Date 11-22-89
Test Site AGA 7-6
Run Number 2
Operator DSW

Ambient Temp
Barometer
Stack Pressure
Stack H2O %
Stack Dia

Meter ΔH@ 1.970
Meter Gamma 1.001
Meter Box # Blue #3
Nozzle Diameter
Probe Length

Probe Mat'l
Filter Number
Samp Box #
PRE LEAK
POST LEAK

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H; "H2O)		TEMPERATURES					PUMP VAC. "Hg
					Desired	Actual	STACK (Ts)	METER INLET	METER OUT	IMPINGER	FILTER	
1	240	0545	886.735	0.0010	1.83	1.8	73	8	2	45	N/A	8
	250	0602	892.5	0.0010	1.83	1.8	72	8	2	45		
2	260	0612	899.3	0.0010	1.83	1.8	67	7	9	44		22
3	280	0632	913.1	0.0010	2.19	2.2	68	8	0	44		20
4	300	0652	928.5	.0011	2.01	2.0	68	8	2	43		22
	309	0708	935.589	0.0011	2.01	2.0	68	8	2	43		22
	324	0723	945.489	- Stopped - High Flow								
5	11	0729	11	0.0010	1.83	1.8	68	8	0	43		19
6	344	0749	959.3	0.0010	~~1.83~~	~~1.8~~	69	7	9	44		20
7	364	0809	972.5	0.0011	2.01	2.0	67	8	0	44		20
8	384	0829	986.0	0.0011	~~2.01~~ 2.01	~~2.0~~ 2.0	69	8	0	44		20
9	404	0849	002.8	0.0011	2.01	2.0	69	8	0	44		20
10	424	0909	017.6	0.0006	1.10	1.1	69	8	0	45		18
11	444	0929	029.9	0.0006	1.10	1.1	69	8	0	45		18
AVERAGE /SUM												

Blue
Low

H = 1,826

ES ENGINEERING-SCIENCE COMPANIES

FIELD DATA

[redacted]

Plant DAH
Date 22 NOV 1984
Test Site AGA 7-6
Run Number 2
Operator DSW

Ambient Temp
Barometer
Stack Pressure
Stack H2O %
Stack Dia

Meter ΔH@
Meter Gamma
Meter Box #
Nozzle Diameter
Probe Length

Probe Mat'l
Filter Number
Samp Box #
PRE LEAK
POST LEAK

TRAVERSE POINT NUMBER	ELAPSED TIME (mins)	CLOCK TIME	GAS METER READING (Vm)	VELOCITY HEAD (delta p)	ORIFICE PRESSURE (delta H; "H2O) Desired	ORIFICE PRESSURE (delta H; "H2O) Actual	TEMPERATURES STACK (Ts)	TEMPERATURES METER INLET	TEMPERATURES METER OUT	TEMPERATURES IMPINGER	TEMPERATURES FILTER	PUMP VAC. "Hg
12	464	0949	~~G~~ 041.5	0.0006	1.10	1.1	69	80		45		18
	484	1009	053228	0.0006	1.10	1.1	69	80		44		18
				✓						C_p = 2.029		
			375.358							C_{pT} = 1.70		
AVERAGE /SUM	484		166.410	0.0031		1.1	70	80				

89 1166

ENGINEERING-SCIENCE, INC.

TRAIN RECOVERY SHEET

HA 76 BLUE

DATE 11-22-89 RUN# 2 METHOD 205-1

FACILITY DAC TYPE Chromium

TECHNICIAN RO IMP. SOLUTION Na_2HCO_3

	SOLUTION	VOL. (ml)	DESCRIPTION
NOZZLE-PROBE RINSE			✓
UMBILICAL RINSE			✓

		FINAL (g) ml	INITIAL (g) ml	NET (g)
IMPINGER # 1		185 ml	100	85
IMPINGER # 2		100	100	0
IMPINGER # 3		5	0	0 ✓
IMPINGER #				
DESCRIPTION				
IMPINGER RINSE				

		FINAL (g)	INITIAL (g)	
SILICA GEL (DESCRIPTION)	All USED	911.6	841.4	70.2
FILTER# (DESCRIPTION)	TEFLON	TOTAL MOISTURE		

155.2 (g)

160.✓

FIELD BLANKS

DISPOSITION/COMMENTS

APPENDIX C

WCAS Analysis

November 29, 1989

WEST COAST ANALYTICAL SERVICE, INC.
ANALYTICAL CHEMISTS

ENGINEERING SCIENCE
75 N. Fair Oaks Ave.
Pasadena, CA 91103

Attn: Rollie Rosario

JOB NO. 14226

A

LABORATORY REPORT

Samples Received: Nine (9) impinger solutions
Date Received: 11/22/89
Purchase order No: 9384-6085

The samples were analyzed as follows:

Samples Analyzed	Analysis	Results
Nine (9) solutions	Total Chromium by ICPMS	Table I
Nine (9) solutions	Hexavalent Chromium by EPA 7196/IC	Table II

Michael Shelton
Senior Chemist

D. J. Northington, Ph.D.
Technical Director

9840 Alburtis Avenue • Santa Fe Springs, California 90670 • 213/948-2225

WEST COAST ANALYTICAL SERVICE, INC.

ENGINEERING SCIENCE
Mr. Rollie Rosario

Job # 14226
November 29, 1989

LABORATORY REPORT

TABLE I

Parts Per Billion (ug/L)

Total Metals

11-28 1st analysis

Re run NUS / 12-5 analysis

7 Day

Sample ID	Chromium	
891159	53	
891160	ND	
891161	620	610
891162	ND	
891163	ND	
891164	31	
891165	13	
891166	180	160
891167	ND	
Detection Limit	10	10

ND-Not Detected

Date Analyzed: 11-28-89

WEST COAST ANALYTICAL SERVICE, INC.

ENGINEERING SCIENCE
Mr. Rollie Rosario

Job # 14226
November 29, 1989

LABORATORY REPORT

TABLE II

Parts Per Billion (ug/L)

Sample ID	Hexavalent Chromium	7 day rerun
891159	49	
891160	1.5	
891161	550	670 ±
891162	0.49	
891163	0.13	
891164	0.07	
891165	0.30	
891166	2.9	6.3 ±
891167	0.07	
Detection Limit	0.01	1.0

Date Analyzed: 11-28-89

December 18, 1989

WCAS
WEST COAST ANALYTICAL SERVICE, INC.
ANALYTICAL CHEMISTS

ENGINEERING SCIENCE
75 N. Fair Oaks Ave.
Pasadena, CA 91103

Attn: Rollie Rosario

JOB NO. 14287

LABORATORY REPORT

RETEST

Samples Received: Two (2) liquids from Previous WCAS Job No. 14226
Date Received: 12-1-89
Purchase Order No: 9394-6085

The samples were analyzed as follows:

Samples Analyzed	Analysis	Results
Two (2) liquids	Total Chromium by ICPMS	Table I
Two (2) liquids	Hexavalent Chromium by EPA 7196/IC	Table II

TABLE I

Parts Per Billion (ug/L)

Total Metals

Sample ID	Chromium
891161	610
891166	180
Detection Limit	10

Date Analyzed: 12-5-89

Michael Shelton
Senior Chemist

D. J. Northington, Ph.D.
Technical Director

9840 Alburtis Avenue • Santa Fe Springs, California 90670 • 213/948-2225 • FAX 213/948-5850

WEST COAST ANALYTICAL SERVICE, INC.

ENGINEERING SCIENCE
Mr. Rollie Rosario

Job # 14287
December 18, 1989

LABORATORY REPORT

RETEST

TABLE II

Parts Per Billion (ug/L)

Sample ID	Hexavalent Chromium
891161	620
891166	6.3
Detection Limit	1

APPENDIX D

Example Calculations

ES ENGINEERING-SCIENCE

Client DNC – NOV '89 | Job No. | Sheet 1 of 4

Subject | By RH | Date 11-30-89

Checked | Rev.

$$\text{mass (ug) Cr} = (\text{ug/l})_{\text{net}} \times \text{l} + (\text{ug})_{\text{filter}}$$

$$\text{mg/day} = \frac{\text{ug Cr} \times 10^{-3}\ \text{mg/ug}}{\text{DSCF (ft}^3\text{)}} \times \text{DSCFM}\left(\frac{\text{ft}^3}{\text{min}}\right) \times \frac{1440\ \text{min}}{\text{day}} \times \frac{\text{min}}{(\text{min} + \text{min})}$$

$$= 1.44 \times \frac{\text{ug Cr}}{\text{DSCF}} \times \text{DSCFM} \times \frac{\text{Run Time a}}{\text{Run time (a+b)}}$$

Samples: WT-5

Low flow

A) mg/day total Cr = $1.44 \times \frac{17.0}{408.720} \times 4706 \times \frac{480}{(480 + 22)}$

= 136.69 mg/day

B) mg/day Cr^{6} = $1.44 \times \frac{ND}{408.720} \times 4706 \times \frac{480}{(480 + 33)}$

= NA //

High flow

C) mg/day total Cr = $1.44 \times \frac{ND}{76.485} \times 4185 \times \frac{33}{(480 + 33)}$

= NA //

D) mg/day Cr^{6} = $1.44 \times \frac{0.22}{76.485} \times 4185 \times \frac{33}{(480 + 33)}$

= 5.86 mg/day

Total mg/day total Cr = A + C = 136.69 + NA

= 136.69 mg //

Total mg/day Cr^{6} = B + D = NA + 5.86

= 5.86 mg/day

1.

ES ENGINEERING-SCIENCE

Client _____ Job No. _____ Sheet 4 of 4

Subject _____ By RR Date 11-30-89

_____ Checked _____ Rev. _____

$$\text{Mass (ug) Cr} = (\text{ug/l})_{\text{int}} \times \text{l} + (\text{ug})_{\text{filter}}$$

$$\text{mg/day} = \frac{\text{ug Cr} \times 10^{-3}\ \text{mg/ug}}{\text{DSCF (ft}^3\text{)}} \times \text{DSCFM}\left(\frac{\text{ft}^3}{\text{min}}\right) \times \frac{1440\ \text{min}}{1\ \text{day}} \times \frac{\text{min}}{(\text{min} + \text{min})}$$

$$= 1.44 \times \frac{\text{ug Cr}}{\text{DSCF}} \times \text{DSCFM} \times \frac{\text{Run Time a}}{\text{Run time (a+b)}}$$

Scrubber: WW-7.6

Low flow

A) mg/day total Cr = $1.44 \times \frac{197.8}{314.68\text{V}} \times 5897 \times \frac{48\text{A}}{(48\text{A} + 3\text{V})}$

= 3V34.81 mg/day //

B) mg/day Cr^{6} = $1.44 \times \frac{7.0}{314.63\text{V}} \times 5897 \times \frac{48\text{A}}{(48\text{A} + 3\text{V})}$

= 170.88 mg/day //

High flow

C) mg/day total Cr = $1.44 \times \frac{7\text{V}\text{A}}{19.194} \times 58954 \times \frac{3\text{V}}{(48\text{A} + 3\text{V})}$

= 1996.83

D) mg/day Cr^{6} = $1.44 \times \frac{0.12}{19.194} \times 58954 \times \frac{3\text{V}}{(48\text{A} + 3\text{V})}$

= 35.66

Total mg/day total Cr = A + C = 3V34.81 + 3565.99

= 6800.78

Total mg/day Cr^{6} = B + D = 170.88 + 35.66

= 206.54

ES ENGINEERING-SCIENCE

Client DAC — NOV '89 | Job No. | Sheet 3 of 4

Object Example Calc Sheet | By RR | Date 11-30-89

Checked | Rev.

SOURCE TANK SDA-01 Condition ✓

TEST DATE 11-22-89

SCRUBBER	HA 7-5		HA 7-6	
LOW FLOW				
DSCF (ft³)	408.230		314.63 ✓	
DSCFM (ft³/min)	4706		5,897	
RUN TIME (min)	480		484	
LIQUID VOL (l)	0.750		0.710	
	TOTAL Cr	Cr⁶	TOTAL Cr	Cr⁶
ug/l (sample)	31	0.07	180	2.9
− ug/l (blank)	<10	0.07	<10.	0.07
ug/l (in liquid)	31	ND	180	2.83
	≈ 17.05 ug	NA	≈ 127.8	≈ 2.01
ug (filter)	N.A.	N.A.	N.A.	N.A.
− ug (blank filt.)	N.A.	N.A.	N.A.	N.A.
ug (on filter)	N.A.	N.A.	N.A.	N.A.
HIGH FLOW				
DSCF (ft³)	76.485		19.134	
DSCFM (ft³/min)	41,855		7954	
RUN TIME (min)	33		3 ✓	
LIQUID VOL (l)	6.690		0.720	
	TOTAL Cr	Cr⁶	TOTAL Cr	Cr⁶
ug/l (sample)	<10	0.13	13	0.70
− ug/l (blank)	<10	0.07	<10	0.07
ug/l (blank)	ND	0.06	10	0.63
	≈ NA.	≈ 0.04 ug	≈ 7.28 ug	≈ 0.13 ug
ug (filter)	N.A.	N.A.	N.A.	N.A.
− ug (blank filter)	N.A.	N.A.	N.A.	N.A.
	N.A.	N.A.	N.A.	N.A.

ENGINEERING-SCIENCE

Client DAC – NOV '89 | Job No. | Sheet 4 of 6

Subject | By RR | Date 11-30-89

Checked | Rev

Condition ✓

TANK SDA-07	mg/day TOTAL Cr	mg/day Cr^{6+}
UNF. HWT-5	736.69	NA
INCL F. HWT-6	NA	5.86
TOTAL	736.69	5.86
UNF. HWT-6	3,734.81	50.88
INCL F. HWT-6	1,996.83	35.66
TOTAL	5731.64	86.54

TANK SDA-07 5468.33 mg/day 92.4 mg/day Cr^{6+}

Auger-hours = 7 loads ≈ 6 loads daily

Aug-hr = 0110 (60 min previous time) 3137 + 508 = 3645

Aug-hr ≈ 0600 (60 min previous time) 777 + 574 = 1351

Total Aug hours 6445

mg/aug hour = $92.4 \frac{mg\ Cr^{6+}}{day} \times \frac{1}{(6445 \times 2)\ \frac{aug\text{-}hr}{day}}$

= 0.005 mg/aug.-hr Tank SDA-07

APPENDIX E

Process Data

11-21-89 ~1:53 pm — 70' 6 skeins (soaqp) 40' 6 skeins (graduation, masked on one side) 980 ft² no air sparge

Totalizer Readings

t	Rectifier 1-1A (West)	Rectifier 2-2A (East)	Voltage	
0	0000	0000		
15	—	0971	24.0	
20	1202	—	24.0	
30	—	1800	24.0	
40	2430	—	24.0	
45	—	2674	24.0	
60	(3350)	(3401)	24.0	≈ 6751 amp

Run 2 ~7:10 pm — 70' 6 skeins (soaqp) 40' 5 skeins (soaqp)

t	Rectifier 1-1A	Rectifier 2-2A	Voltage	
0	0000	0000		
17	0965	—	24.0	
20	—	0184	24.0	
30	1701	0290	24.0	
40	2298	0389	24.0	
— 45	2602	0439	24.0	7:55 pm restart
60	(3347)	(0568)	24.0	≈ 3915 amp hr

Total ≈ 10,666 amp hr

Run 3
1-22-89 70' 6 stains (corp)
~1:10 am 40' 5 stains (corp)

had problems getting water release from vent on well end prior to enodize

t —	Rectifier 1-1A (West)	Rectifier 2-2A (East)	Voltage
0	0000	0000	
20	1267	0203	24.0
40	2345	0360	24.0
60	3137	0508	

≈ 3605 amp. hr

Run 4
1-22-89 70' 6 stains (corp)
~6:00 am 40' 5 stains (corp)

t	Rectifier 1-1A	Rectifier 2-2A	Voltage
0	0000	0000	
20	1002	0205	24.0
40	—	—	
60	2226	0574	

≈ 7800 amp-hr
experienced trouble removing west bus bar (spring switch)

6405 amp hr

APPENDIX F

Quality Assurance

ENGINEERING SCIENCE
Pasadena, California

POST TEST METER BOX CALIBRATION WORK SHEET

Meter Box No. RBD # 2 Date 12-1-89

Barometric Pressure (P_b) 29.66 Calibrated by S,K

Project No. DAC WA 099 ΔH Run AVG 14 Existing Y .0.994

Run		V_w (ft^3)	V_d (ft^3)	T_w (°F)	T_d (°F)	θ (min.)	Y_i (each)
1	Initial	674.955	490.740	63	78	11.10	1.0076
	Final	685.075	500.953	63	78	11.22	
	Net	10.120	10.213	63	78	11.23	
2	Initial	685.075	500.953	63	78	11.25	0.9980
	Final	695.216	511.305	62	78	11:40	
	Net	10.141	10.352	62	78	11:41	
3	Initial	695.216	511.305	61	86	11.42	0.9971
	Final	709.585	526.233	61	86	12.00	
	Net	14.369	14.928	61	86	12.01	

Y_i AVG 1.0009

$$Y_i = \frac{(V_w)\ (P_b)\ (T_d + 460)}{(V_d)\ (P_b + \Delta H/13.6)\ (Tw + 460)}$$

METER BOX CALIBRATION HISTORY

Date Last Calibration 10-16-89 Calibrated by A GARVER

ΔH of Calibration @ 1.6 29 Yi of Calibration 0.994

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Pasadena, California

POST TEST METER BOX CALIBRATION WORK SHEET

Meter Box No. BLUE #1 Date 12-1-89

Barometric Pressure (P_b) 29.68 Calibrated by SK

Project No. 0AE WA 099 ΔH Run 4.7 @ 1 Existing Y 0.97

Run		V_w (ft^3)	V_d (ft^3)	T_w (°F)	T_d (°F)	Θ (min.)	Y_i (each)
1	Initial	711.789	624.217	60	72	13.00	0.9876
	Final	726.318	639.095	60	72	13.17	
	Net	14.529	14.878	60	72	13.18	
2	Initial	726.318	639.095	60	72	13:20	0.9931
	Final	747.944	661.363	62	80	13:35	
	Net	21.626	22.268	62	80	13:36	
3	Initial	747.944	661.363	62	80	13:37	0.9780
	Final	762.070	676.190	60	80	13:50	
	Net	14.126	14.827	60	80	13:51	

Y_i AVG 0.9862

$$Y_i = \frac{(V_w)\ (P_b)\ (T_d + 460)}{(V_d)\ (P_b + \Delta H/13.6)\ (Tw + 460)}$$

METER BOX CALIBRATION HISTORY

Date Last Calibration 9-6-89 Calibrated by A. G

ΔH of Calibration @ 2.00 Yi of Calibration 0.97

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Pasadena, California

POST TEST METER BOX CALIBRATION WORK SHEET

Meter Box No. BUCK 2 Date 11-29-89

Barometric Pressure (P_b) 29.66 Calibrated by S K

Project No. DAE WA 049 ΔH Run 1.970 Existing Y 1.001

Run		V_w (ft^3)	V_d (ft^3)	T_w (°F)	T_d (°F)	θ (min.)	Y_i (each)
1	Initial	582.515	054.225	53	70	07.40	0.9850
	Final	597.010	069.354	53	70	08.00	
	Net	14.495	15.129	53	70	08.01	
2	Initial	597.010	069.354	53	70	08.02	1.040
	Final	612.740	084.905	53	70	08.20	
	Net	15.730	15.551	53	70	08.21	
3	Initial	612.740	084.905	53	70	08.22	0.9796
	Final	627.213	100.065	54	70	08.40	
	Net	14.473	15.1600	54	70	08.41	

53 + 54

Y_i AVG 1.0015

$$Y_i = \frac{(V_w)\ (P_b)\ (T_d + 460)}{(V_d)\ (P_b + \Delta H/13.6)\ (Tw + 460)}$$

METER BOX CALIBRATION HISTORY

Date Last Calibration 10-12-89 Calibrated by T-G

ΔH of Calibration @ 1.970 Yi of Calibration 1.001

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Pasadena, California

POST-TEST METER BOX CALIBRATION WORKSHEET

Meter Box No. RGD # 3 Date 11-29-89 Box Operator S.K

Barometric Pressure (P_b) 29.66 Ambient Temp 71/73 Published Y_i 1.01

Project No. DAC WA199 ΔH Run 4.7 @ 14 Vacuum Run .05 Calibration Operator Init. S.K

Run#		V_w (ft^3)	V_d (ft^3)	T_w (°F)	T_d (°F)	T_i (min.)	Y_i (each)
01	Initial	627.213	044.774	56	71	10:20	
	Final	643.120	060.995	57	71	10:35	0.9956
	Net	15.907	16.221	57	71	10:36	
02	Initial	643.120	060.995	57	71	10:37	
	Final	657.048	074.955	57	73	10:48	1.0167
	Net	13.928	13.960	57	73	10:49	
03	Initial	657.048	074.955	57	73	10:50	
	Final	674.955	092.850	57	73	10:51	1.0198
	Net	17.907	17.895	57	73	11.10	

FINAL LEAK CHECK		FINAL METER READING	Y_i AVERAGE
"			
"Hg	CFM	092.850	1.0107

METER BOX CALIBRATION HISTORY

Date Last Calibration 4-17-89 Calibrated by M. DOBSON

ΔH of Calibration @ 1.74 Y_i of Calibration 1.01

ENGINEERING SCIENCE, INC.
75 N. Fair Oaks Ave.
Pasadena, California
(818) 440-6000

CHAIN OF CUSTODY RECORD PUSH

Project No.	Project Name	Project Manager	ANALYSIS REQUIRED								SENT TO:
	DAC	RR									SHIPPED VIA:
Samples Collected By: RCSMRIO & CREW		Phone:	Cr⁶	TOM Cr							SHIPPED BY:

ES Lab No.	Test Date	Sample Description (Container, Media, Volume, etc.)									Remarks
	11-21-89	891159	@ 795 ml	✓	✓			P.O. # 9388-C088			% WCAS
		1160	@ 700	✓	✓						
		1161	@ 680	✓	✓						MTCE SHELTON
		1162	@ 830	✓	✓						
	11-22-89	891163	@ 670	✓	✓						Cr⁶
		1164	@ 550	✓	✓						
		1165	@ 520	✓	✓						Total Chromium
		1166	@ 710	✓	✓						by DIONEX ≈
		1167	@ 830	✓	✓						MDL 10 ppb
		9									

Relinquished by:	Date/Time	Received by:	Reason for Exchange:	Comments:
Phone: R Rosario	11-22-89	Of: Mary Aldenwall WCAS	11/22 4:50 p.m.	No 14226
Relinquished by:	Date/Time	Received by:	Reason for Exchange:	Comments:
Phone:		Of:		
Relinquished by:	Date/Time	Received by:	Reason for Exchange:	Comments:
Phone:		Of:		
Relinquished by:	Date/Time	Received by:	Reason for Exchange:	Comments: Questions
Phone:		Of:		c/o R. Rosario 440 6685

M. Edwards 440 6610

PRELIMINARY DRAFT
SUBJECT TO CHANGE

November 29, 1989

ENGINEERING SCIENCE
75 N. Fair Oaks Ave.
Pasadena, CA 91103

Attn: Rollie Rosario

JOB NO. 14226 A

LABORATORY REPORT

Samples Received: Nine (9) impinger solutions
Date Received: 11/22/89
Purchase order No: 9384-6085

The samples were analyzed as follows:

Samples Analyzed	Analysis	Results
Nine (9) solutions	Total Chromium by ICPMS	Table I
Nine (9) solutions	Hexavalent Chromium by EPA 7196/IC	Table II

Michael Shelton
Senior Chemist

D. J. Northington, Ph.D.
Technical Director

SUBJECT TO CHANGE

WEST COAST ANALYTICAL SERVICE, INC.

ENGINEERING SCIENCE
Mr. Rollie Rosario

Job # 14226
November 29, 1989

LABORATORY REPORT

TABLE I

Parts Per Billion (ug/L)

Total Metals

Sample ID	Chromium
891159	53
891160	ND
891161	620
891162	ND
891163	ND
891164	31
891165	13
891166	180
891167	ND
Detection Limit	10

ND-Not Detected

Date Analyzed: 11-28-89

PRELIMINARY DRAFT
SUBJECT TO CHANGE

WEST COAST ANALYTICAL SERVICE, INC.

ENGINEERING SCIENCE
Mr. Rollie Rosario

Job # 14226
November 29, 1989

LABORATORY REPORT

TABLE II

Parts Per Billion (ug/L)

Sample ID	Hexavalent Chromium		
891159	49	49/53	92.5% Hex Cr
891160	1.5		
891161	550	550/620	88.7% Hex
891162	0.49		
891163	0.13	.07/31	0.02% Hex
891164	0.07		
891165	0.30	.30/13 = 2.3%	2.9/180 1.6% Hex Cr
891166	2.9		
891167	0.07		
Detection Limit	0.01		

Hex

Date Analyzed: 11-28-89

TOTAL PAGES 1 PROPOSAL/PROJECT No. WA099 DATE: 12-1-89

FROM: ROLLIE R. OFFICE No. 401 EXT. 6085

ATTENTION: BOB OLSON CITY/STATE SANTA FE SPRINGS

COMPANY NAME WCAS TELECOPY No. (213) 948 8510

MESSAGE

☐ PLEASE MAKE COPIES AND DISTRIBUTE WITHIN YOUR OFFICE

☐ PLEASE RESPOND NO LATER THAN _____

Thanks

Dear Mr Bob Olson,

Please rerun hexavalent chromium and total chromium for ES samples 891161
891166

New P.O. = 9394-6085

Thanks
R Rollie

ENGINEERING-SCIENCE, INC., P.O. BOX 7107, PASADENA, CALIFORNIA 91109

Voice: 818 440-6005 Telecopier: 818 440-6195

WCAS
West Coast Analytical Service, Inc.
Analytical Chemists

Date 12-4-89

Fax No. _____
area code/number

Company Name Engineering Science

Location _____

Attn: Rollie Rosario

FAX REPORT

REFERENCE: WCAS Job # 14226

From Bob Olson Time 3:15

Operator RO No. of pages (including cover) 4

9840 Alburtis Avenue Santa Fe Springs, CA 90670
213/948-2225 FAX 213/948-5850

Client Name: Engineering Science Phone No.

Fax No.

Proj. No. P.O.# 9394-6085

Technical Contact: (213) Rollie Rosario Proj. Name

CHAIN OF CUSTODY

WEST COAST ANALYTICAL SERIVCE, INC.
9840 Alburtis Ave Santa Fe Springs, CA 90670
Phone 213/948-2225 FAX 213/948-5850

WCAS Job No h14287

Date Sampled Condition of Samples

Sample # /Description/Remarks	Sample Matrix	Analyses Requested													
		TCL	TPH												
8911161 liquid from prev # 14226	liquid	↓	↓												
8911616 " " # 14226	liquid	↓	↓												

Total # of Containers 2

Relinquished by:(Company & Signature) Received for Lab by: Date/Time

April Richards April Richards 11/1/89 3:00pm

h14287

White copy: Job Env. Yellow copy: Return with Lab Results Pink copy: Client at time of Delivery

samples from previous # 14226

ENGINEERING SCIENCE SOURCE TEST WORK REQUEST	
	Project Number: WA099
	Team Leader: RR

Client: DAC

Address:

City: State: Zip:

Contact Person: Telephone: ( )

Agency: Compliance Test: [yes] [no]

Applicable Rules/Regulations:

SOURCE DESCRIPTION

Unit to be Tested: Diameter of Stack (in):

Height of Platform (ft): Number of Ports:

Stack Temp (deg F): Moisture Content (%):

SAMPLING INFORMATION

Parameter:	Method:	No. of Runs:	Run Time:	Other:
[illegible]	[illegible]	4 + 1		[illegible]
[illegible]				
[illegible]				
[illegible]	[illegible]	2		[illegible]
[illegible]				

SCHEDULE AND PERSONNEL

Scheduled Test Date: Actual Test Date:

Departure from ES: Arrival at Site: [illegible]

Personnel:

NOTES