AP-42 Section 12.20
Reference
Report Sect. 4
Reference 75

TEAM Environmental Services, Inc.

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

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

SOURCE TEST REPORT FOR TOTAL CHROMIUM AND HEXAVALENT CHROMIUM FROM CHROMIC ACID ANODIZING

General Dynamics-Convair
Lindbergh Field Facility, Building #1
3302 Pacific Hwy.
San Diego, CA 92101

TEAM Environmental Services, Inc.

Source Test #: 20128
Dates Tested: 2/16-17/93
Date Issued: 3/24/93
Revision Number: 1

SOURCE TEST REPORT FOR TOTAL CHROMIUM AND HEXAVALENT CHROMIUM FROM CHROMIC ACID ANODIZING

Conducted at:

General Dynamics-Convair
Lindbergh Field Facility, Building #1
3302 Pacific Hwy.
San Diego, CA 92101

Submitted to:

San Diego Air Pollution Control District
9150 Chesapeake Drive
San Diego, CA 92123-1095

Submitted for:

Mr. Randy Venier

General Dynamics-Convair
P.O. Box 85377, MZ-88-2520
San Diego, CA 92186-5377

Prepared by:

Team Environmental Services
Tracer Technologies Division
970 Los Vallecitos Blvd #100
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Dana E. Errett, Sample and Data Management

Anthony J. Host, Tracer Technologies Program Manager

Randy Venier, General Dynamics-Convair

EXECUTIVE SUMMARY

Firm Tested:	General Dynamics-Convair
Address:	Lindbergh Field Facility, Building #1, 3302 Pacific Hwy.
City:	San Diego, CA 92101
Contact:	Mr. Randy Venier (619) 542-7079
Source:	Chromic Acid Anodizing Tank #8 Scrubber

Dates of Test:	16-17 February 1993
Test Requested by:	San Diego Air Pollution Control District
Contact:	Mr. Craig Anderson, SDAPCD
Test Observed by:	Dr. Clint Cooney, SDAPCD, Ian Morris, PhD, SDAPCD, and Gerard Birkhauser, SDAPCD
Test Performed by:	Team Environmental Services, Inc.
Test Objectives:	Quantify hexavalent and total chromium emissions from a chromic acid anodizing tank at the scrubber inlet and outlet.
Test Methods:	Modified CARB Method 425 for total and hexavalent chromium.
Permit Number:	911136

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1.0 SUMMARY OF RESULTS

Plant and Process Data

Process Description: Chromic acid anodizing tank.

Outlet Gas Flow Rate: 10,134 scfm

Table 1-1: Hexavalent Chromium

Hexavalent Chromium				
	inlet (lb/yr)	outlet (lb/yr)	removal efficiency	outlet mg/amp-hr
RUN 1	1.28	0.053	95.9%	.11
RUN 2	1.44	0.004	99.7%	.01
RUN 3	1.61	0.078	95.2%	.15
AVG	**1.44**	**0.045**	**96.9%**	**.09**

Table 1-2: Total Chromium

Total Chromium			
	inlet (lb/yr)	outlet (lb/yr)	removal efficiency
RUN 1	1.47	0.12	91.8%
RUN 2	1.64	0.13	92.1%
RUN 3	1.83	0.16	91.3%
AVG	1.65	0.14	91.5%

lb/yr calculation is based on 3 anodizing loads per day (40 minutes per load), 6 days per week, 50 weeks per year

2.0 INTRODUCTION

On 16 and 17 February 1993, Team Environmental Services (TEAM) personnel conducted a source test at General Dynamics-Convair in San Diego, California, on the exhaust stack of Chromic Acid Anodizing Tank #8's scrubber to determine total and hexavalent chromium mass emissions at the scrubber inlet and outlet. This information will be used for compliance reporting.

The test was conducted by Tony Host, Dale Crow, Dana Errett, Stephen Engleman, and Dwayne Anderson of TEAM. Arrangements prior to testing were conducted through Randy Venier of General Dynamics-Convair, ERM Department.

3.0 EQUIPMENT AND PROCESS DESCRIPTION

General Dynamics conducts aerospace manufacturing activities at it's Lindbergh Field facility. Building #1 has a metal processing operation which includes Tank #8, a chromic acid anodizing tank with a scrubber.

The chromic acid anodizing process is carried out in a tank measuring 3 ft wide by 22 ft long by 6 ft deep and containing approximately 2,715 gallons of a chromic acid solution, maintained at a temperature of 90-95°F. The chrome content of the tank is maintained at approximately 5 weight ounces of free chrome per gallon of solution, with approximately 17 weight ounces of total chrome per gallon of solution. The anodizing process is driven by a voltage drop across the parts, whereby a protective aluminum oxide film is deposited. Voltage is ramped up from zero when parts are immersed, and maintained at a plateau of 18-22 volts. Parts are placed in the solution on an irregular basis, depending on production schedules, where they are immersed for 40 minutes. The tank is air agitated. The tank solution is analyzed weekly. Figure 3-1 is a drawing of the tank and associated vent system.

An exhaust plenum runs along the sides of the tank drawing fumes to a scrubber. The scrubber washes the fumes with a solution maintained at a pH of 3.5, and Nalco product #7408 (Chlorine Oxygen Scavenger) concentration of 20 ppm. The Nalco product is an aqueous sodium bisulfite solution which reduces hexavalent chromium to trivalent chromium (see Figure 3-2).

The fumes are drawn into the scrubber by a fan located on the roof. This fan draws air from the tank, through the scrubber and out an exhaust stack. The sampling ports are located on the roof and at the base of the scrubber inlet.

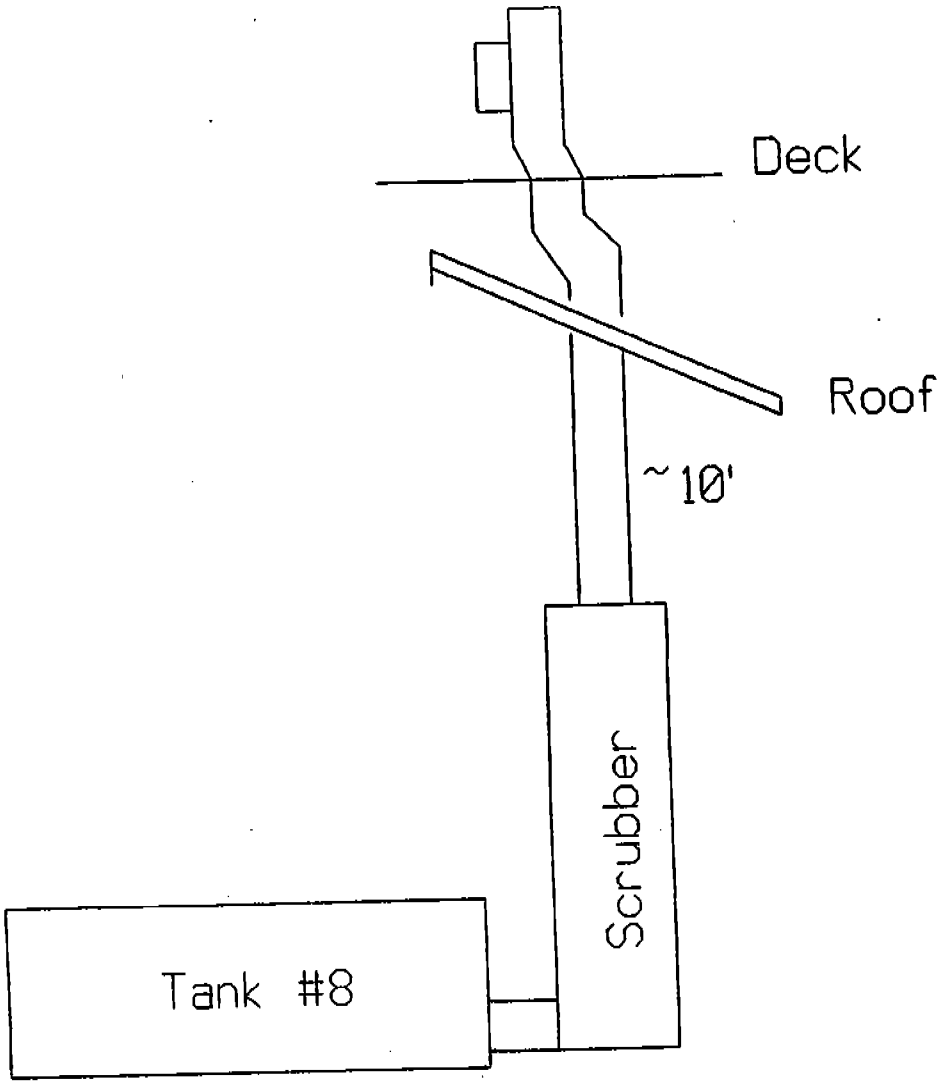


Figure 3-1 Chromic acid anodize tank #8

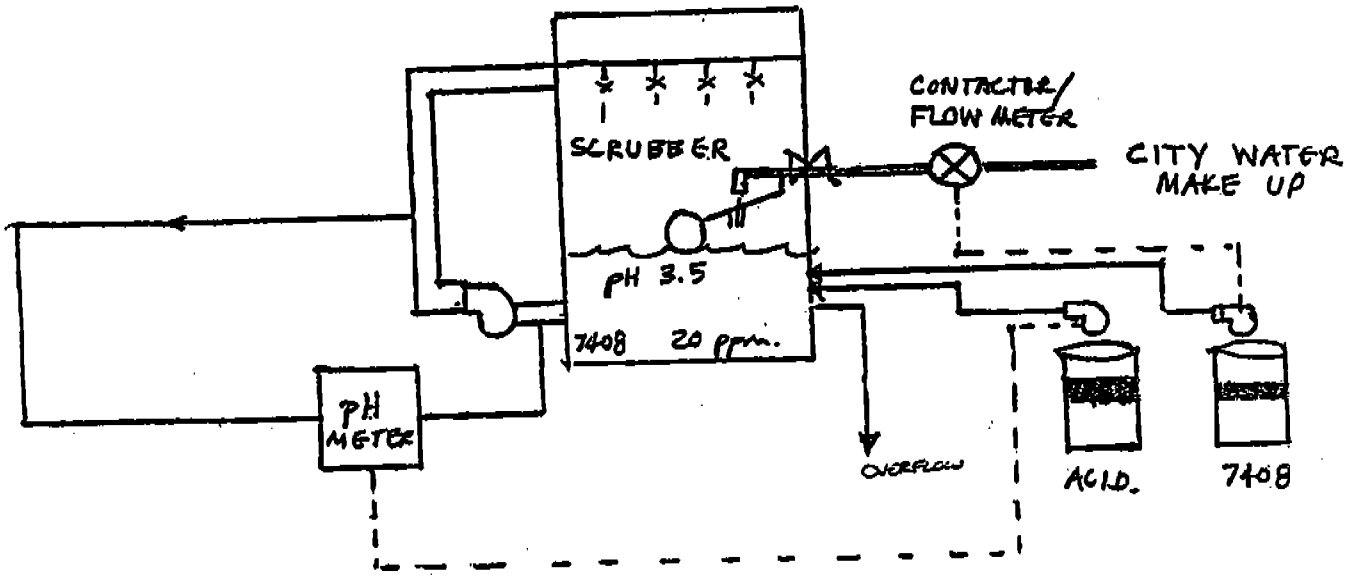


Figure 3-2 Scrubber System for Tank #8

4.0 SAMPLING AND ANALYTICAL PROCEDURES

The objective of this test program was to determine the mass emission rate of hexavalent and total chromium from Tank #8's scrubber exhaust at the scrubber inlet and outlet. Testing was performed while the tank was being operated in a normal manner. Each emission test consisted of four 40 minute tests. Stack gas flow, moisture, mass of hexavalent chromium and mass of total chromium were measured. As no combustion process is involved, ambient air was assumed for gas concentrations.

4.1 Sampling Site Traverse Points

The scrubber inlet is a rectangular duct 29 inches by 42 inches. Since only one sampling port was available on the inlet duct, a 10 point linear traverse was used for sampling. Inlet volumetric flow rate was assumed to be identical to the outlet flow rate. The scrubber exhaust gases are vented through the stack and were sampled at existing sample ports. The stack is 38 inches in diameter and is equipped with two ports situated 90 degrees apart. The nearest downstream disturbance is 61 inches and the nearest upstream is 21 inches. The ports are 1.6 stack diameters downstream and 0.55 diameters upstream from the stack exit. A 24 point traverse was used.

4.2 Cyclonic Flow Check

Cyclonic flow checks were conducted in conjunction with the preliminary traverse using SCAQMD Method 1.1, Section 2.4 "Verification of Parallel (Non-Cyclonic) Flow." The yaw angle average for this source was measured to be 0.0°, indicating no cyclonic flow conditions.

4.3 Modified CARB Method 425 - Chromium and Hexavalent Chromium Emissions

A modified California Air Resource Board Method 425 was used for this testing. The modifications were in the type of impinger solution, elimination of an impinger and analytical detection method.

Using the CARB 425 sampling method, a sample was withdrawn isokinetically from the source stack downstream of the scrubber. Details of the sample location(s) including upstream and downstream dimensions and traverse point layout, are shown in Figures 4-1 and 4-2. Particulate matter and any condensable material (such as water vapor, organic compounds, and/or sulfuric acid) were collected in impingers containing 0.2 mmol sodium carbonate/sodium bicarbonate solution and on an unheated backup teflon filter. The amount of water collected in the sample train was determined gravimetrically.

A schematic of the sample train is shown in Figure 4-3. The sample was collected using a glass goose-necked, sharp-edged nozzle attached to glass probe liner. A stainless-steel sheathed Type K thermocouple was used to measure stack temperature, while a stainless steel S-type Pitot tube and an inclined manometer were used to measure stack gas velocity. To minimize mutual interference, the gas sample probe, thermocouple, and Pitot tube were assembled according to Method 2.1 specifications.

The impingers were all connected with glass ball-joint fittings. The impingers were placed in an ice bath to maintain the sample gas temperature exiting the last impinger to 60°F or less. The first two impingers were of the Greenburg-Smith design and contained measured amounts of 0.2 mmol sodium carbonate/sodium bicarbonate solution. The third impinger was a modified Greenburg-Smith impinger and contained a tared amount of silica gel. The back-up teflon filter was located between the second and third impingers.

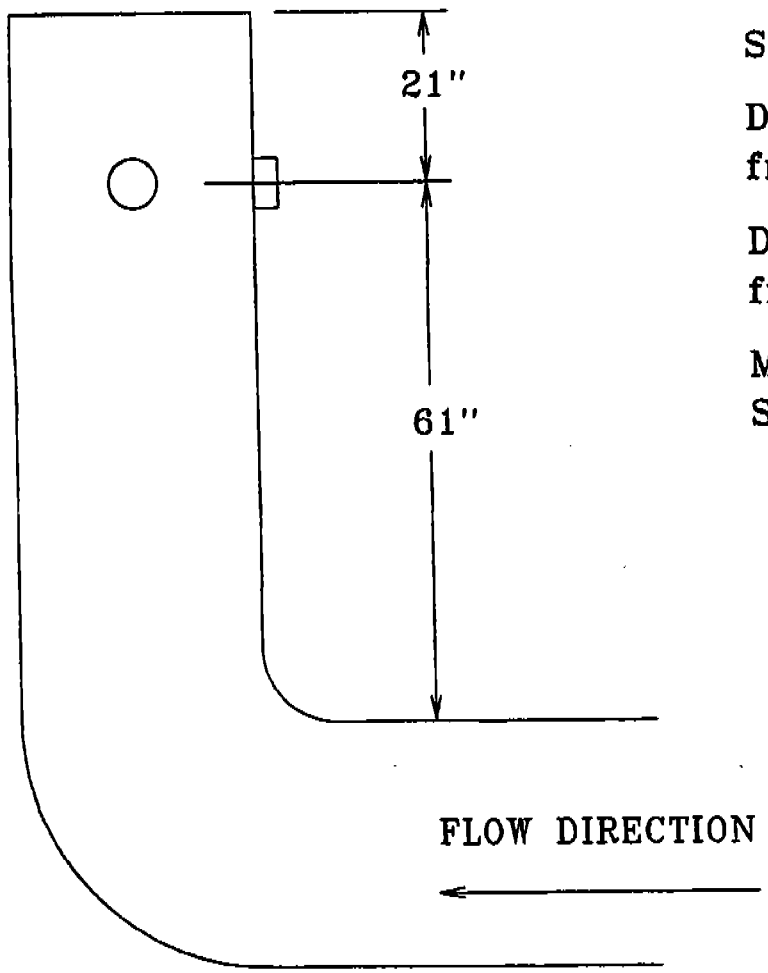
Since chromium anodizing is a 40 minute process, each run was collected as four 40 minute tests. The total sampling time for each run was 160 minutes over a 24 point traverse. The sampling time at each point was either 6.5 or 7 minutes. (outlet)

A pre and post-test leak check was performed on the sample train and pitot lines. The probe liner and nozzle, sample glassware and impingers were recovered after each test.

The most recent and sensitive analytical method for hexavalent chromium is an Ion Chromatography (IC) separation followed by UV/Vis detection. This method gives a 0.01 μgm/l detection limit. The impinger solution required to get this detection limit is a millimolar carbonate/bicarbonate solution. Hexavalent chromium has been proven to be stable in this alkaline solution. All material used in the Method 5 sampling train was glass or Teflon. The wash solution used in the recovery was the impinger solution.

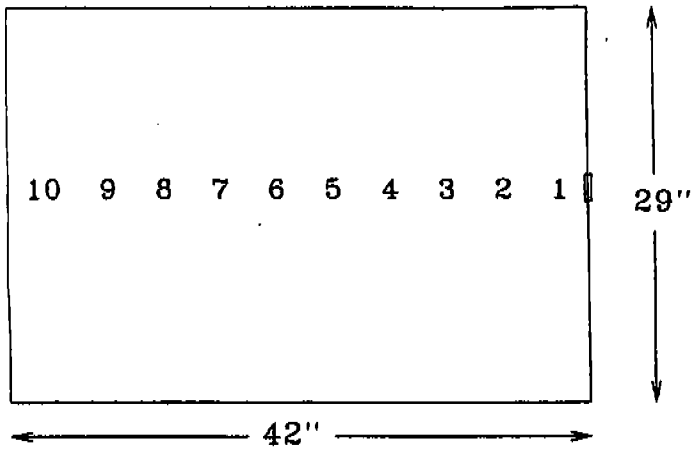
The samples were sent under chain-of-custody procedures to West Coast Analytical Services, of Santa Fe Springs, California for analysis. The samples were analyzed within 48 hours of collection. Hexavalent chromium was analyzed by Ion Chromatography/UV-Vis Spectroscopy. Total chromium was analyzed by Inductively Coupled Plasma/Mass Spectroscopy (ICP/MS).

48hr sampling times



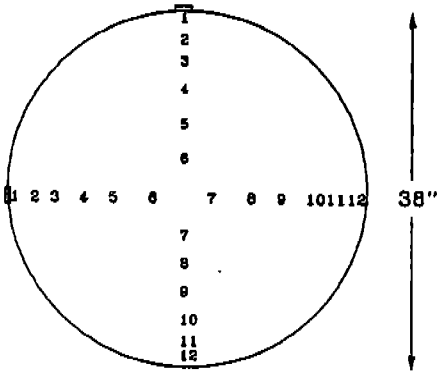
Stack Diameter:	38"
Diameters Upstream from Flow Disturbance:	0.55
Diameters Downstream from Flow Disturbance:	1.6
Minimum Number of Sample Points:	24

Figure 4-1 Stack Diagram



Traverse Point	1	2	3	4	5	6	7	8	9	10
Distance from Inner Wall (in)	2.1	6.3	10.5	14.7	18.9	23.1	27.3	31.5	35.7	39.9

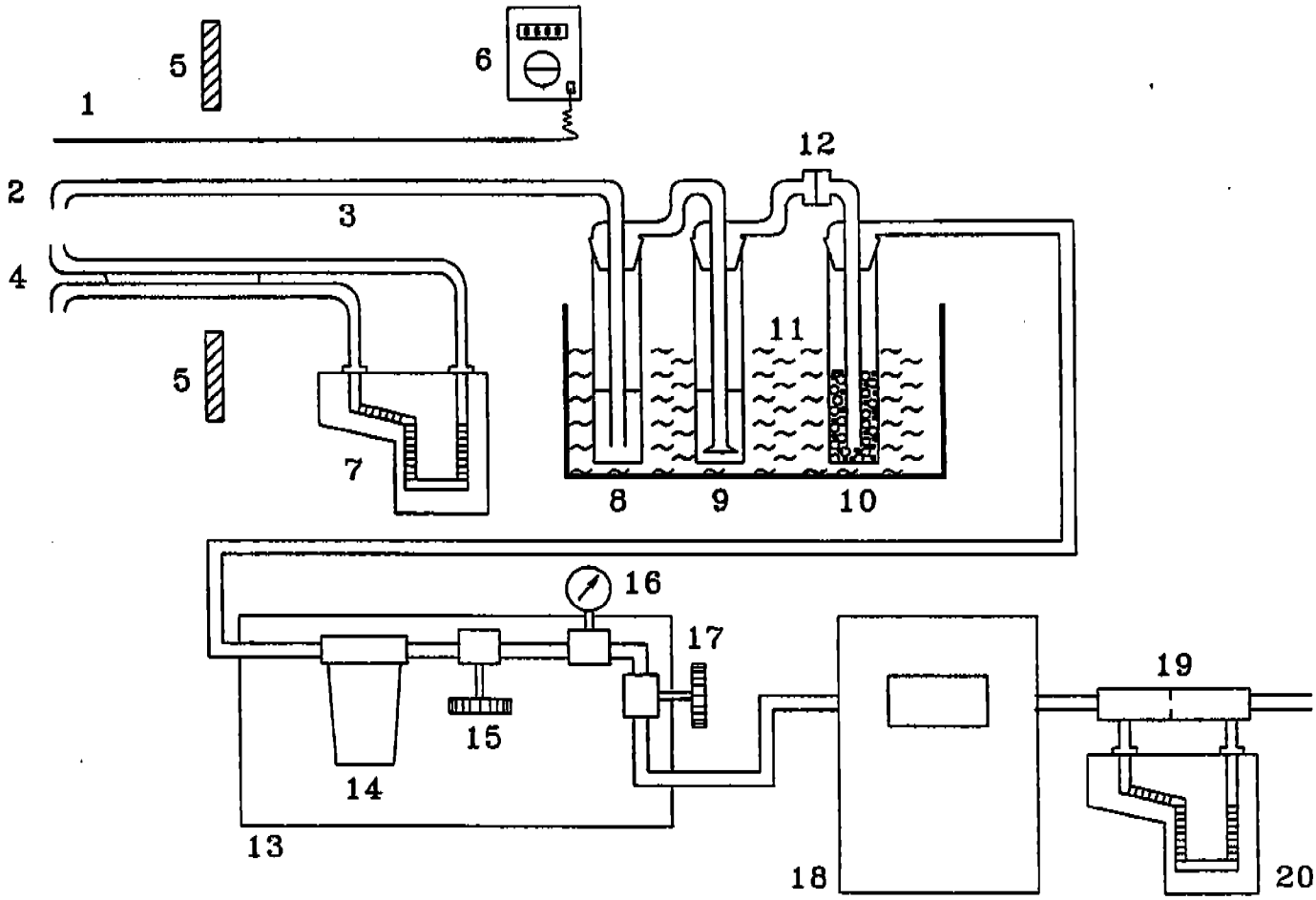
Inlet Traverse



Traverse Point	1	2	3	4	5	6	7	8	9	10	11	12
% of Diameter	2.1	6.7	11.8	17.7	25.0	35.8	64.4	75.0	82.3	88.2	93.3	97.9
Distance from Inner Wall	1.0	2.5	4.5	6.7	9.5	13.6	24.5	28.5	31.3	33.5	35.5	37.0

Outlet Traverse

Figure 4-2 Traverse Diagram



1.	Temperature Sensor	11.	Ice Bath
2.	Nozzle	12.	Teflon Filter
3.	Glass Probe	13.	Sealed Pump (Leak Free)
4.	S-Type Pitot Tube	14.	Filter for Pump
5.	Stack Wall	15.	Metering Valve
6.	Temperature Sensor Meter	16.	Vacuum Gauge
7.	Pitot Tube Inclined Manometer	17.	By-Pass Valve
8.	Impinger with 100 ml carb/bicarb	18.	Dry Gas Meter
9.	Impinger with 100 ml carb/bicarb	19.	Orifice
10.	Bubbler with Silica Gel	20.	Orifice Inclined Manometer

Figure 4-3 CARB 425 Sampling Train

5.0 TEST RESULTS

Table 5-1: Hexavalent Chromium

Hexavalent Chromium				
	inlet (lb/yr)	outlet (lb/yr)	removal efficiency	outlet mg/amp-hr
RUN 1	1.28	0.053	95.9%	.11
RUN 2	1.44	0.004	99.7%	.01
RUN 3	1.61	0.078	95.2%	.15
AVG	**1.44**	**0.045**	**96.9%**	**.09**

Table 5-2: Total Chromium

Total Chromium			
	inlet (lb/yr)	outlet (lb/yr)	removal efficiency
RUN 1	1.47	0.12	91.8%
RUN 2	1.64	0.13	92.1%
RUN 3	1.83	0.16	91.3%
AVG	1.65	0.14	91.5%

lb/yr calculation is based on 3 anodizing loads per day (40 minutes per load), 6 days per week, 50 weeks per year

6.0 QUALITY ASSURANCE AND QUALITY CONTROL PROCEDURES

Team Environmental Services has established a comprehensive Source Testing Quality Assurance/Quality Control (QA/QC) Program that is based on California Air Resource Board (CARB) and South Coast Air Quality Management District (SCAQMD) procedures.

6.1 Sampling Protocol

In preparation for the field test the mobile laboratory, sampling equipment, and laboratory equipment were checked and routine maintenance performed. The instrumentation in the mobile laboratory was checked prior to going into the field to verify proper operation. All of the pitot tubes, thermocouples and control boxes had current annual calibrations. The field test engineers reviewed the appropriate test method protocol to insure that appropriate sampling protocol was followed for the source test.

6.2 Equipment Calibration and Maintenance

The balances used for gravimetric analyses had current calibrations. A daily usage calibration procedure using 4 class S weights was performed for all analytical weights in the laboratory. The field solution balance was calibrated using a secondary balance set.

All reagents used were reagent grade or better. Reagents were dated and initialed upon receipt. Preparation of standards or solutions was recorded in a bound notebook and this reference was recorded on the standard or solution label.

Calibrations were conducted according to Chapter III of the SCAQMD Source Test Manual (March, 1989). All equipment was marked using a "XXX ###" system. For instance, NOZ 001 would be the nozzle #1, PRB 001 would be probe #1.

The S-type Pitot tubes were measured for tube diameters and dimensional angles on a semiannual basis as outlined in the method. They were also examined prior to use. Since the pitot tubes met the measurement criteria, an assigned value of 0.84 was assumed for C_p, the pitot tube constant.

The thermocouples were calibrated at three temperatures; an ice bath, boiling water bath and hot oil bath. This is done on a semiannual and bimonthly basis. The absolute temperature values of the reference thermometer and stack temperature sensors must agree to within 1.5% at each of the points. The reference thermometers were calibrated against a NIST certified thermometer.

The field aneroid barometer is calibrated semiannually by comparison to a mercury barometer.

The field dry gas meter and flow orifice is calibrated against a wet test meter on an annual and bimonthly basis. The field dry gas meter and flow orifice was also field post-checked.

6.3 Data Validation

The compliance test specifies quality assurance procedures to be followed. Team Environmental Services follows these procedures for particulate and gaseous analysis. Pretest and post-test leak checks were performed on the source train, pitot tube lines and gas sampling lines. All materials that came in contact with a sample were suitable for temperature and purposes of the testing. The sample train components were configured properly to avoid sample interference. Preliminary sample and velocity traverses were performed to insure proper sampling conditions and absence of cyclonic flow. The set-up calculations were configured to meet method requirements for minimum sample time and volume requirements.

Current CARB certifications were maintained for the test procedures performed. Finally, audited spreadsheets were used to calculate emission testing results. Check spreadsheets were prepared and filled out to double-check field results.

Test Site: GD (Convair)
Mass Emission Rates (Cr VI) - Inlet / Outlet - Confirmation Report

Test Date: 16/17 Feb
Witness: Ian K Morris

INLET - Chromium VI Tank #8

Time	Sub-test #	total ug collected	DGM Volume Sampled ft3 (STP)	Stack Conc. ug/ft3	Flow DSCFM		MER mg/load	MER lb/yr	
####	1	180	114.092	1.5777	12340	Team	778.74	1.28	Team
		180	115.032	1.5777	12358	APCD	779.89	1.55	APCD
####	2	206	116.272	1.7717	12590	Team	892.23	1.44	Team
		206	116.282	1.7717	12540	APCD	888.68	1.76	APCD
####	3	227	114.812	1.9771	12399	Team	980.58	1.61	Team
		227	114.769	1.9771	12384	APCD	979.38	1.94	APCD
							Avg. lb/yr	1.44	Team
								1.75	APCD

lb/yr calculation based on 3 anodizing loads per day (40 minutes per load), 6 days per week, 50 weeks per year

OUTLET - Chromium VI Tank #8

Time	Sub-test #	total ug collected	DGM Volume Sampled ft3 (STP)	Stack Conc. ug/ft3	Flow DSCFM		MER mg/load	MER lb/yr	
####	1	6.6	100.968	0.0654	10261	Team	27	0.0533	Team
		6.6	100.966	0.0654	10159	APCD	27	0.0527	APCD
####	2	0.1 (N.D.)	100.054	0.0010	10220	Team	*	0.0040	Team
						APCD			APCD
####	3	9.8	98.339	0.0997	9920	Team	40	0.0784	Team
		9.8	98.355	0.0997	10008	APCD	40	0.0792	APCD
							Avg. lb/yr	0.066	Team
								0.066	APCD

Prtd 4/27/93

Team Environmental Results

Hexavalent Chromium				Results	
	inlet (lb/yr)	outlet (lb/yr)	removal efficiency	average test amperage	outlet mg/amp-hr
Run 1	1.280	0.053	95.8	379.0	1.06E-01
Run 2	*	*	*	*	*
Run 3	1.610	0.078	95.1	391.0	1.52E-01
Average	**1.445**	**0.066**	**95.5**	**385.0**	**1.29E-01**

APCD Rule 1201
Sites emitting <2.00 pounds per year Cr IV
Scrubber Efficiency >95%
or
Cr VI Emissions < 0.15 mg / amp hour

Total Chromium Emissions			
	inlet (lb/yr)	outlet (lb/yr)	removal efficiency
Run 1	1.47 (1.75 APCD)	0.12	91.8%
Run 2	1.64 (2.02 APCD)	0.13	92.1%
Run 3	1.83 (2.21 APCD)	0.16	91.3%
Average	**1.65**	**0.14**	**91.5%**

APCD Confirmation

Hexavalent Chromium				Results	
	inlet (lb/yr)	outlet (lb/yr)	removal efficiency	average test amperage	outlet mg/amp-hr
Run 1	1.547	0.053	96.6	379.0	1.06E-01
Run 2	*	*	*	*	*
Run 3	1.943	0.079	95.9	391.0	1.54E-01
Average	**1.75**	**0.066**	**96.2**	**385.0**	**1.30E-01**

* Non Detect Results from Run #2 were omitted to provide a worst case scenario.

Prtd 4/27/93

Test Site: GD (Convair)
Mass Emission Rates (Cr VI) - Inlet / Outlet - Confirmation Report

Test Date: 16/17 Feb 1993
Witness: Ian K Morris

INLET - Chromium VI Tank #8

Time	Sub-test #	total ug collected	DGM Volume Sampled ft3 (STP)	Stack Conc. ug/ft3	Flow DSCFM		MER mg/load	MER lb/yr	
16-Feb	1	180	114.092	1.5777	12340	Team	778.74	1.28	Team
		180	*115.032*	*1.5777*	*12358*	*APCD*	*779.89*	*1.55*	*APCD*
16-Feb	2	206	116.272	1.7717	12590	Team	892.23	1.44	Team
		206	*116.282*	*1.7717*	*12540*	*APCD*	*888.68*	*1.76*	*APCD*
17-Feb	3	227	114.812	1.9771	12399	Team	980.58	1.61	Team
		227	*114.769*	*1.9771*	*12384*	*APCD*	*979.38*	*1.94*	*APCD*
							Avg. lb/yr	1.44	Team
								1.75	*APCD*

lb/yr calculation based on 3 anodizing loads per day (40 minutes per load), 6 days per week, 50 weeks per year

OUTLET - Chromium VI Tank #8

Time	Sub-test #	total ug collected	DGM Volume Sampled ft3 (STP)	Stack Conc. ug/ft3	Flow DSCFM		MER mg/load	MER lb/yr	
16-Feb	1	6.6	100.968	0.0654	10261	Team	27	0.0533	Team
		6.6	*100.966*	*0.0654*	*10159*	*APCD*	27	*0.0527*	*APCD*
16-Feb	2	0.1 (N.D.)	100.054	0.0010	10220	Team	*	0.0040	Team
						APCD			*APCD*
17-Feb	3	9.8	98.339	0.0997	9920	Team	40	0.0784	Team
		9.8	*98.355*	*0.0997*	*10008*	*APCD*	40	*0.0792*	*APCD*
							Avg. lb/yr	0.066	Team
								0.066	*APCD*

Prtd 4/28/93

Team Environmental Results

Hexavalent Chromium				Results	
	inlet (lb/yr)	outlet (lb/yr)	removal efficiency	average test amperage	outlet mg/amp-hr
Run 1	1.280	0.053	95.8	379.0	1.06E-01
Run 2	*	*	*	*	*
Run 3	1.610	0.078	95.1	391.0	1.52E-01
Average	**1.445**	**0.066**	**95.5**	**385.0**	**1.29E-01**

APCD Rule 1201
Sites emitting <2.00 pounds per year Cr IV
Scrubber Efficiency >95%
or
Cr VI Emissions < 0.15 mg / amp hour

Total Chromium Emissions			
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APCD Confirmation

Hexavalent Chromium				Results	
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Run 2	*	*	*	*	*
Run 3	1.943	0.079	95.9	391.0	1.54E-01
Average	**1.75**	**0.066**	**96.2**	**385.0**	**1.30E-01**

* Non Detect Results from Run #2 were omitted to provide a worst case scenario.

Prtd 4/28/93

APCD results based on measured inlet and outlet flow rates.
Team Environmental results based on Inlet Flow = Measured Outlet Flow Rate

CARB METHOD 425: CHROMIUM AND HEXAVALENT CHROMIUM EMISSIONS

PLANT: General Dynamics
LOCATION: San Diego, CA
SAMPLE SITE: Tank 8 Scrubber Inlet
TEST NUMBER: 7254-Cr-Inlet

TEST DATE: 2/16,17/93
SAMPLED BY: AJH
CHECKED BY: DEE

Data Entry	SYMBOL	UNITS	DATA Run 1	Run 2	Run 3	Avg
Round Stack, Diameter	ds	inches				
Rectangular Stack, Length	L	inches	42.000	42.000	42.000	
Width	W	inches	29.000	29.000	29.000	
Nozzle Diameter	dn	inches	0.300	0.300	0.300	
Average Stack Temperature	Fs	deg F	64.2	62.2	67.2	
Average Meter Temperature	Fm	deg F	72.5	71.5	75.8	
Barometric Pressure	Pbar	in. Hg	30.04	30.04	30.2	
Stack Static Pressure	Pg	in. H2O	-2.2	-2.2	-2.2	
Avg Delta H	dH	in. H2O	1.811	1.828	1.802	
Avg Velocity Head	dP	in. H2O	0.197	0.203	0.1960	
Avg sqrt(dP) = sum(sqrt(dP))/N	sqrt(dP)	in. H2O	0.4350	0.443	0.437	
Pitot Coefficient	Cp	none	0.84	0.84	0.84	
Gas Sample Volume non corrected	Vm	cuft	113.599	115.548	114.421	
Meter Calibration Factor 114.535	Y	none	1.0044	1.0044	1.0044	
Total Sampling Time	min	minutes	160	160	160	
Stack Gas Oxygen Content	O2	%	20.9	20.9	20.9	
Stack Gas Carbon Dioxide Content	CO2	%	0.0	0	0	
Total Impinger Gain (Water & Particulate)	Ww	grams	24.3	25	23.3	
Total Chrome (filter + imp. catch + rinses)	Wcr	ug	206.0	235.0	258.0	
Total Hexavalent Chrome (filter + imp. catch + rinses)	Wcr6	ug	180.0	206.0	227.0	
Average amp reading during testing	Amp	na	379	380	391	
Nozzle Area, An = 3.14*(dn/2)^2	An	sq. in.	0.0707	0.0707	0.0707	0.0707
Stack Area, As = [3.14*(ds/2)^2]/144 (round) = L*W/144 (Rectangular)	As	sq. ft.	8.458	8.458	8.458	8.4583
Avg Stack Temperature, Ts = Fs + 460	Ts	deg R	524.2	522.2	527.2	524.5
Avg Meter Temperature, Tm = Fm + 460	Tm	deg R	532.5	531.5	535.8	533.3
Gas Sample Volume at Standard Conditions, Vm(std) = 17.647*Y*(Vm/Tm)*(Pbar+dH/13.6) 115.032	Vm(std)	cu.ft.	114.092	116.272	114.812	115.059
		cu.m.	3.231	3.292	3.251	3.258
Water Collected, Wlc = Ww-[Wsol/1000]	Wlc	grams	24.120	24.794	23.073	23.996
Volume of Water Vapor, Vw(std) = 0.04647*Wlc	Vw(std)	cu.ft.	1.121	1.152	1.072	1.115
Moisture Fraction, Bws = Vw(std)/(Vm(std)+Vw(std))	Bws	none	0.0097	0.0098	0.0093	0.0096
Dry Stack Gas Molecular Weight, Md = (0.32*O2)+(0.44*CO2)+(0.28*(100-O2+CO2))	Md	g/g-mole	28.836	28.836	28.836	28.836
Wet Stack Gas Molecular Weight, Mw = Md*(1-Bws) + 18.0*(Bws)	Mw	g/g-mole	28.731	28.730	28.736	28.732
Absolute Stack Pressure, Ps = Pbar + Pg/13.6	Ps	in. Hg	29.878	29.878	30.038	29.932
Stack Gas Velocity vs = 85.49*Cp*sqrt(dP)*[sqrt(Ts/(Ps*Mw))]	vs	ft/sec	24.411	24.813	24.525	24.583
vsm = 0.3048 * vs	vsm	m/sec	7.440	7.563	7.475	7.493
Actual Stack Gas Flow Rate, Q = 60*vs*As	Q	acf/min	12,389	12,592	12,447	12475.9
Dry Stack Gas Flow Rate (Dry, STP), Qsd = 17.647*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	12,340	12,590	12,399	12442.8
Qsdm = Qsd/35.32	Qsdm	dscm/min	349.37	356.45	351.05	352.287
Isokinetic Rate, I = 100*As*Vm(std)/(min*(An/144)*Qsd)	I	%	99.57	99.46	99.72	99.59
Concentration: Total Chrome (Ccr) = Wcr/Vm(std)	Ccr	ug/scf	1.8056	2.0211	2.2471	2.0246
Hexavalent Chrome (Ccr6) = Wcr/Vm(std)	Ccr6	ug/scf	1.5777	1.7717	1.9771	1.7755
Mass Flow Rate:(using outlet flowrate) OK! by APCD Total Chrome (Mcr) = (Ccr*Qsd*120*6*50)/4.54e8	Mcr	lb/yr	1.47	1.64	1.83	1.65
Hexavalent Chrome (Mcr6) = (Ccr6*Qsd*120*6*50)/4.54e8	Mcr6	lb/yr	1.28	1.44	1.61	1.44
Hexavalent Chrome (mg/amphr) = (Ccr6*Qsd*60)/(1000*Amp)		mg/amphr	2.56E+00	2.87E+00	3.11E+00	2.85E+00

Outlet data

CARB METHOD 425: CHROMIUM AND HEXAVALENT CHROMIUM EMISSIONS

F ral Dynamics
San Diego, CA
E: Tank 8 Scrubber Outlet
BER: 7254-Cr-Outlet

TEST DATE: 2/16,17/93
SAMPLED BY: DC/SE
CHECKED BY: DEE

	SYMBOL	UNITS	DATA Run 1	Run 2	Run 3	Avg
Round Stack, Diameter	ds	inches	38.00	38.00	38.00	
Rectangular Stack, Length	L	inches				
Width	W	inches				
Nozzle Diameter	dn	inches	0.300	0.300	0.300	
Average Stack Temperature	Fs	deg F	58.1	57.1	72.1	
Average Meter Temperature	Fm	deg F	75.4	66.8	75.9	
Barometric Pressure	Pbar	in. Hg	30.04	30.04	30.2	
Stack Static Pressure	Pg	in. H2O	-0.16	-0.16	-0.16	
Avg Delta H	dH	in. H2O	1.387	1.356	1.314	
Avg Velocity Head	dP	in. H2O	0.152	0.151	0.1450	
Avg sqrt(dP) = sum(sqrt(dP))/N	sqrt(dP)	in. H2O	0.3870	0.385	0.378	
Pitot Coefficient	Cp	none	0.84	0.84	0.84	
Gas Sample Volume	Vm	cuft	101.884	99.348	98.817	
Meter Calibration Factor	Y	none	0.9975	0.9975	0.9975	
Total Sampling Time	min	minutes	160	160	160	
Stack Gas Oxygen Content	O2	%	20.9	20.9	20.9	
Stack Gas Carbon Dioxide Content	CO2	%	0.0	0	0	
Total Impinger Gain (Water & Particulate)	Ww	grams	33.6	32.7	31.6	
Total Chrome (filter + imp. catch + rinses)	Wcr	ug	14.9 ✓	16.5 ✓	20.3 ✓	
Total Hexavalent Chrome (filter + imp. catch + rinses) Cr VI	Wcr6	ug	6.6 ✓	<0.1	9.8 ✓	
Average amp reading during testing	Amp	na	379	380	391	
Nozzle Area, An = 3.14*(dn/2)^2	An	sq. in.	0.0707	0.0707	0.0707	0.0707
Stack Area, As = [3.14*(ds/2)^2]/144 (round)	As	sq. ft.	7.876	7.876	7.876	7.8758
= L*W/144 (Rectangular)						
Avg Stack Temperature, Ts = Fs + 460	Ts	deg R	518.1	517.1	532.1	522.433333
Avg Meter Temperature, Tm = Fm + 460	Tm	deg R	535.4	526.8	535.9	532.7
Gas Sample Volume at Standard Conditions,	Vm(std)	cu.ft.	100.968	100.054	98.339	99.787
Vm(std) = 17.647*Y*(Vm/Tm)*(Pbar+dH/13.6)		cu.m.	2.859	2.833	2.785	2.826
Water Collected, Wlc = Ww-[Wsol)/1000]	Wlc	grams	33.593	32.700	31.590	32.628
Volume of Water Vapor, Vw(std) = 0.04647*Wlc	Vw(std)	cu.ft.	1.561	1.520	1.468	1.516
Moisture Fraction, Bws = Vw(std)/(Vm(std)+Vw(std))	Bws	none	0.0152	0.0150	0.0147	0.0150
Dry Stack Gas Molecular Weight, Md = (0.32*O2)+	Md	g/g-mole	28.836	28.836	28.836	28.836
(0.44*CO2)+(0.28*(100-O2+CO2))						
Wet Stack Gas Molecular Weight,	Mw	g/g-mole	28.671	28.674	28.677	28.674
Mw = Md*(1-Bws) + 18.0*(Bws)						
Absolute Stack Pressure, Ps = Pbar + Pg/13.6	Ps	in. Hg	30.028	30.028	30.188	30.082
Stack Gas Velocity	vs	ft/sec	21.559	21.426	21.281	21.422
vs = 85.49*Cp*sqrt(dP)*[sqrt(Ts/(Ps*Mw))]	vsm	m/sec	6.571	6.531	6.487	6.529
vsm = 0.3048 * vs						
Actual Stack Gas Flow Rate, Q = 60*vs*As	Q	acf/min	10,188	10,125	10,057	10122.9
Dry Stack Gas Flow Rate (Dry, STP),	Qsd	dscf/min	10,261	10,220	9,920	10133.9
Qsd = 17.647*Q*(1-Bws)*(Ps/Ts)	Qsdm	dscm/min	290.52	289.36	280.87	286.917
Qsdm = Qsd/35.32						
Isokinetic Rate, I =	I	%	98.67	98.17	99.40	98.75
100*As*Vm(std)/(min*(An/144)*Qsd)						
Concentration:	Ccr	ug/scf	0.1476	0.1645	0.2064	0.1728
Total Chrome (Ccr) = Wcr/Vm(std)	Ccr6	ug/scf	0.0655	0.0050	0.0997	0.0567
Hexavalent Chrome (Ccr6) = Wcr/Vm(std)						
Mass Flow Rate:	Mcr	lb/yr	0.12	0.13	0.16	0.14
Total Chrome (Mcr) = (Ccr*Qsd*120*6*50)/4.54e8						
	Mcr6	lb/yr	0.0533	0.0040	0.0784	0.0452
Hexavalent Chrome (Mcr6) = (Ccr6*Qsd*120*6*50)/4.54e8		mg/amphr	1.06E-01	8.06E-03	1.52E-01	8.87E-02
Hexavalent Chrome (mg/amphr) = (Ccr6*Qsd*60)/(1000*Amp)						

		1	2	3
Cr VI	MER µg/hr	40.33	3.066	60.161

(2.204 x 10^-1)

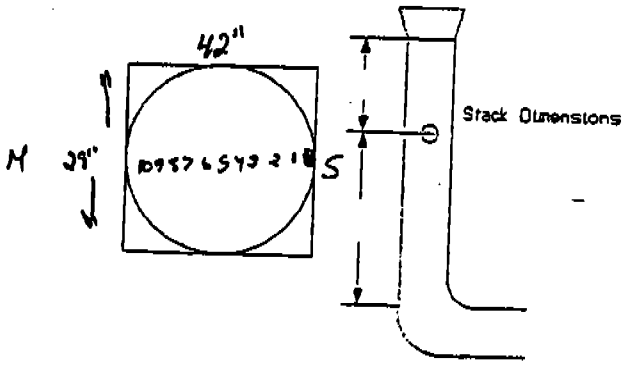
Preliminary
Inlet data

Pr

TRACER TECHNOLOGIES
PRELIMINARY TRAVERSE

SOURCE: General Dynamics
DATE: 02/15/93
LOCATION: Tank #8 Scrubber Inlet
STACK ID: Inlet
PITOT #/Cp: 0.84
BAROMETRIC PRESSURE: ~~30.40~~ 29.99
STATIC PRESSURE: -2.2
TESTED BY: ASH/SE.
TIME START: ____ END: ____

1	2.1"
2	6.3
3	10.5
4	14.7
5	18.9
6	23.1
7	27.3
8	31.5
9	35.7
10	39.9"



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD IN. H20	STACK TEMP DEG F	SWIRL ANGLE DEG
1	0.23	65	
2	0.20		
3	0.13		
4	0.12		
5	0.11		
6	0.12		
7	0.14		
8	0.17		
9	0.25		
10	0.12		
$\sqrt{\Delta P}$ =	0.3945		
AVG:	0.159	65	

TRAVERSE POINT NUMBER	VELOCITY HEAD IN. H20	STACK TEMP DEG F	SWIRL ANGLE DEG
AVG:			

TRACER TECHNOLOGIES
METHOD 5 PRELIMINARY CALCULATIONS

Source: General Dynamics/Lindburg Field
Date: 02/15/93
Pitot ID:
Tester: AJH
Test #: 7254-Cr

Location: San Diego, CA
Stack ID: Tank 8, Scrubber Inlet
Meter Box ID: 124

	dP	Temp	Yaw Angle	
1	0.23	65	0	0.4796
2	0.20	65	0	0.4472
3	0.13	65	0	0.3606
4	0.12	65	0	0.3464
5	0.11	65	0	0.3317
6	0.12	65	0	0.3464
7	0.14	65	0	0.3742
8	0.17	65	0	0.4123
9	0.25	65	0	0.5000
10	0.12	65	0	0.3464
	0.1590	65.0	0.0	0.3945

TRACER TECHNOLOGIES
METHOD 5 PRELIMINARY CALCULATIONS

Source: General Dynamics
Date: 02/15/93
Pitot ID:
Tester: AJH/SE
Test #:

Location: SO Tank #8
Stack ID: Inlet
Meter Box ID: 124

Initial Calculations

Data Entry:

ts:	65	deg. F.
Square(delta P) avg	0.3945	
delta P avg:	0.159	in. H2O
tm(est):	70	deg. F.
Bws(est):	0.02	
Md:	28.84	
Pbar:	29.99	in. Hg.
ps(est):	-2.2	in. H2O
Cp (0.84):	0.84	
theta:	~~1.0044~~ 60	minutes
delta H @:	1.9457	
Y:	1.0044	

Calculations:

Ps = Pbar + (ps(est)/13.6)
Ps = 29.99 in Hg + (-2.2 in H2)/13.6) = 29.83

Ms = Md(1-Bws(est.)) + 18 (BWS(est.)
Ms = 28.84 (1- 0.02) + 18(0.02) = 28.62

vs = 85.49*(Cp)*(Square(delta P)avg)*[(ts + 460)/Ps*Ms)] ^ .5
vs = 22.21 ft/sec

Dn(ideal) = 9.5618 * [37.5*(ts + 460)/(vs*theta*Ps*(1-Bws(est))*520)] ^ .5
Dn(ideal) = 0.298

Dn(actual) = 0.3 in
Nozzle ID:

An(actual) = (Dn ^ 2)*pi/(4*144) = 4.91×10^{-4} square ft

K = 846.72 * (Dn) ^ 4 * (delta H@) * (Cp) ^ 2 * (1-Bws(est)) ^ 2 * Md/Ms * (tm+460)/(ts+460) * Ps/Pm
K = 9.1716

for isokinetic sampling: delta H = delta P * K

TRACER TECHNOLOGIES
METHOD 5 PRELIMINARY CALCULATIONS

Source: General Dynamics/Lindburg Field
Date: 02/15/93
Pitot ID:
Tester: AJH
Test #: 7254-Cr

Location: San Diego, CA
Stack ID: Tank 8, Scrubber Inlet
Meter Box ID: 124

Initial Calculations

Data Entry:

ts:	65.0	deg. F.
Square(delta P) avg:	0.3945	
delta P avg:	0.1590	in. H2O
tm(est):	70	deg. F.
Bws(est):	0.02	
Md:	28.84	
Pbar:	29.99	in. Hg.
ps(est):	-2.2	in. H2O
Cp (0.84):	0.84	
theta:	60	minutes
delta H @:	1.9457	
Y:	1.0044	
Yaw Angle:	0.0	degrees

Calculations:

Ps = Pbar + (ps(est)/13.6)
Ps = 29.83

Ms = Md(1-Bws(est.)) + 18 (BWS(est.)
Ms = 28.62

vs = 85.49*(Cp)*(Square(delta P)avg)*[(ts + 460)/Ps*Ms)] ^ .5
vs = 22.21

Dn(ideal) = 9.5618 * [37.5*(ts + 460)/(vs*theta*Ps*(1-Bws(est))*520)] ^ .5
dn(ideal) 0.298

Dn(act.) = 0.3
Nozzle ID:

An(actual) = (Dn ^ 2*pi)/(4*144) = 4.91E-04

K = 846.72 * (Dn) ^ 4 * (delta H@) * (Cp) ^ 2 * (1-Bws(est)) ^ 2 * Md/Ms * (tm+460)/(ts+460) * Ps/P
K = 9.1716

for isokinetic sampling: delta H = delta P * K

TRACER TECHNOLOGIES
SAMPLE TIME AND VOLUME CHECK

GAS METER VOLUME, Vmstd	110
TEMPERATURE OF STACK, Ts	65
VELOCITY OF STACK, Vs	22.21
NOZZLE SIZE, An	~~290~~ 0.300
STACK PRESSURE, Ps	29.87
STACK MOISTURE CONTENT, Bws	0.02
STANDARD TEMPERATURE, Tstd	60 68/70
SAMPLING TIME, Theta*	_____

*Theta = (91.4288*Vmstd*(Ts+460))/(Vs*An2*Ps*(1-Bws)*(Tstd)

LENGTH OF TIME PER SAMPLE POINT TO THE NEAREST HALF MINUTE:

Theta/# OF POINTS = _____

LENGTH OF TEST, # OF POINTS * TIME/PT _____

SAMPLE VOLUME FOR ACTUAL NOZZLE AND SAMPLE TIME:

Vmstd = (60*Vs*Theta*Pi*An2*Ps*(1-Bws)*Tstd)/(Ts*Pstd*4*144)

Vmstd = _____

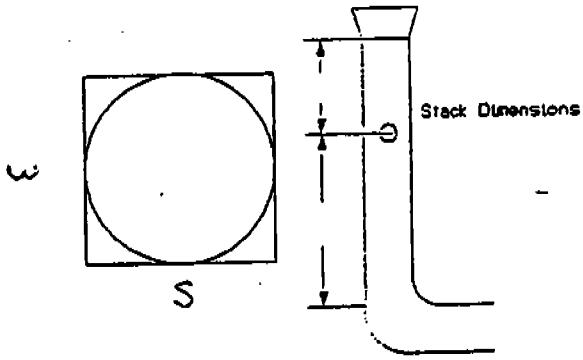
SAMPLE RATE:

SR = Vmstd/Theta, = _____

Preliminary Outlet Data

TRACER TECHNOLOGIES
PRELIMINARY TRAVERSE

SOURCE: General Dynamics
DATE: 16 Feb 93
LOCATION: Outlet
STACK ID:
PITOT #/Cp: /0.84
BAROMETRIC PRESSURE: 30.04
STATIC PRESSURE: -0.16 = 30.05
TESTED BY: D. Crow
TIME START: 0530 END: 0700



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD IN. H20	STACK TEMP DEG F	SWIRL ANGLE DEG	
W1	0.16	56°		0.80
2	0.19			2.55
3	0.22			4.48
4	0.23			6.73
5	0.22			9.50
6	0.20			13.53
7	0.17			24.47
8	0.15			28.50
9	0.15			31.27
10	0.13			33.52
11	0.10			35.45
12	0.09			37.20
	$\sqrt{\Delta p}$ =	0.3207		
	Δp =	0.1558		
AVG:				

TRAVERSE POINT NUMBER	VELOCITY HEAD IN. H20	STACK TEMP DEG F	SWIRL ANGLE DEG
N1	0.13		
2	0.14		
3	0.15		
4	0.15		
5	0.15		
6	0.16		
7	0.17		
8	0.17		
9	0.15		
10	0.14		
11	0.12		
12	0.10		
AVG:			

ΔH = ~1.88
M_d = 28.94
T_s = 68 = 528
V_s = 1.0
t_m = 70

B_{ws} = 0.02

M_s = 28.62
V_s = 22.06
d_n = 0.299

ΔH = 1.9346
Y = 0.9975
#939351

1.37

TRACER TECHNOLOGIES
METHOD 5 PRELIMINARY CALCULATIONS

Source: General Dynamics/Lindburg Field
Date: 02/16/93
Pitot ID:
Tester: DC/SE
Test #: 7254-Cr

Location: San Diego, CA
Stack ID: Tank 8, Scrubber Outlet
Meter Box ID: 839851

	dP	Temp	Yaw Angle	
1	0.16	56	0	0.4000
2	0.19	56	0	0.4359
3	0.22	56	0	0.4690
4	0.23	56	0	0.4796
5	0.22	56	0	0.4690
6	0.20	56	0	0.4472
7	0.17	56	0	0.4123
8	0.15	56	0	0.3873
9	0.15	56	0	0.3873
10	0.13	56	0	0.3606
11	0.1	56	0	0.3162
12	0.09	56	0	0.3000
13	0.13	56	0	0.3606
14	0.14	56	0	0.3742
15	0.15	56	0	0.3873
16	0.15	56	0	0.3873
17	0.15	56	0	0.3873
18	0.16	56	0	0.4000
19	0.17	56	0	0.4123
20	0.17	56	0	0.4123
21	0.15	56	0	0.3873
22	0.14	56	0	0.3742
23	0.12	56	0	0.3464
24	0.1	56	0	0.3162
	0.1558	56.0	0.0	0.3921

TRACER TECHNOLOGIES
METHOD 5 PRELIMINARY CALCULATIONS

Source: General Dynamics/Lindburg Field
Date: 02/16/93
Pitot ID:
Tester: DC/SE
Test #: 7254-Cr

Location: San Diego, CA
Stack ID: Tank 8, Scrubber Outlet
Meter Box ID: 839851

Initial Calculations

Data Entry:

ts:	56.0	deg. F.
Square(delta P) avg:	0.3921	
delta P avg:	0.1558	in. H2O
tm(est):	70	deg. F.
Bws(est):	0.02	
Md:	28.84	
Pbar:	30.04	in. Hg.
ps(est):	-0.16	in. H2O
Cp (0.84):	0.84	
theta:	60	minutes
delta H @:	1.9346	
Y:	0.9975	
Yaw Angle:	0.0	degrees

Calculations:

Ps = Pbar + (ps(est)/13.6)
Ps = 30.03

Ms = Md(1-Bws(est.)) + 18 (BWS(est.)
Ms = 28.62

vs = 85.49*(Cp)*(Square(delta P)avg)*[(ts + 460)/Ps*Ms)] ^ .5
vs = 21.82

Dn(ideal) = 9.5618 * [37.5*(ts + 460)/(vs*theta*Ps*(1-Bws(est))*520)] ^ .5
dn(ideal) 0.297

Dn(act.) = 0.3
Nozzle ID:

An(actual) = (Dn ^ 2*pi)/(4*144) = 4.91E-04

K = 846.72 * (Dn) ^ 4 * (delta H@) * (Cp) ^ 2 * (1-Bws(est)) ^ 2 * Md/Ms * (tm+460)/(ts+460) * Ps/P
K = 9.025

for isokinetic sampling: delta H = delta P * K

Inlet
test #1

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: Inlet #1 Date: 2/16/93

Sampling Location: Jet Dynamics Tank #8 Sample Train: 124

Pre-Test Leak Check:
Filter: 0.007 cfm @ 12 "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check K)

Post-Test Leak Check:
Filter: _____ cfm @ _____ "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check _____)

Time Min	Sample Point #	Gas Meter Reading (ft³)	Stack Velocity (fpm)	Stack Temp °F	Orifice Calculated (in H2O)	Orifice Set (in H2O)	Probe Temp °F	Hot Box Temp °F	Oven Temp °F	Impinger Temp °F In	Impinger Temp °F Out	Vacuum "Hg
		457			3.08							
0.0	1	755.447	0.35	66	3.24	3.17			46	65	65	15
4.0		759.55	0.35	66		3.17			47	67	65	15
8.0		762.76	0.36	65	3.24	3.26			52	69	65	16
12.0		766.600	0.36	65		3.26			57	71	66	17
16.0		770.510										
20.0	2		0.29	65	2.62	2.62			57	73	66	15
24.0		773.81	0.29	65	2.65	2.65			58	73	66	15
28.0		777.29	0.29	65	2.65	2.65			58	74	67	15
32.0		780.74	0.285	65	2.61	2.61			55	75	67	15
36.0		784.25	0.285	65		2.61			56	77	69	14.5
40.0	3	787.66	0.260	66	2.38	2.38			54	76	68	12.0
44.0		790.950	0.26	66	2.38	2.38			54	76	68	12.0
48.0		794.46	0.26	65	2.38	2.38			52	75	69	13
52.0		797.58	0.26	66		2.38			52	75	69	13
56.0	4		0.23	65	2.10	2.10			53	76	69	11.5
60.0		800.00	0.22	65	2.02	2.02			53	76	67	11.0
64.0		803.01	0.22	65	2.02	2.02			53	77	70	11
68.0		806.81	0.22	65	2.03	2.03			53	78	70	11
72.0		809.89	0.22	65					53	78	71	11
76.0	5		0.15	65	1.39	1.39			53	78	71	8.5
80.0		812.55	0.14	65	1.39	1.39			53	78	71	8
84.0		815.00	0.15	65	1.38	1.38			52	80	71	8
88.0		817.52	0.15	65	1.38	1.38			52	79	71	8
92.0		820.80										

1235 (16) (32) 1220 Raw load on for 2min. 36 (48) (64) (80) (60) 72 MIN

See Pg 2

Nozzle #: NOZ 300 0.300 0.300 0.301 ok

Nozzle Diameter: 0.300

Barometric Pressure: 30.04 "HgA

Static Pressure in Stack: _____ "HgA (+/- -2.2 "H20)

Recorded by: AJH

Pitot Factor: 0.84

K = 9.1716

Calibration Data
Inclined Manometer: 124 (Cal: NA)
Pitot Tube No.: _____ (Cal: _____)
Potentiometer No.: _____ (Cal: _____)
Thermocouple No.: _____ (Cal: _____)
Gas Meter No.: 124 (Cal: _____)
Meter Corr. Factor: 1.0044

	Final	Initial	Net
Impinger #1	655.5	603.5	
Impinger #2	491.9	538.7	
Impinger #3	629.4	610.3	
Impinger #4	—	—	
Total Wt Gain:			29.3

Type Sampling Probe: 5' Glass

Pg 2/2

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: 1 Date: 2/16/97

Sampling Location: Inlet - Tank #8 Sample Train: 124

Pre-Test Leak Check:
Filter: _____ cfm @ _____ "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

Post-Test Leak Check:
Filter: _____ cfm @ _____ "Hg vac 9" 0.016" 17" 0.033"
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

Time On	Sample Point #	Gas Meter Reading (gal)	Stack Velocity Head (mbar)	Stack Temp F	dH Calibrated cfm	dH Set cfm	Probe Temp F	Hot Box Temp F	Oven Temp F	Meter Temp F In	Meter Temp F Out	Vacuum "Hg
3rd probe with level 1424	6		0.11	65	1.01	1.01			56	74	72	
4		822.27	0.11	64	1.01	1.01			48	74	71	7
8		824.61	0.11	65	1.01	1.01			44	72	70	7
12		826.89	0.11	64	1.01	1.01			51	73	70	7
16		829.160	0.11	66	1.01	1.01			51	77	73	7
7	7		0.11	66	1.01	1.01			51	77	73	7
20		831.43	0.11	64	1.01	1.01			51	75	71	7
24		833.68	0.11	65	1.01	1.01			50	76	70	7
28		835.94	0.11	64	1.01	1.01			50	76	71	7
32		838.17	0.11	64	1.01	1.01			51	76	71	7
8	8		0.17	63	1.57	1.57			50	76	71	8
36		840.59	0.17	62	1.57	1.57			50	77	71	8
40		843.306	0.18	63	1.66	1.66			52	77	71	9
44		846.00	0.175	62	1.62	1.62			48	78	71	9
48	9		0.175	62	1.62	1.62			49	76	71	9
9		849.30	0.2	62	2.03	2.03			49	76	71	9
52		851.95	0.18	67	2.03	2.03	1.85		50	77	71	9
56		854.92	0.15	62	1.29	1.29			50	77	71	9
60		856.90	0.14	67	1.29	1.29			49	77	71	7
64		859.38	0.14	62	1.29	1.29			50	77	71	7
10	10											
68		861.66	0.14	63	1.29	1.29			51	77	72	7
72		864.50	0.14	63	1.29	1.29			49	77	72	7
76		866.81	0.13	63	1.21	1.21			50	78	72	7
80		869.992	0.13	62	1.21	1.21			50	78	72	7
		114.535	0.197	64.2		1.817			51.6	72.5		10.2

1500 scfm

Static Pressure effects

velocity to 9 ft/sec because of static

Average dH from 1539

Nozzle #: _____ ΣΔP 0.435 Recorded by: _____

Nozzle Diameter: _____"

Pitot Factor: _____

Barometric Pressure: _____ "HgA

Static Pressure in Stack: _____ "HgA (+/- _____ "H20)

Calibration Data		
Inclined Manometer: _____	(Cal: NA)	
Pitot Tube No.: _____	(Cal: _____)	
Potentiometer No.: _____	(Cal: _____)	
Thermocouple No.: _____	(Cal: _____)	
Gas Meter No.: _____	(Cal: _____)	
Meter Corr. Factor: _____		

	Final	Initial	Net
Impinger #1			
Impinger #2			
Impinger #3			
Impinger #4			
Total Wt Gain:			

Type Sampling Probe: _____

40 CFR 428-1 SEC 2.7.3

LEAK CORRECTION $V_{m_{corr}} = V_m - (L - L_a)\theta$

$= 114535 - (.033 - .02)72 = 113599$

Inlet
Test #2

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: Inlet #2 Date: 2/16/93

Sampling Location: Second Agronomic Scrubber Inlet Sample Train: 124

Pre-Test Leak Check:
Filter: 0.015 cfm @ 10" "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

Post-Test Leak Check
Filter: _____ cfm @ _____ "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

Time Min	Sample Point #	Gas Meter Reading (cf)	Stack Velocity Head (mm)	Stack Temp F	dH Calculated dH	dH Set dH	Probe Temp F	Hot Box Temp F	Dryer Temp F	Meter Temp F In	Meter Temp F Out	Vacuum "Hg
Start 1811 Weight 0	0	870.986	0.31	64	2.82	2.82	omitted		61	65	65	
1	4	874.48	0.31	62	2.82	2.82			41	69	66	20
2	8	878.00	0.31	63	2.82	2.82			45	71	66	20
3	12	881.58	0.32	62	2.91	2.80			50	73	67	20
4	16	885.90										
5			0.29	62	2.64	2.64			53	73	67	18
6	20	889.55	0.29	62	2.64	2.64			53	73	68	18
7	24	892.06	0.29	62	2.64	2.64			53	73	68	18
8	28	895.50	0.285	62	2.63	2.63			53	74	68	18
9	32	899.00	0.285	62	2.63	2.63			53	74	68	18
			0.27	62	2.49	2.49			53	74	68	18
	3											
Stop 1851 10	36	902.38	0.27	62	2.49	2.49			53	74	68	17
10	40	905.70	0.27	63	2.49	2.49			54	75	68	17
11	44	909.15	0.27	63	2.49	2.49			54	75	68	16
12	48	913.50	0.27	63	2.49	2.49			50	73	68	16
			0.24	63	2.22	2.22			52	73	68	14
	4											
13	52	915.70	0.24	63	2.22	2.22			52	75	69	14
14	56	919.10	0.22	63	2.03	2.03			52	75	69	13
15	60	922.01	0.22	64	2.03	2.03			54	76	69	13
	64	925.10										
16			0.19	64	1.75	1.75			54	76	69	11
	5											
17	68	927.88	0.19	64	1.75	1.75			54	76	69	11
18	72	930.64	0.18	64	1.66	1.66			55	78	70	10
19	76	933.28	0.17	64	1.57	1.57			54	77	70	10
20	80	935.97	0.17	64	1.57	1.57			54	77	70	10
				See	PJ	2						

Nozzle #: M7-300
Nozzle Diameter: 0.300"
Barometric Pressure: 30.04 "HgA
Static Pressure in Stack: _____ "HgA (+/- -2.2 "H20)

Recorded by: _____
Pitot Factor: _____

Calibration Data

Inclined Manometer: 124 (Cal: NA)
Pitot Tube No.: _____ (Cal: _____)
Potentiometer No.: _____ (Cal: _____)
Thermocouple No.: _____ (Cal: _____)
Gas Meter No.: 124 (Cal: _____)
Meter Corr. Factor: 1.0044

	Final	Initial	Net
Impinger #1	654.2	589.2	____
Impinger #2	522.2	580.4	____
Impinger #3	661.6	647.4	____
Impinger #4	—	—	____

Total Wt Gain: 25.0

Type Sampling Probe: 5' glass

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: Inlet #2 Date: 2/16/93

Sampling Location: General Dynamics Incinerator #8 Sample Train: 124

Pre-Test Leak Check:
Filter: _____ cfm @ _____ "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

Post-Test Leak Check:
Filter: _____ cfm @ _____ "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

0.010 @ 17"
0.020 @ 22"

Time (min)	Sample Point #	Gas Meter Reading (cf)	Stack Velocity Head (in H2O)	Stack Temp (F)	Orifice Deg. (in)	Orifice Set (in)	Probe Temp (F)	Hot Box Temp (F)	Oven Temp (F)	Moisture Temp (F) In	Moisture Temp (F) Out	Vacuum (in Hg)
0	6		0.11	63	1.01	1.01			60	69	69	7.5
4		938.25	0.11	63	1.01	1.01			60	70	69	8.0
8		940.62	0.11	62	1.01	1.01			47	71	69	8.0
12		942.90	0.11	62	1.01	1.01			50	72	69	7.0
16		945.10	0.11	62	1.01	1.01			50	73	68	7.0
	7		0.11	62	1.01	1.01			50	73	68	7.0
20		947.10	0.11	61	1.01	1.01			50	74	68	7.0
24		947.72	0.11	61	1.01	1.01			50	74	69	7.5
28		951.98	0.11	61	1.01	1.01			51	75	69	7.5
32		954.25	0.11	61	1.01	1.01			51	75	69	7.5
	8		0.24	60	1.94	1.94	222	222	52	75	69	13
36		957.04	0.24	60	2.22	2.22			52	75	69	13
40		960.083	0.24	60	2.22	2.22			52	76	69	12
4		963.21	0.24	61	2.22	2.22			51	77	69	12
8		966.32	0.24	61	2.22	2.22			48	74	70	13
	9		0.15	61	1.39	1.39			48	74	70	13
12		969.10	0.15	62	1.39	1.39			50	75	70	9.0
16		971.58	0.15	62	1.39	1.39			51	75	70	9.0
20		974.10	0.16	62	1.48	1.48			51	75	70	9.0
24		976.60	0.16	62	1.48	1.48			51	75	70	9.0
	10		0.15	62	1.39	1.39			51	75	70	9.0
28		979.10	0.15	62	1.39	1.39			51	76	70	9.0
32		981.55	0.15	62	1.39	1.39			51	76	70	9.0
36		984.00	0.15	62	1.39	1.39			51	76	70	9.0
40		986.539	0.15	62	1.39	1.39			51	76	70	9.0
		115.548	0.203	622		1.828			51.1	71.5		12.2

2045
2048

velocity of 19

Nozzle #: N07.000 √ΔP 0.443
Nozzle Diameter: 0.300
Barometric Pressure: 30.04 "HgA
Static Pressure in Stack: -.2 "HgA (+/- _____ "H20)

Recorded by: AJF
Pitot Factor: 0.84

Calibration Data
Inclined Manometer: 124 (Cal: NA)
Pitot Tube No.: _____ (Cal: _____)
Potentiometer No.: _____ (Cal: _____)
Thermocouple No.: _____ (Cal: _____)
Gas Meter No.: 124 (Cal: _____)
Meter Corr. Factor: 1.0044

	Final	Initial	Net
Impinger #1			
Impinger #2			
Impinger #3			
Impinger #4			
Total Wt Gain:			

Type Sampling Probe: 5' glass

Inlet
test 3

1 of 2

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: Inlet #3
Sampling Location: General Dynamics Tech #4
Date: 2/17/93
Sample Train: 124

Pre-Test Leak Check
Filter: 0.017 cfm @ 10 11 "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: —)

Post-Test Leak Check
Filter: _____ cfm @ _____ "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

0836 start

	Time On	Sample Point #	Gas Meter Reading (ft³)	Stack Velocity Head (" H2O)	Stack Temp (°F)	CO2 Condensate (%)	CO2 Dry (%)	Probe Temp (°F)	Hot Box Temp (°F)	Dryer Temp (°F)	Meter Temp (°F) In	Meter Temp (°F) Out	Vacuum (" Hg)
		1	988.132	0.12	64	1.09		6		64	64	63	4
1	4		989.50	0.12	64	1.09	1.09			50	67	65	4
2	8		992.76	0.12	65	1.09	1.09			46	70	66	4
3	12		995.04	0.12	66	1.09	1.09			47	74	66	4
4	16		997.35	0.12	66	1.09	1.09			51	74	67	4
		2		0.28	66	2.55	2.55			51	74	67	6
5	20		1000.5	0.28	66	2.55	2.55			52	77	68	6
6	24		1003.92	0.28	66	2.55	2.55			53	78	68	6
7	28		1007.33	0.28	66	2.55	2.55			53	78	69	6
8	32		1010.69	0.28	66	2.55	2.55			55	80	70	6
		3		0.26	66	2.37	2.37			56	80	70	6
9	36		1014.30	0.26	66	2.37	2.37			56	81	71	6
10	40		1017.34	0.26	66	2.37	2.37			56	81	71	6
11	44		1020.50	0.26	67	2.37	2.37			54	79	72	6
12	48		1024.00	0.24	67	2.37	2.37			54	79	72	6
		4	0.23	0.24	68	2.12	2.12			54	79	72	5
13	52		1027.50	0.23	68	2.12	2.12			55	80	72	5
14	56		1030.14	0.23	67	2.12	2.12			56	81	72	5
15	60		1032.93	0.23	67	2.12	2.12			56	81	73	5
16	64		1035.29	0.23	67	2.12	2.12			56	82	73	5
		5		0.18	68	1.47	1.47			56	82	73	4
17	68		1038.99	0.16	68	1.47	1.47			56	82	83	4
18	72		1041.51	0.16	68	1.47	1.47			57	81	73	4
19	76		1044.80	0.16	68	1.47	1.47			57	81	73	4
20	80		1046.46	0.16	68	1.47	1.47			57	81	73	4

1000

See Pg 2

Nozzle #: NX2300
Nozzle Diameter: 0.300
Barometric Pressure: 30.20 "HgA
Static Pressure in Stack: -2.2 "HgA (+/- _____ "H20)

Recorded by: ASH
Pitot Factor: 0.84

Calibration Data

Inclined Manometer: 124 (Cal: NA)
Pitot Tube No.: _____ (Cal: _____)
Potentiometer No.: _____ (Cal: _____)
Thermocouple No.: _____ (Cal: _____)
Gas Meter No.: 124 (Cal: 11/93)
Meter Corr. Factor: 1.0044

	Final	Initial	Net
Impinger #1	587.1	585.5	
Impinger #2	561.0	559.5	
Impinger #3	660.9	640.7	
Impinger #4	—	-	

Total Wt Gain: 23.3

Type Sampling Probe: PBS010 5' Glass

3.0 SOURCE TEST PROGRAM DESCRIPTION

3.1 Testing Contractor

The source testing will be performed by Team Environmental Services Inc., Tracer Technologies Division. Team Environmental Services has been approved by the Air Resources Board to conduct compliance source testing on behalf of the Air Resources Board pursuant to Section 91200-91220, Title 17, California Code of Regulations.

3.2 Program Organization

Technical and project management for Team Environmental Services, Inc. source testing group is located at their San Marcos corporate headquarters. Field technician and engineering support is provided at this location.

3.3 Program Objectives

The objective of this test program is to determine the mass emission rate of hexavalent and total chromium from Tank #8's scrubber exhaust with the scrubber on and with the scrubber off. Testing will be performed while the tank is being operated in a normal manner. Each emission test will measure consist of three 1-hour tests. Stack gas flow, moisture, mass of hexavalent chromium and mass of total chromium will be measured. As no combustion process is involved, ambient air will be assumed for gas concentrations.

4.0 SOURCE TESTING PROCEDURES

4.1 Instrumentation and Equipment Description

Nutech stack sampling equipment will be used with glass-lined probes and glass nozzles. TEAM's source testing van will be used as a mobile laboratory to recover samples in the field.

4.2 Test and Analytical Methods

A modified California Air Resource Board Method 425 will be used for this testing. The modifications will be in the type of impinger solution, elimination of a Teflon filter and analytical detection method.

The most recent and sensitive analytical method for hexavalent chromium is an Ion Chromatography (IC) separation followed by UV/Vis detection. This method gives a 0.01 μgm/l detection limit. The impinger solution required to get this detection limit is a millimolar carbonate/bicarbonate solution. Hexavalent chromium has been

proven to be stable in this alkaline solution. As no particulate matter is produced by the process, we are proposing eliminating the use of a Teflon filter. With the elimination of the Teflon filter, we propose connecting the glass probe to the first impinger with a length of Teflon tubing. All material used in the Method 5 sampling train will be glass or Teflon. The wash solution used in the recovery will be the impinger solution.

The samples will be sent under chain-of-custody procedures to West Coast Analytical Services, of Santa Fe Springs, California for analysis. Hexavalent chromium will be analyzed by Ion Chromatography/UV-Vis Spectroscopy. Total chromium will be analyzed by Inductively Coupled Plasma/Mass Spectroscopy (ICP/MS).

We will be collecting approximately 40 dscf of sample for this testing. Using the detection limit of 0.01 μgm/l and an assumed recovered sample of 0.250 lt, this would lead to a lower limit of detection of 0.0025 μgm of hexavalent chromium. This calculates out to 6.25×10^{-5} μgm/dscf of hexavalent chromium. Using an assumed flow rate of 8700 dscfm, this result would calculate out to 32 μgm per hour of hexavalent chromium, or 7.2×10^{-8} lb/hr at the detection limit. This value is four orders of magnitude more sensitive than has been reported previously for this facility.

4.3 Reporting Format

Table 4-1 shows an example of how the data will be reported.

TABLE 4-1 CHROMIUM DATA SUMMARY TABLE

PARAMETER	TEST #1	TEST #2	TEST #3	AVG
Total Cr (μg)[1]				
Total Cr^{+6} (μg)[1]				
Volume Sampled, (dscf)				
Mass Flow (dscfm)				
μg/dscf Cr				
μg/dscf Cr^{+6}				
μg/hr Cr				
μg/hr Cr^{+6}				
lb/hr Cr				
lb/hr Cr^{+6}				

[1] Blank corrected values.

The field dry gas meter and flow orifice is calibrated against a wet test meter on an annual and bimonthly basis. The field dry gas meter and flow orifice is also field post-checked on every test.

5.4 Data Validation

The compliance test specify quality assurance procedures to be followed. Team Environmental Services follows these procedures for particulate and gaseous analysis. Pretest and post-test leak checks are performed on the source train, pitot tube lines and gas sampling lines. All materials that come in contact with a sample are suitable for temperature and purposes of the testing. The sample train components are configured properly to avoid sample interference. Preliminary sample and velocity traverses are performed to insure proper sampling conditions and absence of cyclonic flow. The set-up calculations are configured to meet method requirements for minimum sample time and volume requirements.

Current CARB certifications are maintained for the test procedures performed. Finally, audited spreadsheets are used to calculated emission testing results. Check spreadsheets are prepared and filled out to double-check field results.

5.5 Participation in EPA, CARB or APCD Audits

Team Environmental Services, Inc. is a contract source tester for the South Coast Air Quality Management District and participates in their contract source testing audit program. In addition to this, we are a participant in EPA's performance audit program.

5.6 Internal Audits and Corrective Action

Team Environmental Services assigns its own unique job number to each test using a numerical system. A job jacket is created for each job number and all raw data along with a copy of the report is stored in this job jacket. This job jacket is kept in a secured area and stored for a minimum of 5 years.

All analytical work and reports are reviewed by the quality assurance officer prior to issuance of report.

5.7 Documentation

All Team Environmental Services source testing reports contain appendices that contain all quality assurance, laboratory and field data information. Appendix A contains typical field data, quality assurance check forms and calculated data forms.

TRACER TECHNOLOGIES
PRELIMINARY TRAVERSE

SOURCE: _____

DATE: _____

LOCATION: _____

STACK ID: _____

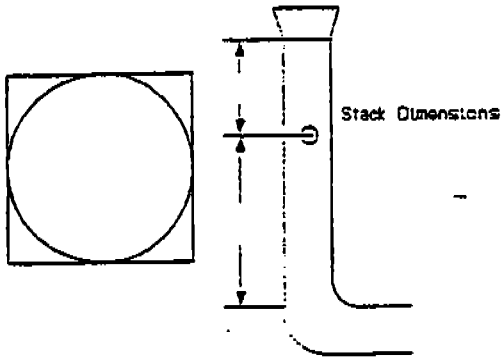
PITOT #/Cp: _____

BAROMETRIC PRESSURE: _____

STATIC PRESSURE: _____

TESTED BY: _____

TIME START: _____ END: _____



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD IN. H20	STACK TEMP DEG F	SWIRL ANGLE DEG
AVG:			

TRAVERSE POINT NUMBER	VELOCITY HEAD IN. H20	STACK TEMP DEG F	SWIRL ANGLE DEG
AVG:			

TRACER TECHNOLOGIES
METHOD 5 PRELIMINARY CALCULATIONS

Source: _____
Date: _____
Pitot ID: _____
Tester: _____
Test #: _____

Location: _____
Stack ID: _____
Meter Box ID: _____

Initial Calculations

Data Entry:

ts: _____ deg. F.
Square(delta P) avg _____
delta P avg: _____ in. H2O
tm(est): _____ deg. F.
Bws(est): _____
Md: _____
Pbar: _____ in. Hg.
ps(est): _____ in. H2O
Cp (0.84): _____
theta: _____ minutes
delta H @: _____
Y: _____

Calculations:

Ps = Pbar + (ps(est)/13.6)
Ps = _____ in Hg + (_____ in H2)/13.6) = _____

Ms = Md(1-Bws(est.)) + 18 (BWS(est.)
Ms = _____ (1-_____) + 18(_____) = _____

vs = 85.49*(Cp)*(Square(delta P)avg)*[(ts + 460)/Ps*Ms)] ^ .5
vs = _____ ft/sec

Dn(ideal) = 9.5618 * [37.5*(ts + 460)/(vs*theta*Ps*(1-Bws(est))*520)] ^ .5
Dn(ideal) = _____

Dn(actual) = _____ in
Nozzle ID: _____

An(actual) = (Dn ^ 2)*pi/(4*144) = _____ square ft

K = 846.72 * (Dn) ^ 4 * (delta H@) * (Cp) ^ 2 * (1-Bws(est)) ^ 2 * Md/Ms * (tm+460)/(ts+460) * Ps/Pm
K = _____

for isokinetic sampling: delta H = delta P * K

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: _____ Date: _____

Sampling Location: _____ Sample Train: _____

Pre-Test Leak Check:

Filter: _____ cfm @ _____ " Hg vac

Probe: _____ cfm @ _____ " Hg vac

(Pitot tube Leak Check: _____)

Post-Test Leak Check:

Filter: _____ cfm @ _____ " Hg vac

Probe: _____ cfm @ _____ " Hg vac

(Pitot tube Leak Check: _____)

Time	Sample Point	Gas meter Reading	Stack		Orifice		Probe Temp	Heat Box Temp	Oven Temp	Meter temp		Vacuum
Dir			Velocity Head (Hvel)	Temp	Calculated	Set				In	Out	

Recorded by: _____

Pitot Factor: _____

Nozzle #: _____

Nozzle Diameter: _____"

Barometric Pressure: _____ "HgA

Static Pressure in Stack: _____ "HgA (+/- _____ "H20)

Calibration Data

Inclined Manometer: _____ (Cal: ___NA___)

Pitot Tube No.: _____ (Cal: _____)

Potentiometer No.: _____ (Cal: _____)

Thermocouple No.: _____ (Cal: _____)

Gas Meter No.: _____ (Cal: _____)

Meter Corr. Factor: _____

	Final	Initial	Net
Impinger #1	____	____	____
Impinger #2	____	____	____
Impinger #3	____	____	____
Impinger #4	____	____	____
Total Wt Gain:			____

Type Sampling Probe: _____

TEAM ENVIRONMENTAL SERVICES INC.
VELOCITY FOR MASS EMISSION CALCULATIONS

Source: APCD Example
Date: 06/03/92
Cp: 0.84
Tester:
Test #:

Location: Anywhere
Stack ID: APCD Exampl
Meter Box ID: 124
Pbar: 29.92
Static: 0.00
Ps: 29.92
Diameter:

%O2:	15.00%
%CO2:	5.00%
%N2:	80.00%
%H2O:	10.00%
Dry MW:	29.40
Wet MW:	28.26

Traverse Point	dP	Stack Temp	dP ^ 0.5	Velocity
1	0.80	83	0.8944	51.47
2	0.70	92	0.8367	48.55
3	0.80	100	0.8944	52.27
4	0.72	103	0.8485	49.72
5	0.55	106	0.7416	43.57
6	0.45	103	0.6708	39.31
7	0.60	104	0.7746	45.43
8	0.75	92	0.8660	50.25
9	0.82	83	0.9055	52.11
10	0.75	78	0.8660	49.61
11	0.57	76	0.7550	43.17
12	0.50	74	0.7071	40.35
13	0.50	74	0.7071	40.35
14	0.50	74	0.7071	40.35
15	0.50	74	0.7071	40.35
16	0.50	74	0.7071	40.35
17	0.50	74	0.7071	40.35
18	0.50	74	0.7071	40.35
19	0.50	74	0.7071	40.35
20	0.50	74	0.7071	40.35
21	0.50	74	0.7071	40.35
22	0.50	74	0.7071	40.35
23	0.50	74	0.7071	40.35
24	0.50	74	0.7071	40.35
25	0.50	74	0.7071	40.35
Avg:	0.5804	82.2	0.7581	
		From avg(dP) ^ 0.5		43.60

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Date:

Test No.:

Sampling Location:

Time On	Gas Meter Reading (dcf)	Stack Velocity Head (H20)	SQRT dP (H20)	Temp F	Set dH	Probe Temp F	Hot Box Temp F	Dryer Temp F	Meter temp F in	Meter temp F out	Vacuum "Hg
	880.725										
1		0.180	0.4243	79	0.26			59	80	79	3.0
2		1.000	1.0000	79	1.47			59	79	78	6.0
3		2.700	1.6432	75	3.96			60	80	79	9.0
4		2.300	1.5166	75	3.38			60	81	79	7.0
5		2.100	1.4491	74	3.08			60	83	79	8.0
6		2.100	1.4491	76	3.08			61	85	79	8.0
7		2.100	1.4491	75	3.08			60	86	80	8.0
8		2.100	1.4491	76	3.08			60	87	79	8.0
9		2.000	1.4142	75	2.94			59	88	80	7.0
10		1.500	1.2247	75	2.20			59	88	80	5.0
11		0.200	0.4472	75	0.29			58	87	81	3.0
12		0.100	0.3162	75	0.15			57	87	81	3.0
13		0.200	0.4472	75	0.29			57	82	80	3.0
14		0.850	0.9220	75	1.24			56	82	80	4.0
15		2.500	1.5811	76	3.67			55	86	81	7.0
16		2.500	1.5811	76	3.67			55	87	81	8.0
17		2.200	1.4832	76	3.23			56	88	81	7.0
18		2.200	1.4832	76	3.23			56	89	82	7.0
19		2.300	1.5166	76	3.38			57	90	82	7.0
20		2.400	1.5492	76	3.52			57	92	83	7.0
21		2.300	1.5166	76	3.38			57	92	83	7.0
22		2.600	1.6125	76	3.82			57	92	83	7.0
23		1.500	1.2247	76	2.20			58	92	84	5.0
24	928.535	0.150	0.3873	76	0.22			57	90	84	2.0
avg		1.6700		75.8	2.451			57.9	83.6		6.1
	47.810	sqr dP=	1.2120								

550.0	530.0	20.0
539.0	537.0	2.0
495.0	494.0	1.0
744.0	740.0	4.0
		27.0 gms

CARB METHOD 425: TOTAL AND HEXAVALENT CHROMIUM

PLANT:
LOCATION:
SAMPLE SITE:
TEST NUMBER:

TEST DATE:
SAMPLED BY: JS,RH,AH
CHECKED BY: DEE

Data Entry	SYMBOL	UNITS	DATA
Test Number	--	--	
Round Stack, Diameter	ds	inches	42.00
Rectangular Stack, Length	L	inches	
Width	W	inches	
Nozzle Diameter	dn	inches	0.190
Average Stack Temperature	Fs	deg F	75.8
Average Meter Temperature	Fm	deg F	83.6
Barometric Pressure	Pbar	in. Hg	29.11
Stack Static Pressure	Pg	in. H2O	-2.8
Avg Delta H	dH	in. H2O	2.451
Avg Velocity Head	dP	in. H2O	1.67
Avg sqrt(dP) = sum(sqrt(dP))/N	sqrt(dP)	in. H2O	1.2120
Pitot Coefficient	Cp	none	0.84
Gas Sample Volume	Vm	cuft	47.810
Meter Calibration Factor	Y	none	1.0044
Total Sampling Time	min	minutes	60
Stack Gas Oxygen Content	O2	%	20.9
Stack Gas Carbon Dioxide Content	CO2	%	0.0
Total Impinger Gain (Water & Particulate)	Ww	grams	27.0
Total Chromium, Cr	Wcr	ug	1.20
Total Hexavalent Chromium	Wcr6	ug	1.30
Total Chromium Blank	Wb	ug	0.48
Total Hexavalent Chromium Blank	W6b	ug	0.21
Net Total Chromium	Wcr-Wb	ug	0.72
Net Hexavalent Chromium	Wcr6-W6b	ug	1.09

CARB METHOD 425: TOTAL AND HEXAVALENT CHROMIUM
CALCULATED DATA

PLANT: TEST DATE:

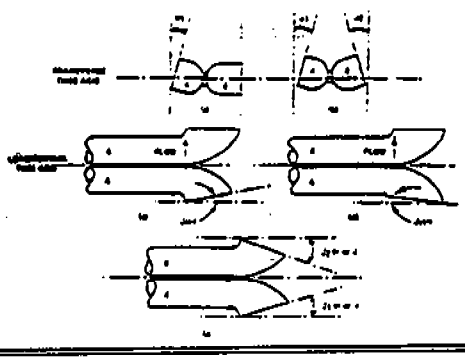
TEST NUMBER:

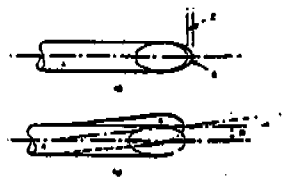
Calculated Data	SYMBOL	UNITS	DATA
Nozzle Area, An = 3.14*(dn/2)^2	An	sq. in.	0.0284
Stack Area, As = 3.14*(ds/2)^2 (round) = L*W/144 (Rectangular)	As	sq. ft.	9.621
Avg Stack Temperature, Ts = Fs + 460	Ts	deg R	535.8
Avg Meter Temperature, Tm = Fm + 460	Tm	deg R	543.6
Gas Sample Volume at Standard Conditions, Vm(std) = 17.380*Y*(Vm/Tm)*(Pbar+dH/13.6)	Vm(std)	cu.ft. cu.m.	44.970 1.273
Water Collected, Wlc = Ww-[Wimp+Wsolv)/1000]	Wlc	grams	26.999
Volume of Water Vapor, Vw(std) = 0.04647*Wlc	Vw(std)	cu.ft.	1.255
Moisture Fraction, Bws = Vw(std)/(Vm(std)+Vw(std))	Bws	none	0.0271
Dry Stack Gas Moleular Weight, Md = (0.32*O2)+ (0.44*CO2)+(0.28*(100-O2+CO2)) Wet Stack Gas Molecular Weight, Mw = Md*(1-Bws) + 18.0*(Bws)	Md Mw	g/g-mole g/g-mole	28.836 28.542
Absolute Stack Pressure, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.904
Stack Gas Velocity vs = 85.49*Cp*sqrt(dP)*[sqrt(Ts/(Ps*Mw))] vsm = 0.3048 * vs	vs vsm	ft/sec m/sec	70.142 21.379
Actual Stack Gas Flow Rate, Q = 60*vs*As	Q	acf/min	40,491
Dry Stack Gas Flow Rate (Dry, STP), Qsd = 17.380*Q*(1-Bws)*(Ps/Ts) Qsdm = Qsd/35.32	Qsd Qsdm	dscf/min dscm/min	36,933 1,045.7
Isokinetic Rate, I = 100*As*Vm(std)/(min*(An/144)*Qsd)	I	%	99.16
Concentration of Total Cr in Gas Stream, Cr/Vm(std) Concentration of Hexavalent Cr in Gas Stream, Cr+6/Vm(std)	Ccr Ccr6	ug/cuft ug/cuft	0.0160 0.0243
Emission Rate of Total Cr, Ccr*Qsd*60 Emission Rate of Hexavalent Cr, Ccr6*Qsd*60	Mcrm Mcr6m	ug/hr ug/hr	35,479 53,776
Mass Flow of Total Cr, Mcrm*10^-6/453.6 Mass Flow of Hexavalent Cr, Mcr6m*10^-6/453.6	Mcr Ws	lb/hr lb/hr	7.822E-05 1.19E-04

TRACER TECHNOLOGIES
DATA SHEET FOR CALIBRATION OF PITOT TUBES

DATE	BY	PITOT TUBE ID	"A" VALUE	"B" VALUE	"Dt" VALUE	α 1	α 2	β 1	β 2	Z	W
7-3-92	BG	PIT 102	0.465	0.465	0.374	0	0	0	0	0.015	0.00
-3-92	BG	PIT 109	0.473	0.473	0.375	0	0	0	0	0.025	0.00
7-3-92	BG	PIT 110	0.470	0.470	0.374	0	0	0	0	0.00	0.00
-3-92	RJH	PIT 106	0.469	0.469	0.371	0	0	0	0	0.047	0.00
-3-92	RJH	PIT 101	0.466	0.466	0.374	0	0	0	0	0.000	0.00
2/1/93	RJH	PIT101	0.466	0.466	0.374	0	0	0	0	0.04	0.00
2/1/93		PIT102	0.463	0.463	0.374	0	0	0	0	0.04	0.00
2/1/93		PIT103	0.471	0.471	0.375	0	0	0	0	0.06	0.00
2/1/93		PIT104	0.476	0.476	0.374	0	0	0	0	0.06	0.00
2/1/93		PIT105	0.469	0.469	0.375	0	0	0	0	0.06	0.00
2/1/93		PIT106	0.469	0.469	0.371	0	0	0	0	0.05	0.00
2/1/93		PIT107	0.466	0.466	0.377	0	0	0	0	0.06	0.00
2/1/93		PIT108	0.468	0.468	0.375	0	0	0	0	0.06	0.00
2/1/93		PIT109	0.474	0.474	0.375	0	0	0	0	0.07	0.00
2/1/93		PIT110	0.471	0.471	0.379	0	0	0	0	0.07	0.00
2/1/93		PIT111	0.467	0.467	0.382	0	0	0	0	0.07	0.00
2/1/93		PIT112	0.470	0.470	0.376	0	0	0	0	0.01	0.00
2/1/93		PIT113	0.311	0.311	0.252	0	0	0	0	0.04	0.00

QA ACCEPTANCE CRITERIA: α1/α2 10 DEG; β1/β2 5 DEG; Z 0.32 cm (1/8 in); AND W 0.08 cm (1/32 in)





SOURCE TEST PROTOCOL

Submitted to:

San Diego Air Pollution Control District
9150 Chesapeake Drive
San Diego, CA 92123-1095

Submitted for:

Mr. Randy Venier

General Dynamics
P.O. Box 85377
Mail Code MZ-88-2520
San Diego, CA 92186-5377

Prepared by:

Team Environmental Services
Tracer Technologies Division
970 Los Vallecitos Blvd #100
San Marcos, CA 92069

CARB Approved Independent Contractor No. G-741
November 20, 1992

EXECUTIVE SUMMARY

Firm Tested:	General Dynamics
Address:	Lindberg Field Facility, Building #1
City:	San Diego, CA 92186-5377
Contact:	Mr. Randy Venier (619) 542-7079
Source:	Chromic Acid Anodizing Tank #8 Scrubber

Proposed Dates: of Testing	Week of December 7th
Test Requested by:	San Diego Air Pollution Control District
Contact:	Mr. George Mazis, SDAPCD
Test Performed by:	Team Environmental Services, Inc.
Test Objectives:	Quantify hexavalent and total chromium emissions from a chromic acid anodizing tank with it's scrubber off-line and on-line for AB 2588 Air Toxics Emissions Inventory.
Test Methods:	Modified CARB Method 425 for total and hexavalent chromium.
Permit Number:	911137

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1.0 INTRODUCTION:

This source test protocol describes the source testing that will be performed for General Dynamics of San Diego, California. Source testing will be performed at the exhaust stack of Chromic Acid Anodizing Tank #8's scrubber to determine total and hexavalent chromium mass emissions with the scrubber on and with the scrubber off. This information will be used for AB 2588 Air Toxics Emission Inventory purposes.

2.0 EMISSION SOURCE INFORMATION

2.1 Facility Description

General Dynamics conducts manufacturing activities at it's Lindberg Field facility. Building #1 has a plating operation which includes Tank #8, a chromic acid anodizing tank with a scrubber.

2.2 Process Information

The chromic acid anodizing process is carried out in a tank containing approximately 14,000 gallons of a chromic acid solution, maintained at a temperature of 90-95°F. The chrome content of the tank is maintained at approximately 5 weight ounces of free chrome per gallon of solution, with approximately 17 weight ounces of total chrome per gallon of solution. The anodizing process is driven by a voltage drop across the parts, whereby a protective aluminum oxide film is deposited. Voltage is ramped up from zero when parts are immersed, and maintained at a plateau of 18-22 volts. Parts are placed in the solution on an irregular basis, depending on production schedules, where they are immersed for approximately 40 minutes. The tank is air agitated. The tank solution is analyzed weekly. Figure 2-1 is a drawing of the tank and associated vent system.

2.3 Emission Source Description

An exhaust plenum runs along the sides of the tank drawing fumes to a scrubber. The scrubber washes the fumes with a solution maintained at a pH of 3.5, a Total Dissolved Solids (TDS) concentration of 2500 μmhos and a Nalco product #7408 (Chlorine Oxygen Scavenger) concentration of 20 ppm. The Nalco product is an aqueous sodium bisulfite solution and reduces any hexavalent chromium to trivalent chromium (see Figure 2-2).

The fumes are drawn into the scrubber by a fan located on the roof. This fan draws air from the tank, through the scrubber and through an exhaust stack. The sampling ports are located on the roof.

2.4 Expected Parameters

The exhaust stack is 30" in diameter (see Figure 2-3). Based on previous test reports we expect the following:

Stack Gas Velocity	~30 ft/sec
Flow Rate	~8,700 dscfm
Temperature	~85 °F
Oxygen	20.95 %
Carbon Dioxide	0.020 %
Moisture Content	~1.0 %

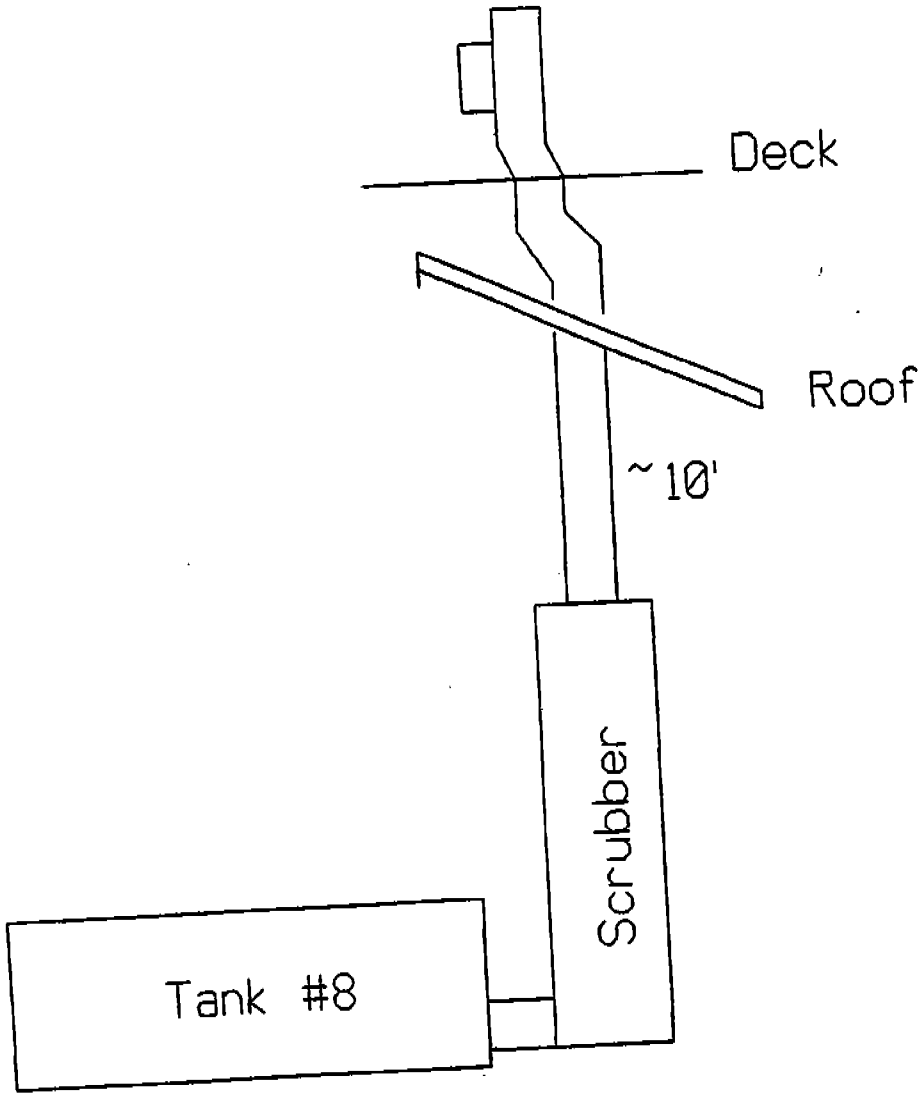

Figure 2-1 Chromic acid anodize tank #8

SUBJECT: REDUCTION OF CHROMATE IN SCRUBBERS

TO REDUCE THE HEXAVALENT CHROME TO TRIVALENT IN YOUR SCRUBBERS WE RECOMMEND THE FOLLOWING FLOW CHART:

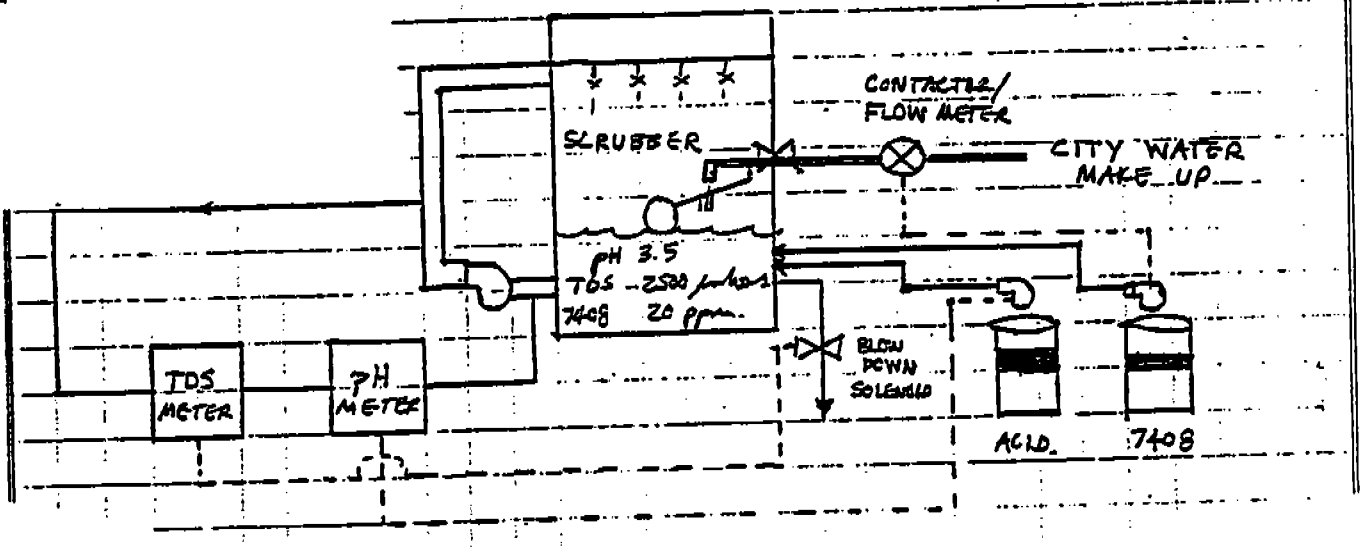

Figure 2-2 Scrubber System for Tank #8

WCAS
WEST COAST ANALYTICAL SERVICE, INC.
ANALYTICAL CHEMISTS

February 24, 1993

TEAM ENVIRONMENTAL SERVICES, INC.
Tracer Technologies Div.
970 Los Vallecitos, Suite 100
San Marcos, CA 92069

Attn: Tony Host

JOB NO. 23358 D

LABORATORY REPORT

Samples Received: Twenty-four (24) Liquids and Seven (7) Filters
Date Received: 2-17-93
Project No: 7254/GD

The samples were analyzed as follows:

Samples Analyzed	Analysis	Results
Twenty-one (21) samples	Total Chromium by CARB 425	Data Sheets
Twenty-three (23) samples	Hexavalent Chromium by CARB 425	Data Sheets

B. Michael Hovanec
Senior Staff Chemist

Michael Shelton
Technical Director

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9840 Alburtis Avenue • Santa Fe Springs, California 90670 • 310/948-2225 • FAX 310/948-5850

WEST COAST ANALYTICAL SERVICE, INC.

TEAM ENVIRONMENTAL SERVICES, INC.
Mr. Tony Host

Job # 23358
February 24, 1993

LABORATORY REPORT

Total Chromium
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry

Sample ID	ppb (ug/L)	Volume (L)	Total Micrograms	
Cr-Inlet 1 A & C	358	0.24	86	
Cr-Inlet 1 B	1000	0.12	120	206 ug
Cr-Inlet 1 D	0.7	0.037	0.026	
Cr-Inlet 2 A & C	490	0.197	97	
Cr-Inlet 2 B	1600	0.086	138	235 ug
Cr-Inlet 2 D	11.3	0.045	0.51	
Cr-Inlet 3 A & C	518	0.195	101	
Cr-Inlet 3 B	1340	0.117	157	258 ug
Cr-Inlet 3 D	15.3	0.037	0.57	
Cr-Outlet 1 A & C1	67.3	0.135	9.1	
Cr-Outlet 1 B	30.4	0.115	3.5	14.9 ug
Cr-Outlet 1 C2	18	0.125	2.3	
Cr-Outlet 1 D	0.9	0.034	0.031	
Cr-Outlet 2 A & C1	121	0.115	14	
Cr-Outlet 2 B	28.1	0.087	2.4	16.7 ug
Cr-Outlet 2 C2	0.6	0.1	0.06	
Cr-Outlet 2 D	2.2	0.04	0.088	
Cr-Outlet 3 A & C1	71.1	0.11	7.8	
Cr-Outlet 3 B	21.1	0.117	2.5	20.3 ug
Cr-Outlet 3 C2	107	0.098	10 - high	
Cr-Outlet 3 D	1.9	0.057	0.11	

Detection Limit 0.6 ug/L

Date Analyzed: 2/22/93

WCAS

WEST COAST ANALYTICAL SERVICE, INC.

TEAM ENVIRONMENTAL SERVICES, INC.
Mr. Tony Host

Job # 23358
February 24, 1993

LABORATORY REPORT

Sample: Cr-Outlet 2C 2
Matrix: Impinger Solution

Parts Per Billion (ug/L)

	Sample	Spike Conc ppb	MS	% Recovery	MSD	% Recovery	RPD %
Chromium	0.6 µg/l	100	90.8	90.2	98.4	97.8	8

Date Analyzed: 2/22/93

Sample: Cr-Inlet 3A & C
Matrix: Impinger Solution

Parts Per Billion (ug/L)

	Sample	Spike Conc ppb	MS	% Recovery	MSD	% Recovery	RPD %
Chromium	518 µg/l	100	627	109%	630		0.5

Date Analyzed: 2/22/93

$\frac{627-518}{100} \times 100$

WCAS

WEST COAST ANALYTICAL SERVICE, INC.

TEAM ENVIRONMENTAL SERVICES, INC.
Mr. Tony Host

Job # 23358
February 24, 1993

LABORATORY REPORT

Hexavalent Chromium by CARB 425

Sample	Parts Per Billion (ug/L)			Volume (Liters)	Total Micrograms	
CR-INLET 1 A & C	370	(366)		0.240	89	Total Cr VI 180µg
CR-INLET 1 B	760	(763)	864)	0.120	91	
CR-INLET 1 D	ND	(ND)		0.037	ND<0.04	
CR-INLET 2 A & C	480	(476)		0.197	95	
CR-INLET 2 B	1290	(1290)	(1128)	0.086	111	206µg
CR-INLET 2 D	8.0	(8)		0.045	0.36	
CR-INLET 3 A & C	510	(514)		0.195	99	
CR-INLET 3 B	1090	(1086)	(1025)	0.117	128	227µg
CR-INLET 3 D	11	(11)		0.037	0.41	
CR-OUTLET 1 A & C1	30	(30)		0.135	4.1	
CR-OUTLET 1 B	5.3	(5.3)		0.115	0.61	6.61µg
CR-OUTLET 1 C2	15	(14.5)		0.125	1.9	
CR-OUTLET 1 D	ND	(ND)		0.034	ND<0.03	
CR-OUTLET 2 A & C1	ND	(ND)		0.115	ND<0.1	
CR-OUTLET 2 B	ND	(0.2)		0.087	ND<0.09	0.3µg ND
CR-OUTLET 2 C2	ND	(ND)		0.100	ND<0.1	
CR-OUTLET 2 D	ND	(ND)		0.040	ND<0.04	
CR-OUTLET 3 A & C1	ND	(ND)		0.110	ND<0.1	
CR-OUTLET 3 B	ND	(0.2)		0.117	ND<0.1	
CR-OUTLET 3 C2	100	(103)		0.098	9.8	9.8µg
CR-OUTLET 3 D	ND	(ND)		0.057	ND<0.06	
AUDIT 1	1030	(1035)		-----	-----	
AUDIT 2	50	(50)		-----	-----	

Detection Limit — 1

Date Analyzed: 2-18-93

* questionable result

See Cr VI Am Ind Hyg Assoc. research paper p61.

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WEST COAST ANALYTICAL SERVICE, INC.

TEAM ENVIRONMENTAL SERVICES, INC.
Mr. Tony Host

Job # 23358
February 24, 1993

LABORATORY REPORT

Matrix Spike/Matrix Spike Duplicate Recovery Summary

Sample:Batch QC
Units :ppb (ug/L)

Analyte	Sample Result	Amount Spiked	MS Result	% Rec MS	MSD Result	% Rec MSD	RPD
Hexavalent Chromium	4.6	10	14.4	98	14.4	98	0

Sample:OUTLET 1 B
Units :ppb (ug/L)

Analyte	Sample Result	Amount Spiked	MS Result	% Rec MS	MSD Result	% Rec MSD	RPD
Hexavalent Chromium	5.3	100	98.5	93	93.2	88	6%

QC Limits

Analyte	RPD Warning	RPD Control	% Recovery Warning		% Recovery Control	
Hexavalent Chromium	9	13	86	108	74	117

result - 53 µg/l

$= \frac{100 \times 84.5}{1261852} =$ 6.6 µg/l (>10%)

MSD should be carried out

WCAS

Abbreviations Summary

General Reporting Abbreviations:

B — Blank - Indicates that the compound was found in both the sample and the blank. The sample value is reported without blank subtraction. If the sample value is less than 10X the blank value times the sample dilution factor, the compound may be present as a laboratory contaminant.

D — Indicates that the sample was diluted, and consequently the surrogates were too dilute to accurately measure.

DL — Detection Limit - Is the minimum value which we believe can be detected in the sample with a high degree of confidence, taking into account dilution factors and interferences. The reported detection limits are equal to or greater than Method Detection Limits (MDL) to allow for day to day and instrument to instrument variations in sensitivity.

J — Indicates that the value is an estimate.

ND — Not Detected - Indicates that the compound was not found in the sample at or above the detection limit.

ppm (ppb) — parts per million (billion) in liquids is usually equivalent to mg/l (ug/l), or in solids to mg/kg (ug/kg). In the gas phase it is equivalent to ul/l (ul/m^3).

TR — Trace - Indicates that the compound was observed at a value less than our normal reported Detection Limit (DL), but we feel its presence may be important to you. These values are subject to large errors and low degrees of confidence.

kg kilogram	mg milligram	l liter	m meter
g gram	ug microgram	ul microliter	

QC Abbreviations:

Control — Control Limits are determined from historical data for a QC parameter. The test value must be within this acceptable range for the test to be considered in control. Usually this range corresponds to the 99% confidence interval for the historical data.

% Error — Percent Error - This is a measure of accuracy based on the analysis of a Laboratory Control Standard (LCS). An LCS is a reference sample of known value such as an NIST Standard Reference Material (SRM). The % Error is expressed in percent as the difference between the known value and the experimental value, divided by the known value. The LCS may simply be a solution based standard which confirms calibration (ICV or CCV - initial or continuing calibration verification), or it may be a reference sample taken through preparation and analysis.

QC Abbreviations (continued):

MS(D)	Matrix Spike (Duplicate) - This refers to a quality control sample. It may be a real sample or blank sample spiked with representative target analytes.
% Rec	Percent Recovery - This is a measure of the accuracy of the analysis. It is expressed in percent as the difference between the result of an MS sample and the unspiked sample, divided by the amount spiked.
RPD	Relative Percent Difference - This is a measure of the precision of the analysis. It is the difference between duplicate results divided by the mean of the duplicates.
Warning	Warning limits are determined from historical data, usually representing a 95% confidence interval. This serves to alert the analyst to problems before reaching the control limits. Data "Out of Warning" is still considered in control.

Environmental Abbreviations:

BNA	Base-Neutral/Acid Fraction - Also called the Extractable Semivolatile fraction, represents the pollutants which can be extracted from a sample, but which boil higher than 120 C and still pass through a gas chromatography column.
CAM	California Assessment Manual - The original draft containing the CA hazardous waste rules, one of which was a list of 17 toxic metals. "CAM Metals" is used to refer to this list.
STLC	Soluble Threshold Limit Concentration - According to California's hazardous waste regulations, a waste is considered hazardous if the concentration in the leachate from the Waste Extraction Test (WET) exceeds this limit.
TCLP	Toxicity Characteristic Leaching Procedure - According to EPA regulations, a waste is considered hazardous if the leachate from the TCLP extraction exceeds certain limits.
TTLC	Total Threshold Limit Concentration - According to California's hazardous waste regulations, a waste exceeding this concentration is considered a hazardous waste.
VOA	Volatile Organics Analysis - Represents a group of volatile organic solvents with a boiling range from below room temperature to approximately 150 C.
WET	Waste Extraction Test - See STLC.

Chrome Analysis QC Results

Probe & Neck Rinse ONLY

Plant: General Dynamics
Location: San Diego, CA
Sampling Site : Tank #8 (Inlet & Oulet)
Test Date: 2/16,2/17/93

Audit Samples Results:

Sample ID:	Hex-Chrome ppb (ug/L)	
Audit 1	1030	(1000)
Audit 2	50	(50)

QC Rinse Results:

Sample ID:	Chrome Total Micrograms:	Hex-Chrome Total Micrograms:
Cr-Inlet 1D	0.026	ND<0.04
Cr-Inlet 2D	0.51	0.36
Cr-Inlet 3D	0.557	0.41
Cr-Outlet 1D	0.031	ND<0.03
Cr-Outlet 2D	0.088	ND<0.04
Cr-Outlet 3D	0.11	ND<0.06

D

TRACER TECHNOLOGIES
DRY GAS METER CALIBRATION DATA FORM

CALIBRATION TYPE: BM
BAROMETRIC PRESSURE, Pb = 29.84
DATE: 1/6/93

DRY GAS METER #: 124
RUN #: 1

ORIFICE MANOMETER SETTING		GAS VOLUME WET TEST METER Vw, ft3		GAS VOLUME DRY TEST METER Vd, ft3		WET TEST METER TEMP/VAC		DRY TEST METER TEMP, F		TIME min
ΔH	VAC	START	END	START	END	tw F	Vac	tdi	tdo	
1.00 ~~0.93~~	1.0	0	10.000	510.000	519.995	71	-0.1	76	71	~~18.35~~
~~2.15~~ 3.00	1.0	0	10.000	543.000	553.215	71	-0.1	78	76	~~10.83~~

BAROMETRIC PRESSURE, Pb = 29.84
DATE: 1/6/93

DRY GAS METER #: 124
RUN #: 2

ORIFICE MANOMETER SETTING		GAS VOLUME WET TEST METER Vw, ft3		GAS VOLUME DRY TEST METER Vd, ft3		WET TEST METER TEMP/VAC		DRY TEST METER TEMP, F		TIME min
ΔH	VAC	START	END	START	END	tw F	Vac	tdi	tdo	
1.00 ~~0.93~~	1.0	0	10.000	521.000	531.005	71	-0.1	76	71	~~18.36~~
~~2.15~~ 3.00	1.0	0	10.000	554.000	564.150	71	-0.1	78	76	~~10.91~~

BAROMETRIC PRESSURE, Pb = 29.84
DATE: 1/6/93

DRY GAS METER #: 124
RUN #: 3

ORIFICE MANOMETER SETTING		GAS VOLUME WET TEST METER Vw, ft3		GAS VOLUME DRY TEST METER Vd, ft3		WET TEST METER TEMP/VAC		DRY TEST METER TEMP, F		TIME min
ΔH	VAC	START	END	START	END	tw F	Vac	tdi	tdo	
~~1.00~~ 0.93	1.0	0	10.000	532.000	542.080	71	-0.1	76	71	~~18.30~~
~~2.15~~ 3.00	1.0	0	10.000	565.000	575.169	71	-0.1	78	76	~~10.95~~

USE FOLLOWING FLOW RATES: 0.5 AND 0.75. RUN IN TRIPLICATE.

TRACER TECHNOLOGIES

DRY GAS METER CALIBRATION CALCULATION FORM

DATE: 01/06/93

AMBIENT TEMPERATURE, DEG F: 71

BAROMETRIC PRESSURE, Pb = 29.84

WET TEST METER CORRECTION FACTOR: 1.0000

TYPE: BIMONTHLY DGM# 124

BY: AJH

RUN #: 1

ORIFICE MANOMETER SETTING DELTA H in H20	GAS VOLUME WET TEST METER, Vw, ft3			GAS VOLUME DRY TEST METER, Vd, ft3			WET TEST METER TEMP tw	tw	tdi	tdo	avg	avg	TIME min	WET TEST METER PRES	DRY TEST METER VAC
	START	STOP	TOTAL	START	STOP	TOTAL	F	R	F	F	F	R			
1.00	0.000	10.000	10.000	510.000	519.995	9.995	71.0	531	76.0	71.0	73.5	534	18.35	-0.10	1.00
3.00	0.000	10.000	10.000	543.000	553.215	10.215	71.0	531	78.0	76.0	77.0	537	10.83	-0.10	1.00

GAS METER CORRECTION FACTOR CALCULATIONS AND DELTA H@ CALCULATIONS

DELTA H in H20	DELTA H / 13.6	GAS METER CORRECTION FACTOR, Y	DELTA H @	
		$Y_m * \frac{V_w*(t_d+460)*[P_b + P_m/13.6]}{V_d*(t_w+460)*[P_b + dH/13.6]}$	$\frac{0.0324 \text{ DELTA H} * (t_a+460) * [t_{dmc}]^2}{P_b * [Y_m]^2 * [V_d]^2}$	
1.00	0.0735	1.0025	1.9433	OK 0.00
3.00	0.2206	0.9825	1.9442	OK 0.00
	AVG:	0.9925	AVG: 1.9438	

TRACER TECHNOLOGIES

DRY GAS METER CALIBRATION CALCULATION FORM

DATE: 01/06/93

TYPE: BIMONTHLY DOM# 124

AMBIENT TEMPERATURE, DEG F: 71

BY: AJH

BAROMETRIC PRESSURE, Pb = 29.84

WET TEST METER CORRECTION FACTOR: 1.0000 1.0000 RUN #: 2

ORIFICE MANOMETER SETTING DELTA H in H20	GAS VOLUME WET TEST METER, Vw, ft3			GAS VOLUME DRY TEST METER, Vd, ft3			WET TEST METER TEMP tw	tw	td1	td2	avg	avg	TIME min	WET TEST METER PRES	DRY TEST METER VAC
	START	STOP	TOTAL	START	STOP	TOTAL	F	R	F	F	F	R			
1.00	0.000	10.000	10.000	521.000	531.005	10.005	71.0	531	76.0	71.0	73.5	534	18.56	-0.10	1.00
3.00	0.000	10.000	10.000	554.000	564.150	10.150	71.0	531	78.0	76.0	77.0	537	10.91	-0.10	1.00

GAS METER CORRECTION FACTOR CALCULATIONS AND DELTA H@ CALCULATIONS

DELTA H in H20	DELTA H / 13.6	GAS METER CORRECTION FACTOR, Y	DELTA H @	
		$Y_m = \frac{V_w*(t_d+460)*[P_b + P_m/13.6]}{V_d*(t_w+460)*[P_b + dH/13.6]}$	$\frac{0.0324\ DELTA\ H * (t_d+460) * [time]^2}{P_b * [Y_m]^2 * [V_d]^2}$	
1.00	0.0735	1.0015	1.9841	OK 0.01
3.00	0.2206	0.9888	1.9984	OK 0.01
		AVG: 0.9951	AVG: 1.9912	

TRACER TECHNOLOGIES

DRY GAS METER CALIBRATION CALCULATION FORM

DATE: 01/06/93

AMBIENT TEMPERATURE, DEG F: 71

BAROMETRIC PRESSURE, Pb = 29.84

WET TEST METER CORRECTION FACTOR: 1.0000

TYPE: BIMONTHLY DGM# 124

BY: AJH

RUN #: 3

ORIFICE MANOMETER SETTING DELTA H in H20	GAS VOLUME WET TEST METER, Vw, ft3			GAS VOLUME DRY TEST METER, Vd, ft3			WET TEST METER TEMP tw	tw	tdi	tdo	avg	avg	TIME min	WET TEST METER PRES	DRY TEST METER VAC
	START	STOP	TOTAL	START	STOP	TOTAL	F	R	F	F	F	R			
1.00	0.000	10.000	10.000	532.000	542.080	10.080	71.0	531	76.0	71.0	73.5	534	18.30	-0.10	1.00
3.00	0.000	10.000	10.000	565.000	575.169	10.169	71.0	531	78.0	76.0	77.0	537	10.95	-0.10	1.00

GAS METER CORRECTION FACTOR CALCULATIONS AND DELTA H@ CALCULATIONS

DELTA H in H20	DELTA H / 13.6	GAS METER CORRECTION FACTOR, Y	DELTA H @	[redacted]	
		$Y_{rm} * \frac{V_w*(t_d+460)*[P_b + P_{rm}/13.6]}{V_d*(t_w+460)*[P_b + \delta H/13.6]}$	$\frac{0.0324\ \text{DELTA H} * (t_a+460) * [time]^2}{P_b * [Y_{rm}]^2 * [V_d]^2}$		
1.00	0.0735	0.9940	1.9003	OK	0.05
3.00	0.2206	0.9870	2.0056	OK	0.05
		AVG: 0.9905	AVG: 1.9529		

TRACER TECHNOLOGIES

DRY GAS METER COEFFICIENT CALCULATIONS

DATE: 01/06/93

AMBIENT TEMPERATURE, DEG F: 71

BAROMETRIC PRESSURE, Pb = 29.84

WET TEST METER CORRECTION FACTOR: 1.0000

TYPE: BIMONTHLY DOM# 124

BY: AJH

APPROX. FLOW RATE (Q) cfm	WET TEST METER # P-2968 FLOW RATE Qrm cfm	AVERAGE METER tw	pw	CORRECTED FLOW RATE (Q'rm scfm)
0.50	0.545	71.0	-0.10	0.532
	0.539	71.0	-0.10	0.526
	0.546	71.0	-0.10	0.534
0.75	0.923	71.0	-0.10	0.902
	0.917	71.0	-0.10	0.895
	0.913	71.0	-0.10	0.892

[redacted]

APPROX. FLOW RATE (Q) cfm	DRY GAS METER #: 124 FLOW RATE Qfm cfm	AVERAGE METER td	pd	CORRECTED FLOW RATE (Q'fm scfm)	COEFFICIENT Yfm (1+/- 0.05)	Yds max. Yds min. <= 0.01	Avg Coef Y	Y	Yfm/Yfm (1+/- 0.02)
0.50	0.545	73.5	1.00	0.531	1.0025 OK				
	0.539	73.5	1.00	0.525	1.0015 OK	0.008	0.9993	Ym =	1.0067
	0.551	73.5	1.00	0.537	0.9940 OK	OK		0.9927	OK
0.75	0.943	77.0	3.00	0.918	0.9825 OK			dH@ =	
	0.930	77.0	3.00	0.905	0.9888 OK	0.006	0.9861	1.9626	0.9933
	0.929	77.0	3.00	0.904	0.9870 OK	OK			OK

OVERALL AVG Yfm: 0.9927 CORRECTION FACTOR

PREVIOUS CORRECTION FACTOR: 1.0044

TRACER TECHNOLOGIES

DRY GAS METER CALIBRATION CALCULATION FORM

DATE: 01/02/93

AMBIENT TEMPERATURE, DEG F: 71

BAROMETRIC PRESSURE, Pb = 29.70

OLD DRY GAS METER CORRECTION FACTOR: 0.9975

WET TEST METER CORRECTION FACTOR: 1.0000

PREVIOUS DELTA H@ CALIBRATION: 1.9346

TYPE: BIMONTHLY DOM#839851

BY: AJH/GDB

RUN #: 1

ORIFICE MANOMETER SETTING DELTA H in H20	GAS VOLUME WET TEST METER, Vw, ft3			GAS VOLUME DRY TEST METER, Vd, ft3			WET TEST METER TEMP tw	tw	tdi	tdo	avg	avg	TIME min	WET TEST METER PRES	DRY TEST METER VAC
	START	STOP	TOTAL	START	STOP	TOTAL	F	R	F	F	F	R			
0.93	0.000	10.000	10.000	400.000	410.260	10.260	71.0	531	84.0	80.0	82.0	542	19.20	-0.11	1.00
2.15	0.000	10.000	10.000	433.000	443.220	10.220	71.0	531	88.0	81.0	84.5	545	12.85	-0.11	1.00

GAS METER CORRECTION FACTOR CALCULATIONS AND DELTA H@ CALCULATIONS

DELTA H in H20	DELTA H / 13.6	GAS METER CORRECTION FACTOR, Y	DELTA H @	
		$Y_m = \frac{V_w*(t_d+460)*[P_b + P_m/13.6]}{V_d*(t_w+460)*[P_b + dH/13.6]}$	$\frac{0.0324\ \text{DELTA H} * (t_s+460) * [time]^2}{P_b * [Y_m]^2 * [V_d]^2}$	
0.93	0.0684	0.9923	1.8866	OK 0.04
2.15	0.1581	0.9978	1.9689	OK 0.04
		AVG: 0.9950	AVG: 1.9277	

TRACER TECHNOLOGIES

DRY GAS METER CALIBRATION CALCULATION FORM

DATE: 01/02/93

TYPE: BIMONTHLY DOM#839851

AMBIENT TEMPERATURE, DEG F: 71

BY: AJH/GDB

BAROMETRIC PRESSURE, Pb = 29.7

WET TEST METER CORRECTION FACTOR: 1.0000 1.0000

RUN #: 2

ORIFICE MANOMETER SETTING DELTA H	GAS VOLUME WET TEST METER, Vw, ft3			GAS VOLUME DRY TEST METER, Vd, ft3			WET TEST METER TEMP tw	tw	tdi	tdo	avg	avg	TIME	WET TEST METER PRES	DRY TEST METER VAC
in H20	START	STOP	TOTAL	START	STOP	TOTAL	F	R	F	F	F	R	min		
0.93	0.000	10.000	10.000	411.000	421.150	10.150	71.0	531	71.0	77.0	74.0	534	19.22	-0.11	1.00
2.15	0.000	10.000	10.000	444.000	454.218	10.218	71.0	531	89.0	81.0	85.0	545	12.92	-0.11	1.00

GAS METER CORRECTION FACTOR CALCULATIONS AND DELTA H@ CALCULATIONS

DELTA H in H20	DELTA H / 13.6	GAS METER CORRECTION FACTOR, Y: Yrm * Vw*(td+460)*[Pb + Prm/13.6] / Vd*(tw+460)*[Pb + dH/13.6]	DELTA H @: 0.0324 DELTA H * (tm+460) * [time]2 / Pb * [Yrm]2 * [Vd]2		
0.93	0.0684	0.9882	1.9317	OK	0.03
2.15	0.1581	0.9989	1.9912	OK	0.03
		AVG: 0.9936	AVG: 1.9615		

TRACER TECHNOLOGIES

DRY GAS METER CALIBRATION CALCULATION FORM

DATE: 01/02/93

AMBIENT TEMPERATURE, DEG F: 71

BAROMETRIC PRESSURE, Pb = 29.7

WET TEST METER CORRECTION FACTOR: 1.0000

TYPE: BIMONTHLY DOM#839851

BY: AJH/GDB

RUN #: 3

ORIFICE MANOMETER SETTING DELTA H in H20	GAS VOLUME WET TEST METER, Vw, ft3			GAS VOLUME DRY TEST METER, Vd, ft3			WET TEST METER TEMP tw	tw	tdi	tdo	avg	avg	TIME min	WET TEST METER PRES	DRY TEST METER VAC
	START	STOP	TOTAL	START	STOP	TOTAL	F	R	F	F	F	R			
0.93	0.000	10.000	10.000	422.000	432.190	10.190	71.0	531	83.0	78.0	80.5	541	19.35	-0.11	1.00
2.15	0.000	10.000	10.000	455.000	465.228	10.228	71.0	531	89.0	82.0	85.5	546	12.89	-0.11	1.00

GAS METER CORRECTION FACTOR CALCULATIONS AND DELTA H@ CALCULATIONS

DELTA H in H20	DELTA H / 13.6	GAS METER CORRECTION FACTOR, Y: Yrm = Vw*(td+460)*[Pb + Prm/13.6] / Vd*(tw+460)*[Pb + dH/13.6]	DELTA H @: 0.0324 DELTA H * (tm+460) * [time]2 / Pb * [Yrm]2 * [Vd]2	[illegible]	
0.93	0.0684	0.9963	1.9426	OK	0.02
2.15	0.1581	0.9988	1.9781	OK	0.02
		AVG: 0.9976	AVG: 1.9603		

B2012

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: Inlet #3 Date: 2/17/93

Sampling Location: Jones Brown Scrubber #8 Sample Train: 124

Pre-Test Leak Check:
Filter: _____ cfm @ _____ "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

Post-Test Leak Check:
Filter: _____ cfm @ _____ "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

	Time On	Sample Point #	Gas Meter Reading (ft³)	Stack Velocity Head (" H2O)	Stack Temp °F	O2 Calibrated %	O2 Stack %	Probe Temp °F	Hot Box Temp °F	Dryer Temp °F	Meter Temp °F In	Meter Temp °F Out	Vacuum "Hg
1028		6	1045.00	0.11	67	1.01	1.01			58	79	74	
21	4		↓	0.11	67	1.01	1.01			55	73	73	4
22	8		1051.25	0.11	68	1.03	1.03			48	75	73	4
23	12		1053.59	0.11	68	1.03	1.03			48	75	73	4
24	16		1055.84	0.11	68	1.03	1.03			52	77	73	4
		7		0.11	68	1.03	1.03			52	77	73	4
25	20		1056.21	0.11	68	1.03	1.03			52	78	73	4
26	24		1060.53	0.11	68	1.03	1.03			53	78	73	4
27	28		1062.55	0.11	67	1.03	1.03			53	79	73	4
28	32		1065.15	0.11	67	1.03	1.03			53	75	73	4
		8		0.24	67	2.24	2.21			53	75	73	5
29	36		1069.32	0.25	67	2.34	2.34			53	75	73	5
30	40		1071.45	0.25	67	2.34	2.34			53	75	73	5
31	4		1074.83	0.25	67	2.30	2.30			54	78	74	5
32	8		1076.10	0.25	67	2.30	2.30			52	80	75	5
		9		0.23	67	2.11	2.11			52	80	75	5
33	12		1081.58	0.22	68	2.02	2.02			55	82	75	5
34	16		1081.31	0.22	68	2.02	2.02			57	83	76	5
35	20		1087.40	0.22	68	2.02	2.02			56	83	76	5
36	24		1090.40	0.22	68	2.02	2.02			56	83	76	5
		10*			68					56	84	76	5
37	28		1093.44	0.22	68	2.02	2.02			56	84	76	5
38	32		1096.50	0.22	69	2.02	2.02			56	85	77	5
39	36		1099.51	0.22	69	2.02	2.02			56	85	77	5
40	40		1102.553										
			114.42	0.196	67.2		1.802			53.9	75.8		4.8

* Reduced cfm due to static pressure.

Nozzle #: N07300 ✓ ID #37
Nozzle Diameter: 0.300
Barometric Pressure: 30.20 "HgA
Static Pressure in Stack: _____ "HgA (+/- -2.2 "H20)

Recorded by: RBT
Pitot Factor: 0.84

Calibration Data
Inclined Manometer: 124 (Cal: NA)
Pitot Tube No.: _____ (Cal: _____)
Potentiometer No.: _____ (Cal: _____)
Thermocouple No.: _____ (Cal: _____)
Gas Meter No.: 124 (Cal: 1/6/93)
Meter Corr. Factor: 1.0044

	Final	Initial	Net
Impinger #1			
Impinger #2			
Impinger #3			
Impinger #4			
Total Wt Gain:			

Type Sampling Probe: 5' glass PBS 010

Inlet

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: 7245-Cr-Inlet 1 Date: 02/16/93

Sampling Location: General Dynamics/Lindburg Field, San Diego CA

Stack ID: Tank 8 Scrubber Inlet

Time Cr	Gas Meter Reading (scf)	Stack Velocity Head (H2O)	Temp F	dH Calculated dH	Set dH	Probe Temp F (SQRT dP)	Hot Box Temp F	Impinger Dryer Temp F	Meter temp F in	Meter temp F out	Vacuum "Hg
	755.457										
1		0.35	66	–	3.17	0.59		46	65	65	15
2		0.35	66	–	3.17	0.59		47	67	65	15
3		0.36	65	–	3.26	0.60		52	69	65	16
4		0.36	65	–	3.26	0.60		57	71	66	17
5		0.29	65	–	2.62	0.54		57	73	66	15
6		0.29	65	–	2.65	0.54		58	73	66	15
7		0.29	65	–	2.65	0.54		58	74	67	15
8		0.29	65	–	2.61	0.53		55	75	67	15
9		0.29	65	–	2.61	0.53		56	77	69	15
10		0.26	66	–	2.38	0.51		54	76	68	13
11		0.26	66	–	2.38	0.51		54	76	68	13
12		0.26	65	–	2.38	0.51		52	75	69	13
13		0.26	66	–	2.38	0.51		52	75	69	13
14		0.22	65	–	2.02	0.47		53	76	69	11
15		0.22	65	–	2.02	0.47		53	77	70	11
16		0.22	65	–	2.03	0.47		53	78	70	11
17		0.15	65	–	1.43	0.39		53	78	71	11
18		0.14	65	–	1.29	0.37		53	78	71	8
19		0.15	65	–	1.38	0.39		52	80	71	8
20		0.15	65	–	1.38	0.39		52	79	71	8
21		0.11	64	–	1.01	0.33		48	74	71	7
22		0.11	65	–	1.01	0.33		44	72	70	7
23		0.11	64	–	1.01	0.33		51	73	70	7
24		0.11	66	–	1.01	0.33		51	77	73	7
25		0.11	64	–	1.01	0.33		51	75	71	7
26		0.11	65	–	1.01	0.33		50	76	70	7
27		0.11	64	–	1.01	0.33		51	76	71	7
28		0.11	64	–	1.01	0.33		51	76	71	7
29		0.17	62	–	1.57	0.41		50	77	71	8
30		0.18	63	–	1.66	0.42		52	73	71	9
31		0.18	62	–	1.62	0.42		48	75	71	9
32		0.18	62	–	1.62	0.42		49	76	71	9
33		0.22	62	–	1.85	0.47		50	77	71	9
34		0.15	62	–	1.39	0.39		50	77	71	9
35		0.11	62	–	1.29	0.33		49	77	71	7
36		0.14	62	–	1.29	0.37		50	77	71	7
37		0.14	63	–	1.29	0.37		51	77	72	7
38		0.14	63	–	1.29	0.37		49	77	72	7
39		0.13	63	–	1.21	0.36		50	78	72	7
40	869.992	0.13	62	–	1.21	0.36		50	78	72	7
avg.		0.197	64.2	–	1.811	0.435	0.0	51.6	72.5		10.2
	114.535										

Impinger

POST	PRE	
655.5	603.5	52.0
491.9	538.7	-46.8
629.4	610.3	19.1
		0.0
		24.3 gms

Filter ID: #

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: 7245-Cr-Inlet 2 Date: 02/16/93

Sampling Location: General Dynamics/Lindburg Field, San Diego CA

Stack ID: Tank 8 Scrubber Inlet

Time	Gas Meter	Stack		dH		Probe	Hot Box	Dryer	Meter temp		Vacuum
dH	Reading	Velocity	Temp	Calculated	Set	Temp	Temp	Temp	F		"Hg
	(cf)	Head	F	dH	dH	F	F	F	In	Out	
	870.986	(inH2O)				SORT dP					
1		0.31	62	–	2.82	0.56		41	69	66	20
2		0.31	63	–	2.82	0.56		45	71	66	20
3		0.32	62	–	2.91 (2.80)	0.57		50	72	67	20
4		0.29	62	–	2.64	0.54		53	73	67	18
5		0.29	62	–	2.64	0.54		53	73	68	18
6		0.29	62	–	2.64	0.54		52	73	68	18
7		0.29	62	–	2.63	0.53		53	74	68	18
8		0.29	62	–	2.63	0.53		53	74	68	16
9		0.27	62	–	2.49 (1.49)	0.52		53	74	68	17
10		0.27	63	–	2.49	0.52		54	75	68	16
11		0.27	63	–	2.49	0.52		54	75	68	16
12		0.27	63	–	2.49	0.52		50	73	68	14
13		0.24	63	–	2.22	0.49		52	75	69	14
14		0.22	63	–	2.03	0.47		52	75	69	13
15		0.22	64	–	2.03	0.47		54	76	69	13
16		0.19	64	–	1.75	0.44		54	76	69	11
17		0.19	64	–	1.75	0.44		54	76	69	11
18		0.18	64	–	1.66	0.42		55	78	70	10
19		0.17	64	–	1.57	0.41		54	77	70	10
20		0.17	64	–	1.57	0.41		54	77	70	10
21		0.11	62	–	1.01	0.33		45	70	69	8
22		0.11	62	–	1.01	0.33		47	71	69	8
23		0.11	62	–	1.01	0.33		50	72	69	7
24		0.11	62	–	1.01	0.33		50	73	69	7
25		0.11	61	–	1.01	0.33		50	74	68	7
26		0.11	61	–	1.01	0.33		50	74	68	8
27		0.11	61	–	1.01	0.33		51	75	68	8
28		0.11	61	–	1.01	0.33		51	75	69	8
29		0.24	60	–	2.22	0.49		52	75	69	13
30		0.24	60	–	2.22	0.49		52	76	69	12
31		0.24	61	–	2.22	0.49		51	72	69	12
32		0.24	61	–	2.22	0.49		48	74	70	13
33		0.15	62	–	1.39	0.39		50	75	70	9
34		0.15	62	–	1.39	0.39		51	75	70	9
35		0.16	62	–	1.48	0.40		51	75	70	9
36		0.16	62	–	(1.18)	0.40		51	75	70	9
37		0.15	62	–	1.39	0.39		51	76	70	9
38		0.15	62	–	1.39	0.39		51	76	70	9
39		0.15	62	–	1.39	0.39		51	76	70	9
40	986.534	0.15	62	–	1.39	0.39		51	76	70	9
avg		0.203	62.2	–	1.828	0.443	0.0	51.1	71.5		12.2
	115.548				1.86						

Impinger Dt

POST	PRE	
654.2	589.2	65.0
522.2	580.4	-58.2
661.6	643.4	18.2
		0.0
		25 gms

Filter ID: #

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: 7245-Cr-Inlet 3 Date: 02/17/93

Sampling Location: General Dynamics/Lindburg Field, San Diego CA

Stack ID: Tank 8 Scrubber Inlet

Time min	Gas Meter Reading (dcf)	Stack Velocity Head (in wg)	Temp F	dH Calculated in	Set dH	Probe Temp F (SORT of)	Hot Box Temp F	Dryer Temp F	Meter temp F in	Meter temp F out	Vacuum in Hg
	988.132										
1		0.12	64	–	1.09	0.35		50	67	65	4
2		0.12	65	–	1.09	0.35		46	70	66	4
3		0.12	66	–	1.09	0.35		49	74	66	4
4		0.12	66	–	1.09	0.35		51	74	67	4
5		0.28	66	–	2.55	0.53		52	77	68	6
6		0.28	66	–	2.55	0.53		53	78	68	6
7		0.28	66	–	2.55	0.53		53	79	69	6
8		0.28	66	–	2.55	0.53		56	80	70	6
9		0.26	66	–	2.37	0.51		56	81	71	6
10		0.26	66	–	2.37	0.51		56	81	71	6
11		0.26	67	–	2.37	0.51		54	79	72	6
12		0.26	67	–	2.37	0.51		54	79	72	6
13		0.23	68	–	2.12	0.48		55	80	72	5
14		0.23	67	–	2.12	0.48		56	81	72	5
15		0.23	67	–	2.12	0.48		56	81	73	5
16		0.23	67	–	2.12	0.48		56	82	73	5
17		0.16	68	–	1.47	0.40		56	82	73	4
18		0.16	68	–	1.47	0.40		57	81	73	4
19		0.16	68	–	1.47	0.40		57	81	73	4
20		0.16	68	–	1.47	0.40		57	81	73	4
21		0.11	67	–	1.01	0.33		55	73	73	4
22		0.11	68	–	1.03	0.33		48	75	73	4
23		0.11	68	–	1.03	0.33		48	75	73	4
24		0.11	68	–	1.03	0.33		52	77	73	4
25		0.11	68	–	1.03	0.33		52	78	73	4
26		0.11	68	–	1.03	0.33		53	79	73	4
27		0.11	67	–	1.03	0.33		53	79	73	4
28		0.11	67	–	1.03	0.33		53	79	73	4
29		0.25	67	–	2.34	0.50		53	79	73	5
30		0.25	67	–	2.34	0.50		53	79	73	5
31		0.25	67	–	2.30	0.50		54	78	74	5
32		0.25	67	–	2.30	0.50		52	80	75	5
33		0.22	68	–	2.02	0.47		55	82	75	5
34		0.22	68	–	2.02	0.47		57	83	76	5
35		0.22	68	–	2.02	0.47		56	83	76	5
36		0.22	68	–	2.02	0.47		56	83	76	5
37		0.22	68	–	2.02	0.47		56	84	76	5
38		0.22	69	–	2.02	0.47		56	84	76	5
39		0.22	69	–	2.02	0.47		56	85	77	5
40	1102.553	0.22	69	–	2.02	0.47		56	85	77	5
avg		0.196	67.2	–	1.802	0.437	0.0	53.9	75.8		4.8

114.421

Impinger wt

POST	PRE	
587.1	585.5	1.6
561.0	559.5	1.5
660.9	640.7	20.2
		0.0
		23.3 gms

Filter ID: #

Outlet #1

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Outlet #1

cation: _____

Date: 2-16-93

Sample Train: _____

Leak Check

_ cfm @ _____ "Hg vac ✓

Probe: _____ cfm @ 10.0 "Hg vac

(Pitot tube Leak Check: ✓)

Post-Test Leak Check

Filter: _____ cfm @ _____ "Hg vac

Probe: ✓ cfm @ _____ "Hg vac

(Pitot tube Leak Check: _____)

	Time On 1239	Sample Point #	Gas Meter Reading (m3)	Stack Velocity Head (in H2O)	Stack Temp F	dH Calculated dH	dH Set dH	Probe Temp F	Hot Box Temp F	Dryer Temp F	Meter temp F In	Meter temp F Out	Vacuum "Hg
	0		800.591					—	—				
3.0		1	802.550	0.16	60	1.45	1.45	—	—	52	73	75	3.5
6.5		1	805.000	0.17	60	1.54	1.55	—	—	52	76	75	3.5
9.5		2	807.550	0.18	62	1.63	1.65	—	—	55	78	75	3.7
13.0		2	809.420	0.18	59	1.63	1.65	—	—	59	80	75	3.8
	16.0	3	811.600	0.20	59	1.90	1.90	—	—	59	81	75	4.0
	19.5	3	814.100	0.20	59	1.81	1.80	—	—	58	82	75	4.0
	22.5	4	816.500	0.21	59	1.92	1.90	—	—	60	84	76	4.0
	26.0	4	819.000	0.21	59	1.92	1.90	—	—	60	84	76	4.0
	29.0	5	821.300	0.22	60	2.01	2.00	—	—	60	85	76	4.0
	33.0	5	824.325	0.22	59	2.01	2.00	—	—	60	85	76	4.0
	36.0	6	826.550	0.20	59	1.83	1.85	—	—	61	86	77	4.0
1319	40.0	6	829.483	0.20	59	1.83	1.85	—	—	60	86	76	4.0
		0						—	—				
	43.0	7	831.400	0.16	59	1.46	1.45	—	—	60	79	76	3.3
7	47.0	7	834.000	0.16	58	1.46	1.45	—	—	56	81	76	3.5
	50.0	8	835.900	0.14	58	1.29	1.30	—	—	55	82	75	3.2
	54.0	8	838.400	0.14	58	1.28	1.30	—	—	56	81	75	3.2
	57.0	9	840.200	0.13	58	1.19	1.20	—	—	56	81	75	3.0
15	60.5	9	842.300	0.13	58	1.19	1.20	—	—	55	81	75	3.0
	63.5	10	844.050	0.11	58	1.01	1.00	—	—	55	80	75	3.0
	67.0	10	846.000	0.11	58	1.01	1.00	—	—	55	80	75	3.0
	70	11	847.600	0.10	58	0.91	0.91	—	—	55	80	75	3.0
	73.5	11	849.500	0.10	59	0.91	0.91	—	—	55	80	75	3.0
	76.5	12	850.935	0.09	59	0.82	0.82	—	—	55	81	75	2.8
	80.0	12	852.678	0.09	59	0.82	0.82	—	—	55	81	75	2.8
			Leak check 0.000 @ 5.0" Hg					—	—				
			852.853					—	—				

See p2

Nozzle #: _____

Nozzle Diameter: 0.300 "

Barometric Pressure: 30.04 "HgA

Static Pressure in Stack: 30.05 "HgA (+/- -0.16 "H20)

Recorded by: D. Crow

Pitot Factor: 0.94

Calibration Data		
Inclined Manometer: _____	(Cal: NA)	
Pitot Tube No.: _____	(Cal: _____)	
Potentiometer No.: _____	(Cal: _____)	
Thermocouple No.: _____	(Cal: _____)	
Gas Meter No.: 839851	(Cal: _____)	
Meter Corr. Factor: 0.9975	✓	
ΔH@ = 1.9346		

Type Sampling Probe: _____

	Final	Initial	Net
Impinger #1	582.2	567	582.8
Impinger #2	573.6	569.4	
Impinger #3	666.2	646.2	
Impinger #4			

Total Wt Gain: 33.6

	0	
	1	3.0
6.5	1	6.5
	2	9.5
6.5	2	13.0
	3	16.0
6.5	3	19.5
	4	22.5
6.5	4	26.0
	5	29.0
7.0	5	33.0
	6	36.0
7.0	6	40.0

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: Outlet #1 Shed #2 Date: 2-16-93

Sampling Location: _____ Sample Train: _____

Pre-Test Leak Check:
Filter: _____ cfm @ _____ "Hg vac
Probe: 0.005 cfm @ 40 "Hg vac
(Pitot tube Leak Check: _____)

Post-Test Leak Check:
Filter: _____ cfm @ _____ "Hg vac
Probe: 0.014 cfm @ 4.0 "Hg vac
(Pitot tube Leak Check: _____)

Time On M29	Sample Point #	Gas Meter Reading (cu ft)	Stack Velocity Head (inch H2O)	Stack Temp F	dH Orifice dH	dH Set dH	Probe Temp F	Hot Box Temp F	Dryer Temp F	Meter Temp F In	Meter Temp F Out	Vacuum In Hg
0		852.853										
83.0	1	854.700	0.13	57	1.18	1.20	—	—	56	71	71	3.0
86.5	1	856.775	0.13	57	1.18	1.20	—	—	50	72	71	3.0
89.5	2	858.575	0.13	57	1.18	1.20	—	—	49	73	71	3.0
93.0	2	860.800	0.14	57	1.27	1.25	—	—	51	74	71	3.0
96.0	3	862.550	0.14	58	1.27	1.25	—	—	53	76	71	3.0
99.5	3	864.630	0.13	57	1.18	1.20	—	—	54	76	71	3.0
102.5	4	866.500	0.15	57	1.36	1.35	—	—	54	76	70	3.0
106	4	868.700	0.15	57	1.36	1.35	—	—	54	76	70	3.0
109	5	870.550	0.15	58	1.36	1.35	—	—	55	77	71	3.0
113	5	873.200	0.16	58	1.45	1.45	—	—	55	78	71	3.5
116	6	875.100	0.16	58	1.45	1.45	—	—	55	79	72	3.5
120	6	877.723	0.16	58	1.45	1.45	—	—	55	78	71	3.5
							—	—				
123	7	879.800	0.18	57	1.65	1.65	—	—	56	73	69	3.5
127	7	882.500	0.18	57	1.65	1.65	—	—	52	73	69	3.5
130	8	884.600	0.18	57	1.65	1.65	—	—	53	74	69	3.5
134	8	887.300	0.17	57	1.55	1.55	—	—	53	75	69	3.5
137	9	889.200	0.15	56	1.37	1.35	—	—	53	75	68	3.5
140.5	9	891.400	0.15	57	1.37	1.35	—	—	53	75	69	3.5
143.5	10	893.250	0.14	57	1.28	1.28	—	—	54	75	69	3.3
147	10	895.350	0.14	57	1.28	1.30	—	—	54	76	69	3.1
150	11	897.100	0.17	57	1.10	1.10	—	—	54	76	69	3.0
153.5	11	899.085	0.17	57	1.10	1.10	—	—	54	75	68	3.0
156.5	12	900.650	0.10	57	0.91	0.91	—	—	54	75	69	3.0
160	12	902.475	0.10	57	0.91	0.91	—	—	54	75	69	3.0
							—	—				
		101.884	0.152	58.1		1.378			55.2	75.4		3.3
			Av 0.378			Av ΔH						

Nozzle #: _____ Recorded by: D. Crow

Nozzle Diameter: 0.300 "

Pitot Factor: 0.84

Barometric Pressure: _____ "HgA

Static Pressure in Stack: _____ "HgA (+/- _____ "H20)

Calibration Data

Inclined Manometer: _____ (Cal: NA)
Pitot Tube No.: _____ (Cal: _____)
Potentiometer No.: _____ (Cal: _____)
Thermocouple No.: _____ (Cal: _____)
Gas Meter No.: _____ (Cal: _____)
Meter Corr. Factor: _____

	Final	Initial	Net
Impinger #1			
Impinger #2			
Impinger #3			
Impinger #4			
Total Wt Gain:			

Type Sampling Probe: _____

Outlet #2

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Date: 2-16-93

Test No.: Outlet #2

Sample Train: _____

Sampling Location: General Dynamics

Pre-Test Leak Check:
Filter: 0.014 cfm @ 10.0 "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check ✓)

Post-Test Leak Check:
Filter: 0.010 cfm @ 5.0 "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

Time (hr)	Sample Point #	Gas Meter Reading (cf)	Stack Velocity Head (in H2O)	Stack Temp (F)	dH Calculated (in)	dH Set (in)	Probe Temp (F)	Hot Box Temp (F)	Dryer Temp (F)	Meter Temp (F) In	Meter Temp (F) Out	Vacuum (in Hg)
0		902.835					—	—				
3.0	1	904.830	0.18	56	1.60	1.60	—	—	56	58	58	4.0
6.5	1	907.100	0.17	56	1.51	1.50	—	—	49	59	58	4.0
9.5	2	909.100	0.18	56	1.51	1.50	—	—	47	60	58	4.0
13.0	2	911.400	0.18	56	1.61	1.60	—	—	49	62	59	4.5
16.0	3	913.600	0.20	58	1.79	1.80	—	—	51	65	59	4.5
19.5	3	916.000	0.20	57	1.79	1.80	—	—	51	67	59	4.5
22.5	4	918.200	0.22	57	1.97	1.95	—	—	52	68	60	4.5
26.0	4	920.700	0.22	57	1.97	1.95	—	—	53	70	60	5.0
29.0	5	923.000	0.22	56	1.97	1.95	—	—	53	71	61	5.0
33.0	5	925.900	0.22	57	1.97	1.95	—	—	53	72	61	5.0
36.0	6	928.100	0.21	57	1.88	1.90	—	—	52	72	62	5.0
1850 40.0	6	931.028	0.21	57	1.88	1.90	—	—	57	73	62	5.0
							—	—				
1905 43	7	933.000	0.17	57	1.54	1.55	—	—	52	66	62	5.0
47	7	935.650	0.17	56	1.54	1.55	—	—	47	67	62	5.0
50	8	937.550	0.15	57	1.36	1.35	—	—	47	68	62	5.0
54	8	940.040	0.15	57	1.36	1.35	—	—	48	69	67	5.0
57	9	942.000	0.14	57	1.36	1.35	—	—	49	71	63	5.0
60.5	9	944.050	0.14	57	1.36	1.35	—	—	49	72	63	5.0
63.5	10	946.000	0.12	57	1.09	1.10	—	—	49	72	63	5.0
67	10	947.800	0.12	58	1.09	1.10	—	—	50	72	64	4.8
70	11	949.400	0.10	58	0.91	0.91	—	—	50	73	64	4.0
73.5	11	951.200	0.10	58	0.91	0.91	—	—	50	73	64	4.0
76.5	12	952.700	0.09	58	0.82	0.82	—	—	50	73	65	4.0
80	12	954.355	0.09	58	0.82	0.82	—	—	50	72	65	4.0
							—	—				
							—	—				

Recorded by: D. Crow

Pitot Factor: 0.84

Nozzle #: _____

Nozzle Diameter: 0.200 "

Barometric Pressure: — _____ "HgA

Static Pressure in Stack: _____ "HgA (+/- _____ "H20)

Calibration Data

Inclined Manometer: _____ (Cal: NA)

Pitot Tube No.: _____ (Cal: _____)

Potentiometer No.: _____ (Cal: _____)

Thermocouple No.: _____ (Cal: _____)

Gas Meter No.: 839851 (Cal: _____)

Meter Corr. Factor: 0.9975

ΔH@: 1.9346

Type Sampling Probe: _____

	Final	Initial	Net
Impinger #1	596.7	584.3	
Impinger #2	571.9	567.1	
Impinger #3	653.9	636.3	
Impinger #4			

Total Wt Gain: 32.7

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Test No.: _____ Date: 2-16-93

Sampling Location: BD Outlet Run 2 Sample Train: _____

2 of 2

Pre-Test Leak Check:
Filter: 0.06 cfm @ 5.0 "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

Post-Test Leak Check:
Filter: 0.08 cfm @ 50 "Hg vac
Probe: _____ cfm @ _____ "Hg vac
(Pitot tube Leak Check: _____)

Time (min)	Sample Point #	Gas Meter Reading (ft³)	Stack Velocity (fpm)	Stack Temp (°F)	dH Calculated (in)	dH Set (in)	Probe Temp (°F)	Hot Box Temp (°F)	Dryer Temp (°F)	Meter Temp (°F) In	Meter Temp (°F) Out	Vacuum (Hg)
BD		954.458										
83.0	1	956.200	0.12	58	1.09	1.10	—	—	53	64	63	4.0
86.5	1	958.140	0.12	58	1.09	1.10	—	—	47	65	63	4.0
90.5	2	960.400	0.12	57	1.08	1.10	—	—	47	67	63	4.0
93.0	2	961.800	0.13	57	1.19	1.15	—	—	48	69	64	4.5
96.0	3	963.600	0.14	57	1.26	1.25	—	—	50	70	64	4.5
99.5	3	965.670	0.14	58	1.26	1.25	—	—	50	71	64	5.0
102.5	4	967.500	0.14	58	1.26	1.25	—	—	51	72	64	5.0
106	4	969.550	0.14	57	1.26	1.25	—	—	51	72	65	5.0
109	5	971.450	0.16	57	1.44	1.45	—	—	51	73	65	5.0
113	5	974.040	0.16	57	1.44	1.45	—	—	51	73	65	5.0
116	6	976.000	0.16	57	1.44	1.45	—	—	51	74	67	5.0
120	6	978.550	0.17	57	1.44	1.45	—	—	51	74	65	5.0
							—	—				
123	7	980.55	0.18	57	1.61	1.60	—	—	52	69	65	5.0
127	7	983.240	0.18	57	1.61	1.60	—	—	50	71	65	5.1
130	8	985.200	0.16	57	1.44	1.45	—	—	51	72	65	5.0
134	8	987.760	0.16	58	1.44	1.45	—	—	50	73	65	5.0
137	9	989.500	0.13	58	1.17	1.15	—	—	51	74	66	4.8
140.5	9	991.600	0.13	57	1.17	1.15	—	—	51	74	66	4.8
143.5	10	993.300	0.12	58	1.08	1.10	—	—	50	75	66	4.5
147	10	995.250	0.12	57	1.08	1.10	—	—	50	74	66	4.5
150	11	996.800	0.10	58	0.90	0.90	—	—	50	75	66	4.0
153.5	11	998.800	0.11	57	0.99	0.99	—	—	49	74	66	4.0
156.5	12	000.300	0.10	58	0.90	0.90	—	—	49	74	67	4.0
160	12	002.183	0.10	57	0.90	0.90	—	—	49	74	66	4.0
							—	—				
		99.348	0.151	57.1		1.352			50.1	66.8		4.6
			1st 0.385									

Nozzle #: _____ Recorded by: DLW

Nozzle Diameter: 0.300 "

Pitot Factor: _____

Barometric Pressure: _____ "HgA

Static Pressure in Stack: _____ "HgA (+/- _____ "H20)

Calibration Data
Inclined Manometer: _____ (Cal: NA)
Pitot Tube No.: _____ (Cal: _____)
Potentiometer No.: _____ (Cal: _____)
Thermocouple No.: _____ (Cal: _____)
Gas Meter No.: _____ (Cal: _____)
Meter Corr. Factor: _____

	Final	Initial	Net
Impinger #1			
Impinger #2			
Impinger #3			
Impinger #4			
Total Wt Gain:			

Type Sampling Probe: _____

Static Pressure in Stack: _____ "HgA (+/- _____ "H20)

Calibration Data
Inclined Manometer: _____ (Cal: NA)
Pitot Tube No.: _____ (Cal: _____)
Potentiometer No.: _____ (Cal: _____)
Thermocouple No.: _____ (Cal: _____)
Gas Meter No.: 839851 (Cal: _____)
Meter Corr. Factor: 0.9975
ΔH@ = 1.9346

	Final	Initial	Net
Impinger #1	600.1	588.0	
Impinger #2	582.1	580.2	
Impinger #3	683.7	666.1	
Impinger #4			
Total Wt Gain:			31.6

Type Sampling Probe: Probe 001

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Date: 02/16/93

Test No.: 7245-Cr-Outlet 1

Sampling Location: General Dynamics/Lindburg Field, San Diego CA

Stack ID: Tank 8 Scrubber Outlet

Time Min	Gas Meter Reading (ACF)	Stack Velocity Head (mm)	Temp F	dH Calculated dH	Bias dH	Probe Temp F (SORT dP)	Hot Box Temp F	Dryer Temp F	Meter temp F In	Out	Vacuum "Hg
	800.591										
1		0.16	60	–	1.45	0.40		52	73	75	3.5
2		0.17	60	–	1.54	0.41		52	76	75	3.5
3		0.18	62	–	1.63	0.42		55	78	75	3.7
4		0.18	59	–	1.63	0.42		59	80	75	3.8
5		0.21	59	–	1.90	0.46		59	81	75	4.0
6		0.20	59	–	1.81	0.45		59	82	75	4.0
7		0.21	59	–	1.92	0.46		58	84	76	4.0
8		0.21	59	–	1.92	0.46		60	84	76	4.0
9		0.22	59	–	2.01	0.47		60	85	76	4.0
10		0.22	60	–	2.01	0.47		60	85	76	4.0
11		0.20	59	–	1.83	0.45		61	86	77	4.0
12		0.20	59	–	1.83	0.45		60	86	76	4.0
13		0.16	59	–	1.46	0.40		60	79	76	3.3
14		0.16	59	–	1.46	0.40		56	81	76	3.5
15		0.14	58	–	1.28	0.37		55	82	75	3.2
16		0.14	58	–	1.28	0.37		56	81	75	3.2
17		0.13	58	–	1.19	0.36		56	81	75	3.0
18		0.13	58	–	1.19	0.36		55	81	75	3.0
19		0.11	58	–	1.01	0.33		55	80	75	3.0
20		0.11	58	–	1.01	0.33		55	80	75	3.0
21		0.10	58	–	0.91	0.32		55	80	75	3.0
22		0.10	59	–	0.91	0.32		55	80	75	3.0
23		0.09	59	–	0.82	0.30		55	81	75	2.8
24		0.09	59	–	0.82	0.30		55	81	75	2.8
25		0.13	57	–	1.20	0.36		56	71	71	3.0
26		0.13	57	–	1.20	0.36		50	72	71	3.0
27		0.13	57	–	1.20	0.36		49	73	71	3.0
28		0.14	57	–	1.25	0.37		51	74	71	3.0
29		0.13	58	–	1.25	0.36		53	76	71	3.0
30		0.15	57	–	1.20	0.39		54	76	71	3.0
31		0.15	57	–	1.35	0.39		54	76	70	3.0
32		0.15	57	–	1.35	0.39		54	76	70	3.0
33		0.16	58	–	1.35	0.40		55	77	71	3.0
34		0.16	58	–	1.45	0.40		55	76	71	3.5
35		0.16	58	–	1.45	0.40		55	79	72	3.5
36		0.16	58	–	1.45	0.40		55	78	71	3.5
37		0.18	57	–	1.65	0.42		56	73	69	3.5
38		0.18	57	–	1.65	0.42		52	73	69	3.5
39		0.18	57	–	1.65	0.42		53	74	69	3.5
40		0.17	57	–	1.35	0.41		53	75	69	3.5
41		0.15	56	–	1.35	0.39		53	75	68	3.5
42		0.15	57	–	1.35	0.39		53	75	69	3.5
43		0.14	57	–	1.28	0.37		54	75	69	3.3
44		0.14	57	–	1.30	0.37		54	76	69	3.1
45		0.12	57	–	1.10	0.35		54	76	69	3.0
46		0.12	57	–	1.10	0.35		54	75	68	3.0
47		0.10	57	–	0.91	0.32		54	75	69	3.0
48	902.475	0.10	57	–	0.91	0.32		54	75	69	3.0
avg		0.152	58.1	–	1.378	0.387	0.0	55.2	75.4		3.3
	101.884										

POST	PRE	
592.2	582.8	9.4
573.6	569.4	4.2
666.2	646.2	20.0
		0.0
		33.6 gms

Filter ID: #

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Date: 02/16/93

Test No.: 7245-Cr-Outlet 2

Sampling Location: General Dynamics/Lindburg Field, San Diego CA

Stack ID: Tank 8 Scrubber Outlet

Time min	Gas Meter Reading (cf)	Stack Velocity Head (mm)	Temp F	dH Calculated dH	Bar dH	Probe Temp F (SCFF dP)	Hot Box Temp F	Dryer Temp F	Meter temp F in	out	Vacuum "Hg
	902.835										
1		0.18	56	--	1.60	0.42		50	58	58	4.0
2		0.17	56	--	1.50	0.41		49	58	58	4.0
3		0.18	56	--	1.50	0.42		47	60	58	4.0
4		0.18	56	--	1.60	0.42		49	62	59	4.5
5		0.20	56	--	1.80	0.45		51	65	59	4.5
6		0.20	57	--	1.80	0.45		51	67	59	4.5
7		0.22	57	--	1.95	0.47		52	68	60	4.5
8		0.22	57	--	1.95	0.47		53	70	60	5.0
9		0.22	56	--	1.95	0.47		53	71	61	5.0
10		0.22	57	--	1.95	0.47		53	72	61	5.0
11		0.21	57	--	1.90	0.46		52	72	62	5.0
12		0.21	57	--	1.90	0.46		52	73	62	5.0
13		0.17	57	--	1.55	0.41		52	66	62	5.0
14		0.17	56	--	1.55	0.41		47	67	62	5.0
15		0.15	57	--	1.35	0.39		47	68	62	5.0
16		0.15	57	--	1.35	0.39		48	69	67	5.0
17		0.14	57	--	1.35	0.37		49	71	63	5.0
18		0.14	57	--	1.35	0.37		49	72	63	5.0
19		0.12	57	--	1.10	0.35		49	72	63	5.0
20		0.12	58	--	1.10	0.35		50	72	64	4.8
21		0.10	58	--	0.91	0.32		50	73	64	4.0
22		0.10	58	--	0.91	0.32		50	73	64	4.0
23		0.09	58	--	0.82	0.30		50	73	65	4.0
24		0.09	58	--	0.82	0.30		50	72	85	4.0
25		0.12	58	--	1.10	0.35		53	64	63	4.0
26		0.12	57	--	1.10	0.35		47	65	63	4.0
27		0.12	57	--	1.10	0.35		47	67	63	4.0
28		0.13	57	--	1.15	0.36		48	69	64	4.5
29		0.14	57	--	1.25	0.37		50	70	64	4.5
30		0.14	58	--	1.25	0.37		50	71	64	5.0
31		0.14	58	--	1.25	0.37		51	72	64	5.0
32		0.14	57	--	1.25	0.37		51	72	65	5.0
33		0.16	57	--	1.45	0.40		51	73	65	5.0
34		0.16	57	--	1.45	0.40		51	73	65	5.0
35		0.16	57	--	1.45	0.40		51	74	67	5.0
36		0.17	57	--	1.45	0.41		51	74	65	5.0
37		0.18	57	--	1.60	0.42		52	69	65	5.0
38		0.18	57	--	1.60	0.42		50	71	65	5.1
39		0.16	57	--	1.45	0.40		51	72	65	5.0
40		0.16	58	--	1.45	0.40		50	73	65	5.0
41		0.13	58	--	1.15	0.36		51	74	66	4.8
42		0.13	57	--	1.15	0.36		51	74	66	4.8
43		0.12	58	--	1.10	0.35		50	75	66	4.5
44		0.12	57	--	1.10	0.35		50	74	66	4.5
45		0.10	58	--	0.90	0.32		50	75	66	4.0
46		0.11	57	--	0.99	0.33		49	74	66	4.0
47		0.10	58	--	0.90	0.32		49	74	67	4.0
48	1002.183	0.10	57	--	0.90	0.32		49	74	66	4.0
avg		0.151	57.1	--	1.356	0.385	0.0	50.1	66.8		4.6
	99.348										

POST	PRE	
596.7	584.3	12.4
571.9	569.1	2.8
653.8	636.3	17.5
		0.0
		32.7 gms

Filter ID: #

TRACER TECHNOLOGIES
TRAVERSE SOURCE TEST DATA

Date: 02/17/93

Test No.: 7245-Cr-Outlet 3

Sampling Location: General Dynamics/Lindburg Field, San Diego CA

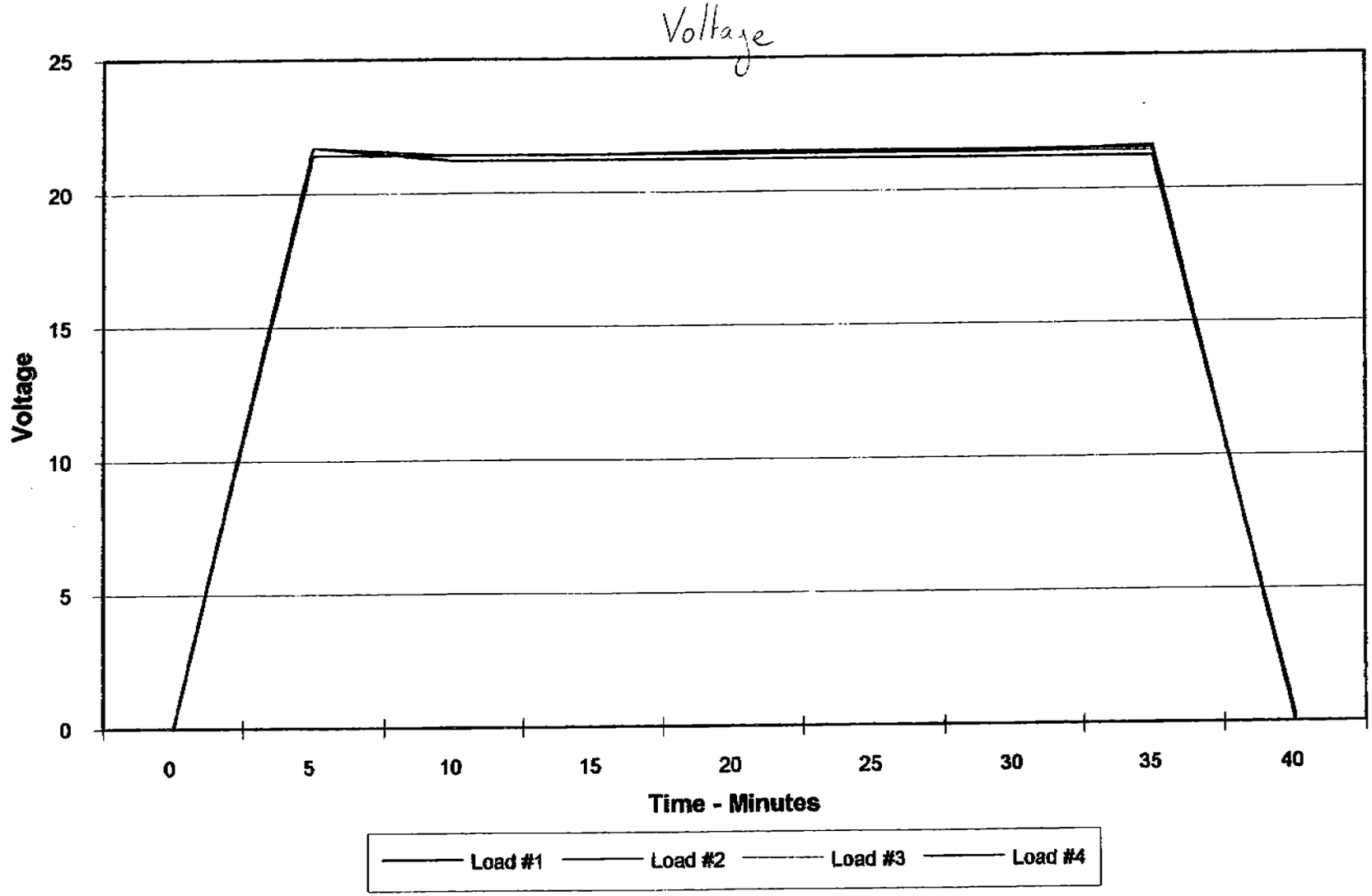
Stack ID: Tank 8 Scrubber Outlet

Time Cr	Gas Meter Reading (cuf)	Stack Velocity Head (inH2O)	Temp F	dH Calculated dH	Set dH	Probe Temp F SQRT dP	Hot Box Temp F	Dryer Temp F	Meter Temp F In	Out	Vacuum inHg
	2.274										
1		0.17	57	–	1.50	0.41		54	62	61	4.0
2		0.17	58	–	1.50	0.41		52	64	61	4.0
3		0.18	58	–	1.60	0.42		54	66	62	4.3
4		0.18	58	–	1.60	0.42		55	67	62	4.3
5		0.21	59	–	1.85	0.46		57	69	63	5.0
6		0.21	59	–	1.85	0.46		56	71	63	5.0
7		0.22	59	–	1.95	0.47		57	73	64	5.0
8		0.22	59	–	1.95	0.47		58	74	64	5.0
9		0.22	59	–	1.95	0.47		58	74	65	5.0
10		0.22	59	–	1.95	0.47		57	75	65	5.0
11		0.20	[illegible]	–	1.80	0.45		58	76	66	5.0
12		0.21	595	–	1.90	0.46		58	76	66	5.0
13		0.18	[illegible]	–	1.60	0.42		58	71	66	4.5
14		0.17	59	–	1.55	0.41		60	74	67	4.5
15		0.14	59	–	1.25	0.37		59	74	67	4.0
16		0.15	59	–	1.35	0.39		58	75	67	4.0
17		0.13	60	–	1.15	0.36		58	76	68	3.8
18		0.13	60	–	1.15	0.36		58	76	66	3.8
19		0.10	60	–	0.90	0.32		59	77	69	3.5
20		0.10	60	–	0.90	0.32		60	77	69	3.1
21		0.08	62	–	0.72	0.28		60	77	69	3.0
22		0.08	62	–	0.72	0.28		60	78	71	3.0
23		0.08	63	–	0.72	0.28		60	78	70	3.0
24		0.08	63	–	0.72	0.28		60	78	70	3.0
25		0.12	61	–	1.10	0.35		62	73	71	3.3
26		0.12	61	–	1.10	0.35		60	75	72	3.3
27		0.12	61	–	1.10	0.35		60	77	72	3.5
28		0.12	61	–	1.10	0.35		59	79	73	3.5
29		0.14	61	–	1.25	0.37		59	80	73	4.0
30		0.14	61	–	1.25	0.37		60	81	73	4.0
31		0.13	61	–	1.20	0.36		60	83	75	4.0
32		0.14	61	–	1.25	0.37		60	84	75	4.0
33		0.15	61	–	1.35	0.39		60	85	76	4.0
34		0.15	61	–	1.35	0.39		61	86	77	4.0
35		0.15	61	–	1.40	0.39		61	88	78	4.0
36		0.15	61	–	1.40	0.39		61	88	78	4.0
37		0.17	62	–	1.60	0.41		59	83	80	4.3
38		0.17	62	–	1.60	0.41		60	85	80	4.5
39		0.15	62	–	1.40	0.39		60	88	81	4.0
40		0.15	62	–	1.40	0.39		61	88	82	4.0
41		0.13	63	–	1.20	0.36		62	91	83	4.0
42		0.13	63	–	1.20	0.36		60	91	84	4.0
43		0.11	63	–	1.00	0.33		60	91	84	3.5
44		0.11	63	–	1.00	0.33		60	91	84	3.5
45		0.10	64	–	0.92	0.32		61	91	84	3.2
46		0.10	66	–	0.92	0.32		61	91	85	3.2
47		0.10	66	–	0.92	0.32		61	91	85	3.2
48	101.091	0.10	66	–	0.92	0.32		60	92	86	3.2
avg		0.145	72.1	–	1.314	0.378	0.0	59.0	75.9		4.0
	98.817										

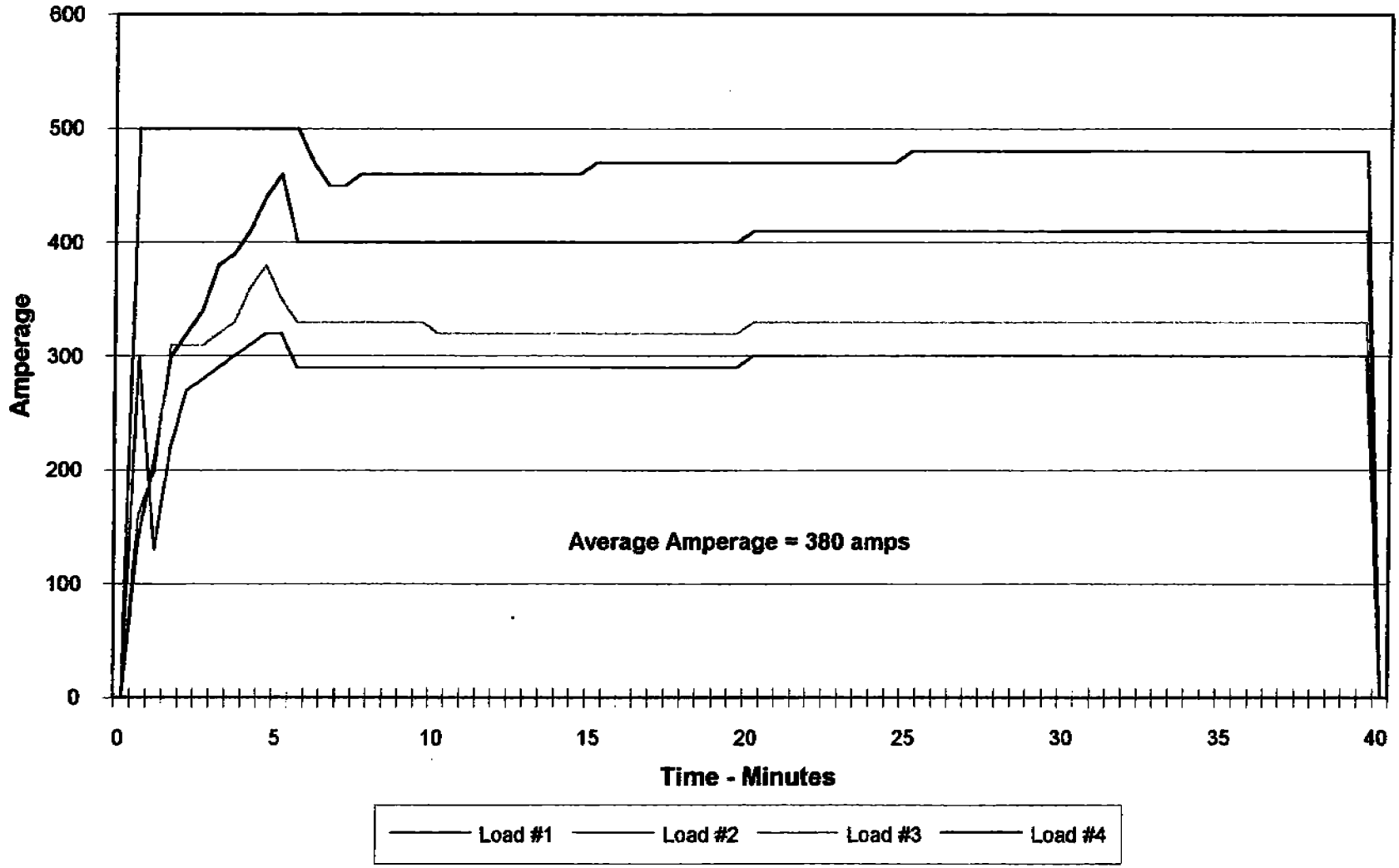
POST	PRE	
600.1	588.0	12.1
582.1	580.2	1.9
683.7	666.1	17.6
		0.0
		31.6 gms

Filter ID: #

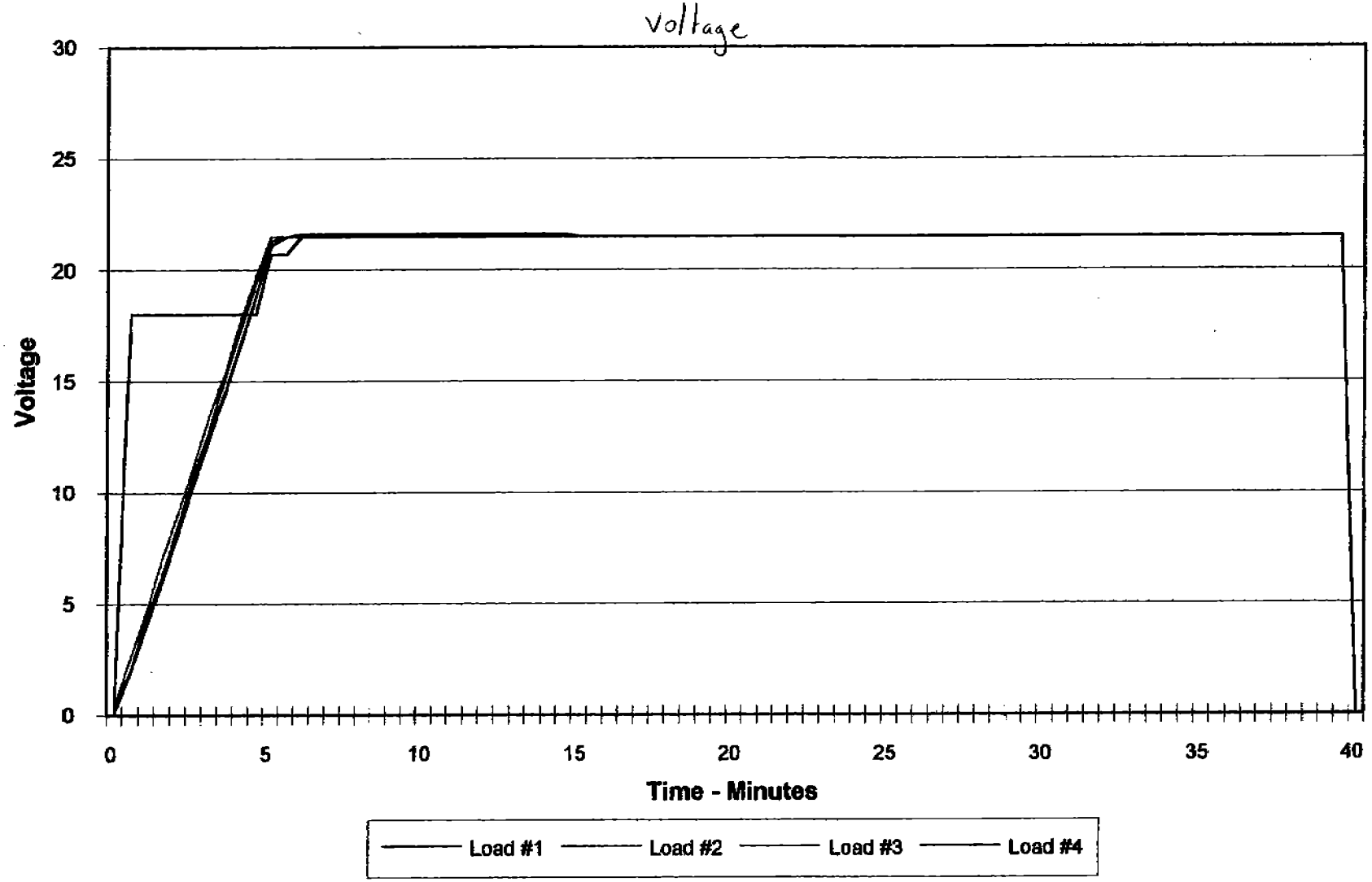
General Dynamics - Tank #8
02/16/93 - Run #1



General Dynamics - Tank #8
02/16/93 - Run #2



General Dynamics - Tank #8
02/16/93 - Run #2



Date: 02/16/93
Run Number: 2

Tested by: DA

General Dynamics Tank #8 Voltage/Amperage Readings

Load #: 1
Start Time: 1815

Time	Voltage	Amperage
0	0.1	0
0.5	1.9	140
1	3.9	210
1.5	5.9	300
2	8.1	320
2.5	10.3	340
3	12.4	380
3.5	14.4	390
4	16.6	410
4.5	18.8	440
5	21.1	460 —
5.5	21.5	400
6	21.6	400
6.5	21.6	400
7	21.6	400
7.5	21.6	400
8	21.6	400
8.5	21.6	400
9	21.6	400
9.5	21.6	400
10	21.6	400
15	21.5	400
20	21.5	410
25	21.5	410
30	21.5	410
35	21.5	410 —
40	0	0
Avg	21.5	414.3

Load #: 2
Start Time: 1900

Time	Voltage	Amperage
0	0.2	0
0.5	1.9	300
1	4.2	130
1.5	6.1	220
2	8.4	270
2.5	10.7	280
3	12.7	290
3.5	15.1	300
4	17.3	310
4.5	19.4	320
5	21.3	320
5.5	21.5	290
6	21.5	290
6.5	21.5	290
7	21.5	290
7.5	21.5	290
8	21.5	290
8.5	21.5	290
9	21.5	290
9.5	21.5	290
10	21.5	290
15	21.5	290
20	21.5	300
25	21.5	300
30	21.5	300
35	21.5	300
40	0	0
Avg	21.5	300.0

Load #: 3
Start Time: 2010

Time	Voltage	Amperage
0	0.3	0
0.5	2.5	160
1	4.5	200
1.5	6.9	310
2	9	310
2.5	11.1	310
3	13.4	320
3.5	15.3	330
4	17.7	360
4.5	19.7	380
5	21.5	350
5.5	21.5	330
6	21.5	330
6.5	21.5	330
7	21.5	330
7.5	21.5	330
8	21.5	330
8.5	21.5	330
9	21.5	330
9.5	21.5	330
10	21.5	320
15	21.5	320
20	21.5	330
25	21.5	330
30	21.5	330
35	21.5	330
40	0	0
Avg	21.5	330.0

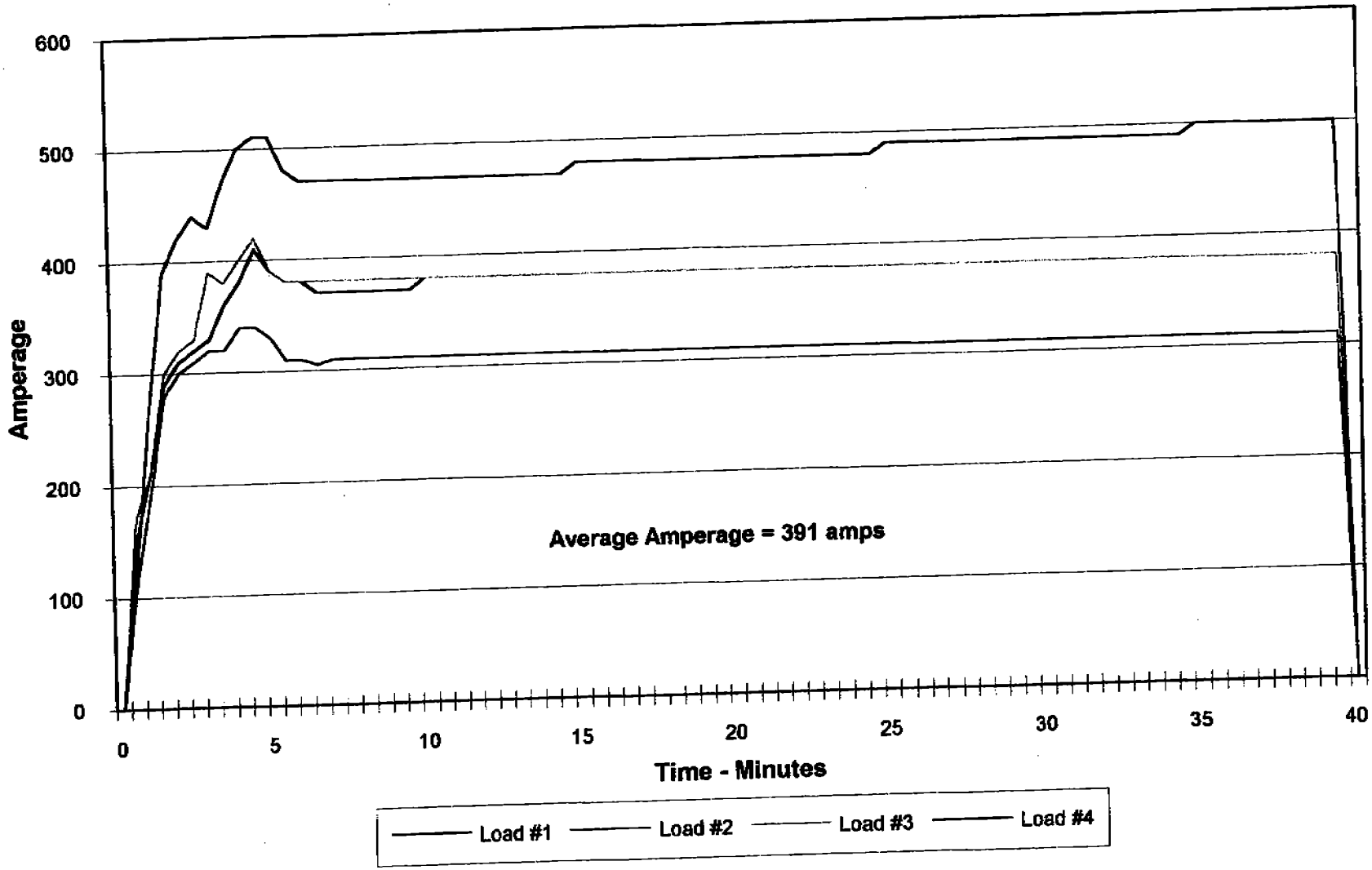
Load #: 4
Start Time: 1955

Time	Voltage	Amperage
0	0	0
0.5	18	500
1	18	500
1.5	18	500
2	18	500
2.5	18	500
3	18	500
3.5	18	500
4	18	500
4.5	18	500
5	20.7	500
5.5	20.7	500
6	21.5	470
6.5	21.5	450
7	21.5	450
7.5	21.5	460
8	21.5	460
8.5	21.5	460
9	21.5	460
9.5	21.5	460
10	21.5	460
15	21.5	470
20	21.5	470
25	21.5	480
30	21.5	480
35	21.5	480
40	0	0
Avg	21.4	477.1

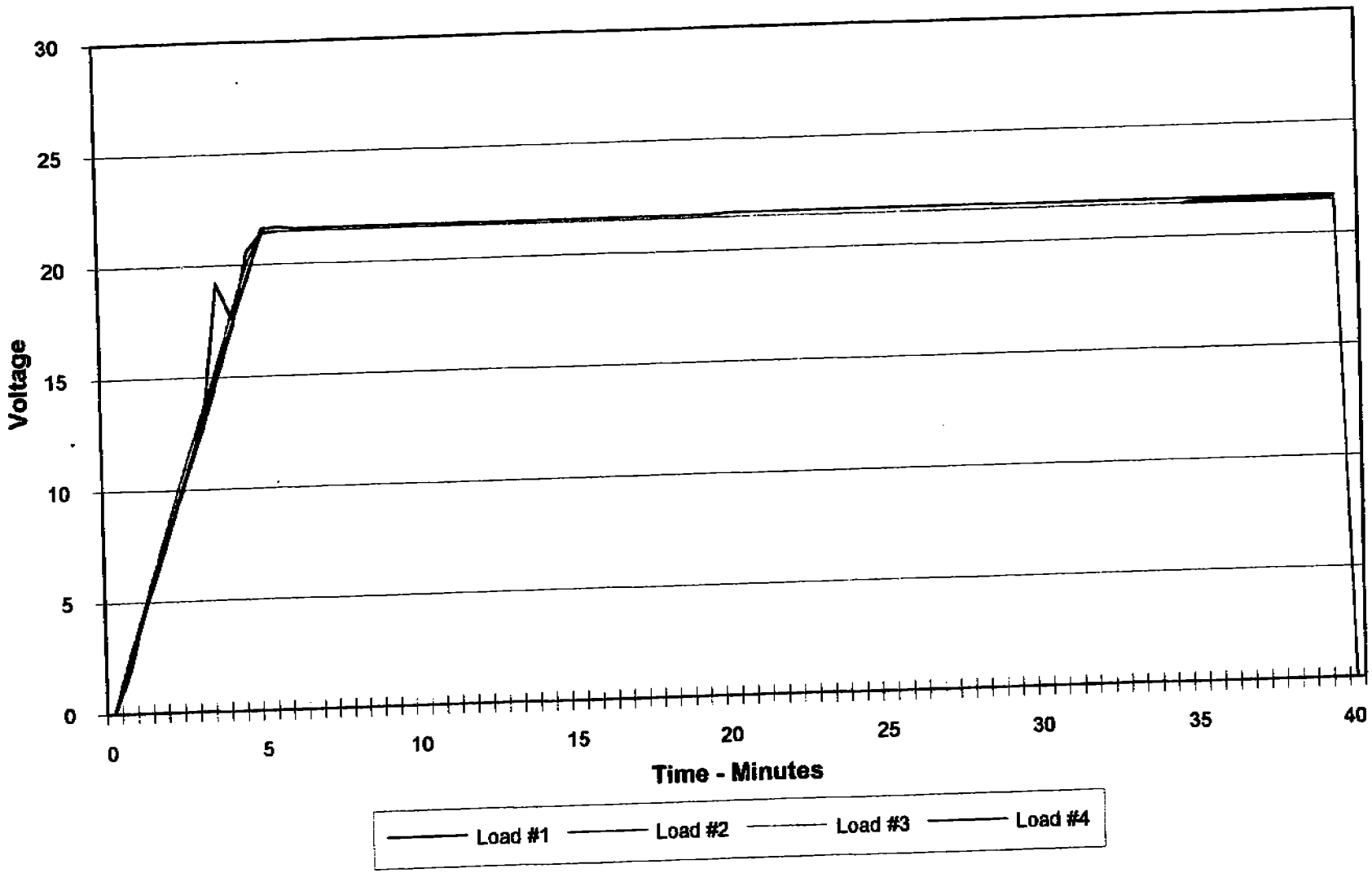
Average Amperage = 380 amps

Average calulated using readings once stablization was reached (5-35 min.)

General Dynamics - Tank #8
02/17/93 - Run #3



General Dynamics - Tank #8
02/17/93 - Run #3



Date: 02/17/93
Run Number: 3

Tested by: DA

General Dynamics Tank #8 Voltage/Amperage Readings

Load #: 1
Start Time: 0842

Time	Voltage	Amperage
0	0	0
0.5	1.8	150
1	4.4	210
1.5	6.4	290
2	8.6	310
2.5	10.7	320
3	12.7	330
3.5	15	360
4	17.3	380
4.5	20.6	410
5	21.4	390
5.5	21.5	380
6	21.5	380
6.5	21.5	370
7	21.5	370
7.5	21.5	370
8	21.5	370
8.5	21.5	370
9	21.5	370
9.5	21.5	370
10	21.5	380
15	21.5	380
20	21.5	380
25	21.5	380
30	21.5	380
35	21.5	380
40	0	0
Avg	21.5	381.4

Load #: 2
Start Time: 0925

Time	Voltage	Amperage
0	0	0
0.5	2.2	110
1	4.4	190
1.5	6.6	280
2	8.7	300
2.5	10.8	310
3	13.1	320
3.5	15.3	320
4	17.4	340
4.5	19.5	340
5	21.4	330
5.5	21.5	310
6	21.5	310
6.5	21.5	305
7	21.5	310
7.5	21.5	310
8	21.5	310
8.5	21.5	310
9	21.5	310
9.5	21.5	310
10	21.5	310
15	21.5	310
20	21.5	310
25	21.5	310
30	21.5	310
35	21.5	310
40	0	0
Avg	21.5	312.9

Load #: 3
Start Time: 1033

Time	Voltage	Amperage
0	0	0
0.5	2.5	170
1	4.6	210
1.5	6.9	300
2	9.2	320
2.5	11.4	330
3	13.5	390
3.5	15.6	380
4	18.0	400
4.5	20.1	420
5	21.5	390
5.5	21.5	380
6	21.5	380
6.5	21.5	380
7	21.5	380
7.5	21.5	380
8	21.5	380
8.5	21.5	380
9	21.5	380
9.5	21.5	380
10	21.5	380
15	21.5	380
20	21.5	380
25	21.5	380
30	21.5	380
35	21.6	380
40	0	0
Avg	21.5	381.4

Load #: 4
Start Time: 1119

Time	Voltage	Amperage
0	0	0
0.5	2	120
1	4.3	270
1.5	6.5	390
2	8.6	420
2.5	10.8	440
3	12.8	430
3.5	19.2	470
4	17.6	500
4.5	19.4	510
5	21.6	510
5.5	21.7	480
6	21.6	470
6.5	21.6	470
7	21.6	470
7.5	21.6	470
8	21.6	470
8.5	21.6	470
9	21.6	470
9.5	21.6	470
10	21.6	470
15	21.6	480
20	21.7	480
25	21.7	490
30	21.7	490
35	21.7	500
40	0	0
Avg	21.7	486.6

Average Amperage = 391 amps
Average calculated once stabilization was reached (5-35 min)

VOU GV/Convair Cal Control No 139040 (volt)
139041 (Amp)
Meter ID 321691-34

Subtest #1

START TIME: 12:42 5 min increments

2/10
TRAIN 1

		VOLTS	AMPS
R 1	1.	0	0
5min	2.	21.7	400
10min	3.	21.2	380
15min	4.	21.2	390
20min	5.	"	"
25min	6.	"	"
30min	7.	"	"
R V 2 ~:15	8.	0.2	0
	9.	21.7	470
	10.	21.4	480
	11.	"	"
	12.	21.5	"
	13.	"	"
	14.	"	"
	15.	"	"
R 1 3 2:28	16.	0	0
	17.	21.4	340
	18	"	350
	19.	"	"
	20.	"	"
	21.	21.4	350
	22.	"	"
	23.	"	"
	24.	0	0
3:12	25.	21.4	290
	26.	"	300
	27.	21.4	"
	28.	"	"
	29.	"	"
	30.	"	"
	31.	21.6	300
	32		

Subtest
#2

TRAIN 2

TA 1: 6:15

	V	A	V	A
Run 1	10.1	0		
~~min 1~~	2.1.9	140		
min 1	3.3.9	210		
	4.5.9	300		
min 2	5.8.1	320		
	6.10.3	340		
min 3	7 12.4	380		
	8 14.4	390		
4	9 16.6	410		
	10 18.8	440		
5	11 21.1	460		
	12 21.5	400		
min 6	13 21.6	400		
	14 "	"		
7 min	15 "	"		
10 min	14 "	"		
15	21.5	400		
20	"	410		
~~25~~	"	"		
30	"	"		
35	"	"		
40	"	"		

30 sec

RUN 2	START 7:00	
	0.2	0
	1.9	300
1 min	4.2	130
	6.1	220
2	8.4	270
	10.7	280
3	12.7	290
	15.1	300
4	17.3	310
	19.4	320
5 min	21.3	"
	21.5	290
6	"	"
	"	"
7 m	"	"
10	"	"
15	"	"
20	"	300
25	21.5	300
30	"	"
35	"	"
40		

TRAIN 2

START TIME: 8:10

RUN 3	0.3	0
	2.9	160
1 min	4.5	200
	6.9	310
2	9.0	310
	11.1	"
3	13.4	320
	~15.3	330
4	17.7	360
	19.7	380
5	21.5	350
	21.5	330
6	"	"
	"	"
7	"	"
10	"	320
15	"	"
20	"	"
25	21.5	330
30	"	"
35	"	"
40		

RUN 4 (Dummy Load)	4min 18.0	500
	5 20.7	500
	6 21.5	470
	10 21.5	460
	15 21.5	470
	20 "	"
	25 "	480
	30 "	"
	35 "	"
	40	
	6.30 21.5	450
	700 "	"
	730 "	460

2/17

START: 8:42

	volt	amps
RUN 1	0	0
30 s	2.8	150
1 min	4.4	210
	6.4	290
2 min	8.4	310
	10.7	320
3	12.7	330
	15.0	360
4	17.3	380
	20.6	410
5	21.4	390
	21.5	380
6	"	"
	"	370
7	"	"
10	"	380
15	"	"
20	"	"
25	"	"
30	"	"
35	"	"

START 9:25

	volt	amps
RUN 2		
	2.2	110
1 min	4.4	190
	6.6	280
2	8.7	300
	10.8	310
3	13.1	320
	15.3	"
4	17.4	340
	19.5	"
5	21.4	330
	21.5	310
6	"	"
	"	305
7	"	310
10	"	"
15	"	"
20	"	"
25	"	"
30	"	"
35	"	"

RUN 3
START 10:33

30 sec	2.5	170
1 min	4.6	210
	6.9	300
2	9.2	320
	11.4	330
3	13.5	350
	15.6	380
4	18.0	400
	20.1	420
5	21.5	390
	21.5	380
6	"	"
	"	"
7	"	"
10	"	"
15	"	"
20	"	"
25	"	"
30	"	"
35	21.6	"

RUN 4 START 11:19 2/17

	2.0	120
1 min	4.3	270
	6.5	390
2	8.6	420
	10.8	440
3	12.8	470
	15.2	470
4	17.6	500
	19.4	510
5	21.6	510
	21.7	480
6	21.6	470
	21.6	470
7	"	"
10	"	"
15	"	480
20	21.7	"
25	"	490
30		
35	"	"
	"	500

Source category: Electroplating
Plant name : General Dynamics-Convair
Process : Chromic acid anodizing

Filename: REF_4-75.WQ1
Location: San Diego, CA
Test date: 2/16-17/93

Date: 04/19/96
Ref. No.: 4-75
Process rate basis:

Tank type	Type of control	Pollutant	Run No.	Test Meth.	Samp. time, min	Isokin. %	Gas volume, DSCF	Volum. flow rate, DSCFM	Mass, ug	Concen., gr/DSCF	Emission rate, lb/hr	Process rate, ft2	Emission factor g/hr-m2	Emission factor gr/hr-ft2	Rat.
Chromic acid anodizing	none	total Cr	1	CARB 425	160	99.6	114.09	12,340	206	2.8E-05	0.00295	66	0.22	0.31	
		total Cr	2		160	99.5	116.27	12,590	235	3.1E-05	0.00337	66	0.25	0.36	
		total Cr	2		160	99.7	114.81	12,399	258	3.5E-05	0.00369	66	0.27	0.39	
		Average								3.0E-05			0.23	0.33	A
		Cr+6	1	CARB 425	160	99.6	114.09	12,340	180	2.4E-05	0.00258	66	0.19	0.3	
		Cr+6	2		160	99.5	116.27	12,590	206	2.7E-05	0.00295	66	0.22	0.31	
		Cr+6			160	99.7	114.81	12,399	227	3.1E-05	0.00324	66	0.24	0.34	
		Average								2.6E-05			0.20	0.29	A
	WS	total Cr	1	CARB 425	160	98.7	100.68	10,261	14.9	2.3E-06	0.00020	66	0.015	0.021	
		total Cr	2		160	98.2	100.05	10,220	16.5	2.5E-06	0.00022	66	0.016	0.024	
		total Cr	2		160	99.4	98.339	9920	20.3	3.2E-06	0.00027	66	0.020	0.029	
		Average								2.4E-06			0.016	0.022	A
		Cr+6	1	CARB 425	160	98.7	100.68	10,261	6.6	1.0E-06	8.9E-05	66	0.0066	0.0094	
		Cr+6	2		160	98.2	100.05	10,220	0.63	9.6E-08	8.4E-06	66	0.00062	0.00090	
		Cr+6			160	99.4	98.34	9,920	9.8	1.5E-06	0.00013	66	0.010	0.014	
		Average								5.5E-07			0.0036	0.0052	B

Notes
Wet scrubber with chlorine oxygen scavenger.
Cr+6 analysis by IC; total Cr by ICP
Cr+6, Run 2 below quantification limit.