Background Report Reference

AP-42 Section Number: 12.20

Background Chapter: 4

Reference Number: 45

Title: State of California Air Resources Board. Chrome Plating Company. Total and Hexavalent Chromium Emissions from Chromium Plating Tanks 3 and 4

April 1987

ELECTROPLATING
REF. 4-45

State of California
AIR RESOURCES BOARD

CHROMAL PLATING COMPANY
TOTAL AND HEXAVALENT CHROMIUM EMISSIONS
FROM CHROMIUM PLATING TANKS 3 AND 4

Engineering Evaluation Branch
Test Report

C-86-125

Report Date: April 3, 1987

APPROVED:

David F. Todd Project Engr.,
Testing Section

Peter K. Ouchida Manager,
Testing Section

[signature] Chief,
Engineering Evaluation Branch

CHROMAL PLATING COMPANY
TOTAL AND HEXAVALENT CHROMIUM EMISSIONS
FROM CHROMIUM PLATING TANKS 3 AND 4

This report presents an estimate of emissions from Chromal Plating Company. These emission estimates are based on tests performed by the Air Resources Board (ARB) staff using a draft ARB test method. The results have been reviewed by the staff and are believed to be accurate within the limits of the method. However, data are usually affected by the test method and process variables which are sometimes not apparent during the tests. The data should not, therefore, be necessarily considered typical of a specific source or industry until the effects of such variables are known and taken into account.

ACKNOWLEDGEMENTS

The project engineer was David Todd and the field engineer was Al Jenkins of ARB. Instrument technicians were Jack LaBrue and Bud Thoma of ARB. The chemist was Ed Jeung of the California Department of Health, Air and Industrial Hygiene Laboratory (AIHL). Assistance was provided by Ray Bokelman of Chromal Plating Company. Additional assistance was provided by Frances Cameron of the ARB Toxic Pollutants Branch. Chemical analyses were performed by AIHL.

CALIFORNIA AIR RESOURCES BOARD TEST OF CHROMAL PLATING COMPANY
Report No. C-86-125
April 3, 1987

UNACCEPTABLE

The inside cover of this report says that the data in the report are an estimate of chromium emissions from this source. In addition, sampling is for an inlet location only, and only 12 points were sampled. The correct number of points for this location is 24, if the sampling is to conform with Reference Method 1. In sampling for chromium, it is necessary to use the specified number of points since past sampling has shown that the distribution of the pollutant is not uniform across the duct. Since this test was merely to obtain an estimate of the emissions, this is the probable reason for using too few points.

CALIFORNIA AIR RESOURCES BOARD TEST OF PRICE PFISTER, INC.
Report No. C-86-106
April 3, 1987

UNACCEPTABLE

The inside cover of this report says that the data in the report are an estimate of chromium emissions from this source. Since data are an estimate, this may account for the insufficient number of sampling points used during the test. It is necessary to use the appropriate number of sampling points - which is 24 - when sampling for chromium since the distribution of chromic acid mist is not uniform within the duct. The presence of chromic acid droplets at the inlet also makes it necessary to sample the proper number of points if accurate data are to be obtained.

CHROMIUM EMISSIONS TESTS FOR TANK 193 AND TANK 195 AT DOUGLAS AIRCRAFT COMPANY (DAC)
March 5, 1987

As per instructions from Andy Smith, this test report was not reviewed since the test report is for an anodizing operation.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

April 20, 1989

MEMORANDUM

SUBJECT: Acceptability of Test Reports

FROM: Frank R. Clay FRC
Field Testing Section, EMB, TSD (MD-14)

TO: Andrew Smith
Industrial Studies Branch, ESD (MD-13)

Attached are three test reports that have been reviewed for acceptability. None was acceptable and the reasons are given below.

Attachment

cc: Dallas Safreit

4/20/89
I got these from F. Clay today.
I don't recall my asking Frank not
to review Douglas Aircraft,
And apparently he did & 4
review standard Nichols Chromium
page 1. He had it before but rejected
it because of no field data sheets.
This was to be reviewed again with the field data
sheets

State of California
AIR RESOURCES BOARD

CHROMAL PLATING COMPANY
TOTAL AND HEXAVALENT CHROMIUM EMISSIONS
FROM CHROMIUM PLATING TANKS 3 AND 4

Engineering Evaluation Branch
Test Report

C-86-125

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 1-4H ✓ Meter ΔH 1.98

Location Scrubber Inlet, Tank 4 VERY IMPORTANT - FILL IN ALL BLANKS

Date 12/16/86 Read and record at the start of each test point.

Operator D Tudd

Sample Box No. Leak Test = Before 16 0R After 17 0R

Meter Box No. 695195 Pitot Tube Factor 0.81

Amps: _____

Ambient Temp °F 65

Bar. Press. "Hg 29.74

Assumed Moisture % ~1 26.5 ml

Heater Box Setting, °F —

Probe Tip Dia., In. 5/16"

Probe Length 28"

Probe Heater Setting —

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. 60 °F Inlet	Dry Gas Temp. 60 °F Outlet	Pump Vacuum In. Hg Gauge	Impinger Temp °F	Stack Press In. Hg	Stack Temp °F	Amps
4 I	000	109.55	0.27	3.2	3.2			10	50	-2.3	75	1700
2	12.3	120.6	0.34	4.0	4.0			12	50		75	0
3	20.0	128.3	0.35	4.1	4.1			13	50		75	-
4	30-40	138.6	0.50	5.8	4.9			17	50		75	20
5	40-50	149.0	0.65	7.6	4.9			17	50		75	1000
6	50-60	160.4	0.53	6.2	4.9							
End		171.4										
V 6	60-70	184.0	0.44	5.2	4.7			17	50		75	
5	70-80	194.2	0.40	4.7	4.7			17	50		75	
4	80-90	204.8	0.39	4.5	4.7			16	50		75	
3	90-100	215.7	0.37	4.3	4.3			16	50		75	
2	100-110	225.6	0.32	3.7	3.7			12.5	50		75	
1	110-120	234.6	0.26	3.0	3.0			10	50		75	
End												
	1600											
			VAP AVG									
	120	125.1	0.63		4.3						75	

Power Outage @ 43 min amp change on restart

H_2O = 26.5

Dia = 26"

Cr III =

(D

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 1-4T ✓
Location Scrubber Inlet Tank 4
Date 12/16/86
Operator D Todd
Sample Box No. ____
Meter Box No. ARB 05418

Meter ΔH 1.92
VERY IMPORTANT - FILL IN ALL BLANKS
Read and record at the start of each test point.
Leak Test = Before 150 ok | After 16 ok
Pitot Tube Factor 0.81

Amps ____
Ambient Temp °F ~~70~~ 65
Bar. Press."Hg 29.74
Assumed Moisture % ~1 32.0 ml
Heater Box Setting, °F ____
Probe Tip Dia., In. 5/16
Probe Length 28"
Probe Heater Setting ____

Point	1315 Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. 60 °F Inlet	Dry Gas Temp. 60 °F Outlet	Pump Vacuum In. Hg Gauge	Impinger Temp °F	Stack Press In. Hg	Stack Temp °F
V 6	000	855.25	0.44	5.2	4.3			16	55	-2.3	75
5	14.6	870.9	0.40	4.7	4.2			16	50		75
4	20.0	876.8	0.39	4.5	4.2			16	50		75
3	30.0	887.9	0.37	4.3	4.2			16	50		75
2	40.0	899.0	0.32	3.7	4.2			16	50		75
1	50.0	910.6	0.26	3.0	4.1			16	50		75
		921.4									
H 1	60.2-70	931.1	0.27	3.2	3.2			11.0	50		75
2	70-80	942.0	0.34	4.0	4.0			15.0	50		75
3	80-90	953.0	0.35	4.1	4.1			15.5	50		75
4	90-100	964.0	0.50	5.8	4.1			15.5	50		75
5	100-110	975.2	0.65	7.6	4.1			15.5	50		75
6	110-120	986.1	0.53	6.2	4.1			15.5	50		75
End											
	1600										
	120	130.85	√ΔP AVG 0.63		4.1						75

Amps 1700 G - 26 1000

V6-4 on V-4 @ 45 min power outage. H_2O = 32.0 ml
Stack 0 = 24"

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 2-4TV
Location Tunk 4 Inlet
Date 12/18/86
Operator DTodd
Sample Box No. ____
Meter Box No. AR13 05418

Meter ΔH 1.92
VERY IMPORTANT - FILL IN ALL BLANKS
Read and record at the start of each test point.
Leak Test = Before: 16" ok | After: 15" ok
Pitot Tube Factor Pone 0.81

Ambient Temp °F ~~55~~ 55
Bar. Press."Hg 29.70
Assumed Moisture % ~1 29.3 ml
Heater Box Setting, °F ____
Probe Tip Dia., In. 5/16"
Probe Length 28"
Probe Heater Setting ____

Point	Clock Time 8:11	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. 60 °F Inlet	Dry Gas Temp. 60 °F Outlet	Pump Vacuum In. Hg Gauge	Impinger Temp °F	Stack Press In. Hg	Stack Temp °F	Amps
V 4 (6)	000	987.02		5.2	4.0			16	40	-2.3	60	1000
4 (5)	11.2	999.6		4.7	4.0			16	40		60	
4	21.9	011.4		4.5	4.0			16	40		60	G-26
3	30	021.5		4.3	4.0			16				
2	40	031.5		3.7	4.0			16	40		65	
1	50	44.3		3.0	~~3.0~~ 3.0			16	40		65	
H 1	60	53.06		3.2	3.2			~~16~~ 12	45		65	1000
2	70	62.9		4.0	3.9			16			65	
3	80	73.9		4.1	4.6			16	50		65	
4	90	91		5.8	3.9			16	50		65	
5	100	99.09		7.6	3.9			16	50		65	
6	110	108		6.2	3.9			16	55		70	
End	120	~~+117.74~~ 117.74	~~AVG~~									
			AVG									
	120	130.72	0.64		3.82						64	

H_2O = 29.3
Dip = 26

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 2-4H ✓ Meter ΔH 1.98

Location Tank 4, Scrubber Inlet VERY IMPORTANT - FILL IN ALL BLANKS

Date 12/~~17~~/86 Read and record at the start of each test point.

Operator D Tudd

Sample Box No. ____

Meter Box No. 695195

Leak Test = Before: 17" ok / After: 18" ok

Pitot Tube Factor None 0.81

Ambient Temp °F ~~53~~ 65

Bar. Press."Hg 29.70

Assumed Moisture % ~1 26.2ml

Heater Box Setting, °F ____

Probe Tip Dia., In. 5/16"

Probe Length 28"

Probe Heater Setting ____

Point	Clock Time 8:13	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. 60 °F Inlet	Dry Gas Temp. 60 °F Outlet	Pump Vacuum In. Hg Gauge	Impinger Temp °F	Stack Press In. Hg	Stack Temp °F
H 1	000	234.90		3.2	3.2			10	40	-2.3	60
2	010	244.3		4.0	4.0			13	40		60
3	020	254.8		4.1	4.1			13	40		60
4	030	265.0		5.8	~~5.8~~ 4.6			17			65
5	040	276.5		7.6	4.6			17	40		65
6	050	288.7		6.2	4.6			17	40		65
V 6(4)	060	298.99		5.2	4.6			17	45		60
5(4)	070	310.2		4.7	4.7			17	45		65
4	080	321		4.5	4.5			17			65
3	90	333.1		4.3	4.3			16	45		66
2	100	343.5		3.7	3.7			12	45		65
1	111	354		3.0	3.0			10	50		70
End	120	362.55									
			TOT AVG								
	(120)	(127.65)	(0.64)		(4.16)						(64)

H_2O = 26.2
Dia = 26"

Amps: 1000 G-26 1000

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 3-4H ✓
Location Tank 4
Date 12/17/86
Operator D Tuttle
Sample Box No. ____
Meter Box No. 695195

Meter ΔH 1.98
VERY IMPORTANT - FILL IN ALL BLANKS
Read and record at the start of each test point.
Leak Test = Before 15"hg / After 20"hg
Pitot Tube Factor None 0.81

Ambient Temp °F 70
Bar. Press."Hg 29.66
Assumed Moisture % ~1 20.0ml
Heater Box Setting, °F ____
Probe Tip Dia., In. 5/16"
Probe Length 28"
Probe Heater Setting ____

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O Δ P	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. 60 °F Inlet	Dry Gas Temp. 60 °F Outlet	Pump Vacuum In. Hg Gauge	Impinger Temp °F	Stack Press In. Hg	Stack Temp °F
H 1	000	362.80		3.2	3.2			16	60	-2.3	75
2	010	368.8		4.0	4.0			16	60		75
3	020	379.0		4.1	4.1			17.5	60 55		75
4	030	389.9		5.8	4.2 4.1			17	55		75
5	040	400.5		7.6	4.2 4.2			17	55		75
6	50	410.9		6.2	4.2			17	55		75
	60	421.4									
V 6 (4)	60-70	432.0		5.2	4.2			17	50		75
5 (4)	70-80	442.6		4.7	4.2			17	50		75
4	80-90	453.1		4.5	4.2			17	50		75
3	90-100	463.6		4.3	4.2			17	50		75
2	100-110	473.6		3.7	3.7			15	50		75
1	110-120	482.7		2.0	3.0			12	50		75
			√ΔP AVG								
	120	119.9	0.64		3.95						75

H_2O = 20.0 ml
Dia = 2.6"

4445
500
G - 26
500

C86-125
Chromel Plating Co.

FIELD DATA

Run No. ~~5-4T~~ 3-4T Meter ΔH 1.92

Location Chrome Tank 4

Date 12/17/86

Operator DTodd

Sample Box No. ____

Meter Box No. ARB 05418

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

Leak Test = Before 16"Hg / After 17"Hg

Pitot Tube Factor None 0.81

Ambient Temp °F 70

Bar. Press."Hg 29.66

Assumed Moisture % ~1 24.0ml

Heater Box Setting, °F ____

Probe Tip Dia., In. 5/16"

Probe Length 28"

Probe Heater Setting ____

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O Δ P	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. 60 °F Inlet	Dry Gas Temp. 60 °F Outlet	Pump Vacuum In. Hg Gauge	Impinger Temp °F	Stack Press In. Hg	Stack Temp °F
~~V4~~ (6)	000	118.08		5.2	4.0			16	60	-2.3	75
~~3-4~~ (5)	010	129.4		4.7	4.3			16	60		75
4	020	140.9		4.5	4.3			16	55		75
3	030	152.5		4.3	4.3			16	55		75
2	040	163.2		3.7	3.7			13	55		75
1	050	173.1		3.0	3.0			11	55		75
	060	183.2									
H 1	60-70	192.8		3.2	3.2			10	55		75
2	70-80	203.8		4.0	4.0			14	55		75
3	80-90	214.8		4.1	4.1			14.5	55		75
4	90-100	225.9		5.8	4.1			14.5	55		75
5	100-110	236.9		2.6	4.1			14.5	55		75
6	110-120	247.9		6.2	4.1			14.5	55		75
			Vapava								
	120	129.82	0.64		3.93						75

Acfms 500 G-26 500

H_2O = 24.0ml

Dia = 26"

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 4-4H ✓ Meter ΔH 1.98

Location Tank 4

Date 12/18/86

Operator J Tackl

Sample Box No. _____

Meter Box No. 695195

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

Leak Test = Before 15"OK After 17"OK

Pitot Tube Factor None 0.81

Ambient Temp °F 60

Bar. Press."Hg 29.82

Assumed Moisture % ~1 29.0 ml

Heater Box Setting, °F —

Probe Tip Dia., In. 5/16"

Probe Length 28"

Probe Heater Setting —

Point	9:08 Clock Time	Dry Gas Meter, CF 483.00	Pitot in. H_2O ΔP	Orifice ΔH in H_2O		Dry Gas Temp. 60 °F		Pump Vacuum In. Hg Gauge	Impinger Temp °F	Stack Press In. Hg	Stack Temp °F	Amps
				Desired	Actual	Inlet	Outlet					
#1	10	494.2	.72	4.9	4.9			17	40	-2.3	65	
2	20	505.5	.38	4.4	4.4			17	40		65	
3	30	516.4	.36	4.2	4.2			15	40		65	G-26
4	40	526.9	.33	3.9	3.9			14	40		65	
5	50	537.7	.36	4.2	4.2			15	40		65	1000
6	60	548.90	.44	5.2	4.6			17	45		65	
V 4 (6)	70	559.5	.37	4.3	4.3			15	45		70	
4 (5)	80	570.3	.32	4.3	4.3			15	45		70	
4 (4)	90	581.0	.37	4.3	4.3			15	45		70	
3	100	591.8	.37	4.3	4.3			15	45		70	1000
2	110	603	.35	4.1	4.1			16	50		70	
1	120	611.55	.24	2.8	2.8			10	50		70	
	11:15											
			ΔP AVG									
	120	128.55	0.60		4.19						67.5	

H_2O = 29.0 ml
Dia = 24"

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 4-4T ✓ | Meter ΔH 1.93 | Ambient Temp °F 60

Location Tank 4 | VERY IMPORTANT - FILL IN ALL BLANKS | Bar. Press."Hg 29.82

Date 12/18/86 | Read and record at the start of each test point. | Assumed Moisture % ~1 28.1 ml

Operator D Tindel | Leak Test = Before 15" ok / After 15½" ok | Heater Box Setting, °F —

Sample Box No. | | Probe Tip Dia., In. 5/16"

Meter Box No. ARB #05418 | Pitot Tube Factor None 0.81 | Probe Length 28"

Probe Heater Setting —

Point	Clock Time (9:09)	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. 60 °F Inlet	Dry Gas Temp. 60 °F Outlet	Pump Vacuum In. Hg Gauge	Impinger Temp °F	Stack Press In. Hg	Stack Temp °F	Amps
Start	000	248.21										
V-6 (4)	0-10	258	.39	~~4.5~~ 4.3	4.0			15½	40	-2.7	65	
5 (4)	10-20	270.1	.37	4.3	4.0			16	40		65	6 - 28
4	20-30	281.1	.37	4.3	4.0			16	40		65	
3	30-40	292.2	.37	4.3	4.0			16	40		65	
2	40-50	303.4	.35	4.1	4.0			16	40		65	1000
1	60	312.71	.24	2.8	2.8			10½	45		65	
H 1	70	323.5	.42	4.9	4.1			15½	45		70	
2	80	334.4	.38	4.4	4.0			15½	45		70	
3	90	345.4	.36	4.2	4.0			15½	45		70	1000
4	100	356.3	.33	3.9	3.9			15½	45		70	
5	110	367	.36	4.2	3.9			15½	50		70	
6	120	378.10	.44	5.2	~~3.8~~ 3.9			15½	50		70	
	11:17											
			TAP AVG									
	(120)	(129.89)	(0.60)		(3.88)						(67.5)	

H_2O = 28.1
Dia = 26"

C86-125
Chromel Plating Co.

NOTE: 1st 20 minutes nothing was being processed.

FIELD DATA

Run No. 1-3H ✓ Meter ΔH 1.64

Location CHROMAL VERY IMPORTANT - FILL IN ALL BLANKS

Date 12/ /86 Read and record at the start of each test point.

Operator JENKINS Leak Test = Before ok / After 15 ok

Sample Box No. ____

Meter Box No. JP497710 Pitot Tube Factor 0.81

Ambient Temp °F 75 12-17-86

Bar. Press."Hg 29.74 29.70

Assumed Moisture % ~1 24.9 ml

Heater Box Setting, °F ____

Probe Tip Dia., In. 5/16

Probe Length 3'

Probe Heater Setting ____

Point	Clock Time 1219	Dry Gas Meter, CF 50.615	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. 60 °F Inlet	Dry Gas Temp. 60 °F Outlet	Pump Vacuum In. Hg Gauge	#2 Impinger Temp °F	AMPS ~~Stack Press In Hg~~	#3 Stack Temp °F
H 1	0-10	57.2	~~0.25~~ 0.15	1.6	1.6			6.0	50		70
2	10-20		0.24	2.6	2.6			11.0	45		70
* 3	20-30	76.20	0.26	2.8	2.8			12.0	50	6800	55
4	30-40	86.10	0.26	2.8	2.8			12.0	50		55
5	40-50	95.70	0.27	2.9	2.9			13.0	50		55
6	50-60	105.4	0.27	2.9	2.9			13.0	50		55
V 6	60-70	115.2	0.25	2.7	2.7			12.5	50		55
5	70-80	125.0	0.25	2.7	2.7			12.0	50		55
* 4	80-90	135.1	0.25	2.7	2.7			12.0	50		55
3	90-100	144.4	0.25	2.7	2.7			12.0	50		55
2	100-110	154.2	0.25	2.7	2.7			12.0	50		55
1	110-120	163.4	0.22	2.4	2.4			10.5	50		55
	0900										
			√ΔP AVG								
	120	112.8	0.49		2.63						57.5

* Note: V-6, 5, 4 all run at V-4.

** Resume run @ 0710 12-17-86.

H_2O = 24.9 Dio = 24"

G - 26

NOTE; 1st 20 minutes no material was being processed.

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 1-3T ✓ Meter ΔH 1.90

Location CHROMAL

Date 12/16/86

Operator JENKINS

Sample Box No. ____

Meter Box No. JP483396

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

Leak Test = Before 0k / After 12 0k

Pitot Tube Factor 0.81

Ambient Temp °F 75

Bar. Press."Hg 29.74

Assumed Moisture % ~1

Heater Box Setting, °F —

Probe Tip Dia., In. 5/16

Probe Length 3'

Probe Heater Setting —

12-17-86
29.70
21.4ml

Point	Clock Time 1218	Dry Gas Meter, CF 478.530	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. 60 °F Inlet	Dry Gas Temp. 60 °F Outlet	Pump Vacuum In. Hg Gauge	Impinger Temp #/ °F	AMP ~~Stack Press~~ ~~In. Hg~~	#3 Stack Temp °F
V 6 *	0-10		0.25	2.9	2.9			10.0	50		70
5 *	10-20	494.3	0.25	2.9	2.9			10.0	50		70
* 4 *	20-30	503.4	0.25	2.9	2.9			10.0	50	6800	55
3	30-40	512.8	0.25	2.9	2.9			10.0	50		55
2	40-50	522.5	0.25	2.9	2.9			10.0	50		55
1	50-60	530.5	0.22	2.6	2.6			9.0	50		55
4 1	60-70	538.2	0.15	1.8	1.8			6.0	50		55
2	70-80	547.1	0.24	2.8	2.8			9.5	50		55
3	80-90	556.6	0.26	3.0	3.0			10.5	50		55
4	90-100	565.8	0.26	3.0	3.0			10.5	50		55
5	100-110	575.6	0.27	3.2	3.2			11.5	50		55
6	110-120	585.1	0.27	3.2	3.2			11.5	50		55
	0900										
			√ΔP AVG								
	120	106.6	0.49		2.84						57.5

* NOTE! V-6, 5 & 4 ALL RUN AT POINT V-4. AVG.

** Resume run @ 0710 12-17-86

H_2O = 21.4 Dia = 24" . Cone =

G - 26

C86-125
Chromel Plating Co.

FIELD DATA

Run No. Z-3T ✓ | Meter ΔH 1.90 | Ambient Temp °F 60

Location CHROMAL | VERY IMPORTANT - FILL IN ALL BLANKS | Bar. Press."Hg 29.70

Date 12/ /86 | Read and record at the start of each test point. | Assumed Moisture % ~1 23.0 ml

Operator JENKINS | Heater Box Setting, °F —

Sample Box No. | Leak Test = Before 15 ok / After 13 ok | Probe Tip Dia., In. 5/16

Meter Box No. JP483396 | Pitot Tube Factor 0.81 | Probe Length 3'

Probe Heater Setting —

Point	Clock Time ≈1015	Dry Gas Meter, CF 585.5	Pitot in. H_2O ΔP	Orifice ΔH in H_2O		Dry Gas Temp. 60 °F		Pump Vacuum In. Hg Gauge	Impinger Temp °F	AMP ~~Stack Press Inwdlg~~	Stack Temp °F
				Desired	Actual	Inlet	Outlet				
V- 6	0-10	594.7	0.25	2.9	2.9			10	40	6800	60
5	10-20	603.8	0.25	2.9	2.9			10	40		60
4	20-30	613.1	0.25	2.9	2.9			10	40		60
3	30-40	622.3	0.25	2.9	2.9			10	40		65
2	40-50	631.5	0.25	2.9	2.9			10	40		65
1	50-60	639.8	0.22	2.6	2.6			9	40		65
H- 1	60-70	647.1	0.15	1.8	1.8			5.5	45		65
2	70-80	656.1	0.24	2.8	2.8			10	45		65
3	80-90	665.6	0.26	3.0	3.0			11	45		65
4	90-100	675.1	0.26	3.0	3.0			11	45		65
5	100-110	685.0	0.27	3.2	3.2			11.5	45		65
6	110-120	694.1	0.27	3.2	3.2			11	45		65
			√ΔT AVG								
	(120)	(108.6)	(0.49)		(2.84)						(63.8)

V-6,5,4 run at pt.4 H_2O = 23.0 (VOL =

Dia = 24"

G - 26

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 2-3H ✓ Meter ΔH 1.64

Location CHROMAL VERY IMPORTANT - FILL IN ALL BLANKS

Date 12/ /86 Read and record at the start of each test point.

Operator JENKINS Leak Test = Before 15ok / After 15ok

Sample Box No. ____

Meter Box No. JP497710 Pitot Tube Factor 0.81

Ambient Temp °F 60

Bar. Press."Hg 29.70

Assumed Moisture % ~1 22.0ml

Heater Box Setting, °F ____

Probe Tip Dia., In. 5/16

Probe Length 3'

Probe Heater Setting ____

Point	Clock Time 2:10:15	Dry Gas Meter, CF 164.02	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. 60 °F Inlet	Dry Gas Temp. 60 °F Outlet	Pump Vacuum In. Hg Gauge	Impinger Temp °F	AMP ~~Stack Press~~ ~~In. Hg~~	Stack Temp °F
H 1	0-10	171.5	0.15	1.6	1.6			6	40	6800	60
2	10-20	180.6	0.24	2.6	2.6			11	40		60
3	20-30	190.3	0.26	2.8	2.8			12	40		65
4	30-40	200.6	0.26	2.8	2.8			12	40		65
5	40-50	209.9	0.27	2.9	2.9			12.5	40		65
6	50-60	219.7	0.27	2.9	2.9			12.5	40		65
V 6	60-70	229.1	0.25	2.7	2.7			11	45		65
5	70-80	238.7	0.25	2.7	2.7			11	45		65
4	80-90	248.2	0.25	2.7	2.7			11	45		65
3	90-100	258.1	0.25	2.7	2.7			11	45		65
2	100-110	267.7	0.25	2.7	2.7			11	45		65
1	110-120	276.3	0.22	2.4	2.4			11	45		65
			$\sqrt{\Delta P}$ AVG								
	120	112.28	0.49		2.63						64.2

V- 6,5,4 run at pt. 4 H_2O = 22.0 (VI --

Dia = 24"

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 3-3T ✓

Location CHROMAL

Date 12/18/86

Operator JENKINS

Sample Box No. _____

Meter Box No. JP483396

Meter ΔH 1.90

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

Leak Test = Before 15 ok / After 16 ok

Pitot Tube Factor 0.81

Ambient Temp °F 65

Bar. Press."Hg 29.82

Assumed Moisture % ~1 28.5 ml

Heater Box Setting, °F —

Probe Tip Dia., In. 5/16

Probe Length 3'

Probe Heater Setting —

Point	Clock Time 1045	Dry Gas Meter, CF 694.7	Pitot in. H_2O ΔP	Orifice ΔH in H_2O		Dry Gas Temp. 60 °F		Pump Vacuum In. Hg Gauge	Impinger Temp °F	AMP ~~Stack Press In. Hg~~	Stack Temp. °F
				Desired	Actual	Inlet	Outlet				
V-6 (4)	0-10	704.4	0.28	3.3	3.3			13	40	2500	60
5 (4)	10-20	714.0	0.27	3.1	3.1			12	40		60
4 (4)	20-30	723.5	0.25	2.9	2.9			11	40		60
3	30-40	732.5	0.24	2.8	2.8			10.5	40		60
2	40-50	741.6	0.25	2.9	2.9			11	40	4500	65
1	50-60	750.3	0.22	2.6	2.6			9	40		65
H-1	60-70	760.0	0.28	3.3	3.3			13	40		65
2	70-80	769.4	0.25	2.9	2.9			11	40		65
3	80-90	778.6	0.25	2.9	2.9			11	40		65
4	90-100	787.8	0.25	2.9	2.9			11	40		65
5	100-110	796.3	0.21	2.4	2.4			9	40		65
6	110-120	804.2	0.18	2.1	2.1			7.5	40		65
			VAP AVG								
	120	109.5	0.49		2.84						63

H_2O = 28.5 ml

Dia - 24"

C86-125
Chromel Plating Co.

FIELD DATA

Run No. 3-3H ✓ Meter ΔH 1.64 Ambient Temp °F 65

Location CHROMAL VERY IMPORTANT - FILL IN ALL BLANKS Bar. Press."Hg 29.82

Date 12/18/86 Read and record at the start of each test point. Assumed Moisture % ~1 28.5 ml

Operator JENKINS Heater Box Setting, °F —

Sample Box No. Leak Test = Before 150 ~~2~~ After 160 ~~2~~ Probe Tip Dia., In. 5/16

Meter Box No. JP497710 Pitot Tube Factor 0.81 Probe Length 3'

Probe Heater Setting —

Point	Clock Time 1045	Dry Gas Meter, CF 276.9	Pitot in. H_2O ΔP	Orifice ΔH in H_2O		Dry Gas Temp. 60 °F		Pump Vacuum In. Hg Gauge	Impinger Temp °F	AMP ~~Stack Probe~~ ~~In Hg~~	Stack Temp °F
				Desired	Actual	Inlet	Outlet				
H-1	0-10	286.8	0.28	3.3	3.3			13	40	2500	60
2	10-20	296.9	0.25	2.9	2.9			11	40		60
3	20-30	306.8	0.25	2.9	2.9			11	40		60
4	30-40	316.7	0.25	2.9	2.9			11	40		60
5	40-50	325.8	0.21	2.4	2.4			9	40	4500	65
6	50-60	334.2	0.18	2.1	2.1			7.5	40		65
V-6(4)	60-70	344.7	0.28	3.3	3.3			13	40		65
-5(4)	70-80	355.1	0.27	3.1	3.1			12.5	40		65
4	80-90	365.1	0.25	2.9	2.9			11	40		65
3	90-100	375.0	0.24	2.8	2.8			11	40		65
2	100-110	384.8	0.25	2.9	2.9			11	40		65
1	110-120	394.3	0.22	2.6	2.6			10	40		65
			√ΔP AVG								
	120	117.4	0.49		2.84						63

H_2O = 28.5

Dia = 244

G - 26

Chromed Plating Co.

12-16-86 C-86-125 L.A.

Run #	Silica Gel	Nozzle Cp	Probe Cp	Filter #	Velocity Probe #	H_2O NET	Total Impinger H
1-I3-T	1782.6 1802			16	1	21.4	202
1-I3-H	1771.6 1795.5			17		24.9	201
1-I4-T	1777 1810.0			18		32.0	199
1-I4-H	1787 1815.5			19		26.5	198
2-I3-T	1775 1798			31		23.0	200
2-I3-H	1768 1790			32		22.0	200
2-I4-T	1785 1816.3			29		29.3	198
2-I4-H	1779 1805.2			30		26.2	200
3-I4-T	1754.5 1781.5			33		24.0	197
3-I4-H	1769 1792.0			34		20.0	197
3-I3-T	1767.5 1790			35		28.5	206
3-I3-H	1776.5 1800.0			36		28.5	205
4-I3-T							
4-I3-H							
4-I4-T	1779.4 1807			38		28.1	201
4-I4-H	1776.5 1803.5			39		29.0	202
Blank # 1				37			
Blank # 2				40			
Blank # 3				41			
Blank # 4							

File No. 86-~~000~~ 125

State of California

AIR RESOURCES BOARD

Stationary Source Control Division
Engineering Evaluation Branch

VELOCITY TRAVERSE DATA

Traverse Point Number	Velocity Head in. H_2O	Distance from inside wall (in.)	Stack Temperature (T_s), °F	Velocity Head in. H_2O	$\sqrt{\Delta P}$	Stack Temperature (T_s), °F
H - 1	0.28		65			
2	0.25					
3	0.25					
4	0.25					
5	0.21					
6	0.18					
V - 1	0.22					
2	0.25					
3	0.24					
4	0.25					
5	0.27					
6	0.28		↓			
Average						

Plant CHROMAL

Sampling Site Tank #3

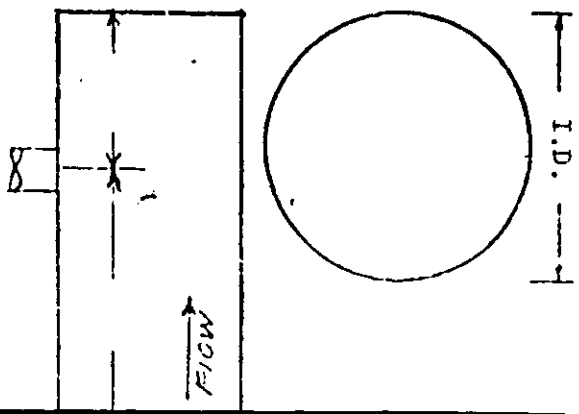
Remarks

Barometric Pressure, in. Hg 29.82

Static Pressure in Stack (P_g) in. H_2O -2.0

Operators JENKINS Date 12-18-86

Pitot Tube Factor -------



File No. 86-106 125

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AIR RESOURCES BOARD

Stationary Source Control Division
Engineering Evaluation Branch

VELOCITY TRAVERSE DATA

ΔH 2.4
ΔP 0.2
S/N #1

TANK #4

Traverse Point Number	Velocity Head in. H_2O	Distance from inside wall (in.) w/o/FF		Stack Temperature (T_s), °F	Velocity Head in. H_2O	$\sqrt{\Delta P}$	Stack Temperature (T_s), °F
4" HORIZ							
1	0.27	1.1	5.1	65			
2	0.34	3.8	7.8	65			
3	0.35	7.7	11.7	65			
4	0.50	18.3	22.3	65			
5	0.65	22.2	26.2	65			
6	0.53	24.9	28.9	65			
6" VERTICAL							
1	0.26	1.1	7.1	65			
2	0.32	3.8	9.8	65			
3	0.37	7.7	13.7	65			
4	0.39	18.3	24.3	65			
5	0.40	22.2	28.2	65			
6	0.44	24.9	30.9	65			
	Avg 0.40						
Average							

Plant CHROMAL

Sampling Site TANK #4 OUTLET

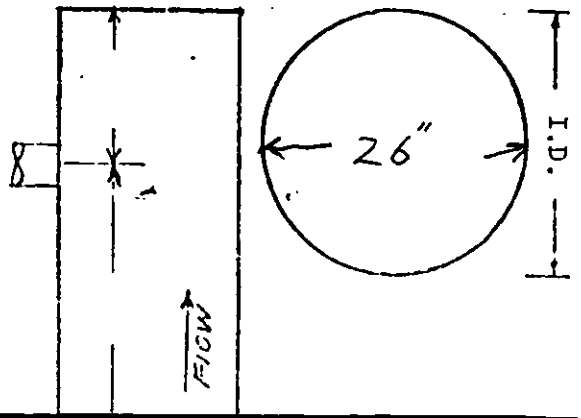
Remarks

Barometric Pressure, in. Hg 29.74

Static Pressure in Steck (P_g) in. Hg 2.3" H_2O

Operators H. HENKINS Date 12-16-86

Pitot Tube Factor ------



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State of California

AIR RESOURCES BOARD

Stationary Source Control Division
Engineering Evaluation Branch

VELOCITY TRAVERSE DATA

S/N #1

Traverse Point Number	Velocity Head in. H_2O	Distance from inside wall (in.)	Stack Temperature (T_s), °F	Velocity Head in. H_2O	$\sqrt{\Delta P}$	Stack Temperature (T_s), °F
H- 1	0.42		65			
2	0.38					
3	0.36					
4	0.33					
5	0.36					
6	0.44					
V- 1	0.24					
2	0.35					
3	0.37					
4	0.37					
5	0.37					
6	0.39					
Average						

Plant CHROMAL

Sampling Site Tank #4

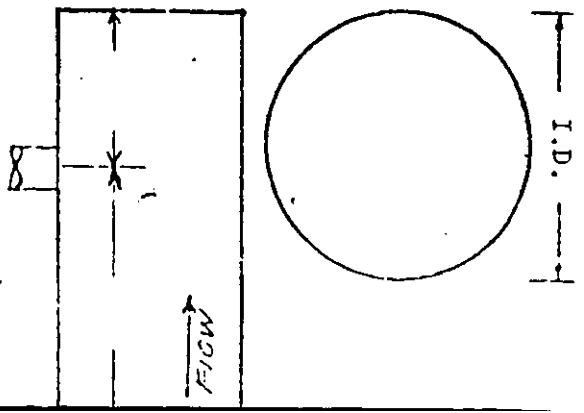
Remarks

Barometric Pressure, in. Hg 29.82

Static Pressure in Stack (P_g) in. H_2O -2.3

Operators JENKINS Date 12-18-86

Pitot Tube Factor -------



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Engineering Evaluation Branch

6" NIPPLE

VELOCITY TRAVERSE DATA

TANK #3

S/N #1

Traverse Point Number	Velocity Head in. H_2O	Distance from inside wall (in.) w/out		Stack Temperature (T_s), °F	Velocity Head in. H_2O	$\sqrt{\Delta P}$	Stack Temperature (T_s), °F
6" VERTICAL							
1	0.22	1.0	7.0	62			
2	0.25	3.5	9.5	62			
3	0.25	6.9	12.9	62			
4	0.25	16.6	22.6	62			
5	0.25	20.0	26.0	62			
6	0.25	22.5	28.5	62			
6" HORIZ							
1	0.15	1.0	7.0	62			
2	0.24	3.5	9.5	62			
3	0.26	6.9	12.9	62			
4	0.26	16.6	22.6	62			
5	0.27	20.0	26.0	62			
6	0.27	22.5	28.5	62			
	Avg 0.24			62			
Average							

Plant CHROMAL

Sampling Site TANK #3 OUTLET

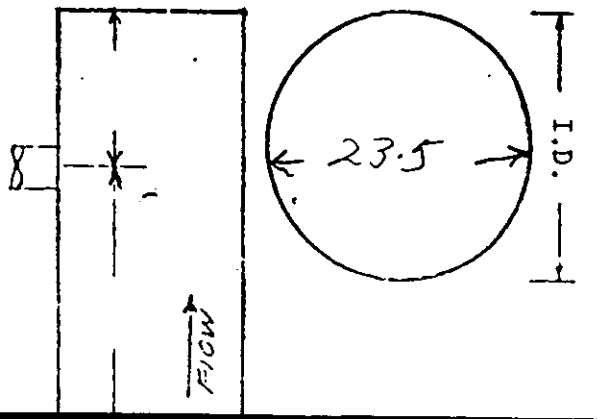
Remarks

Barometric Pressure, in. Hg 29.74

Static Pressure in Stack (P_s) in. Hg -1.9" H_2O

Operators A. JENKINS Date 12-16-86

Pitot Tube Factor -------



Duct #3

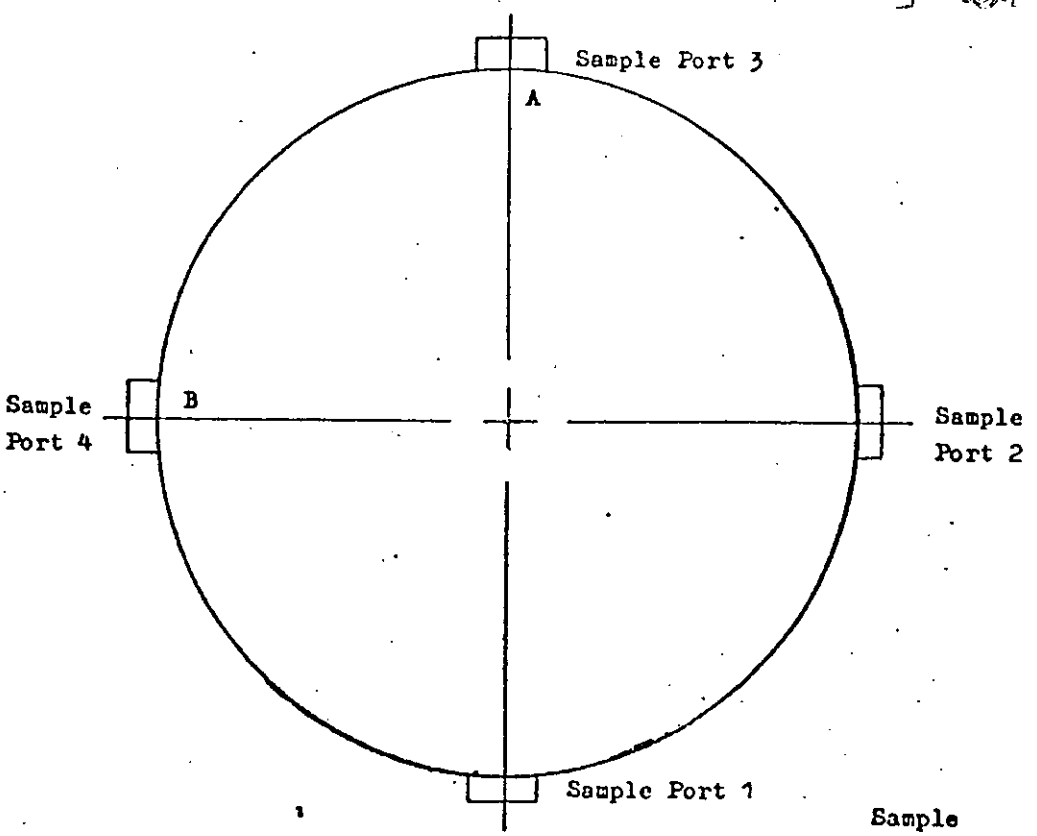
Nipple + Nipple Dia Dia

3 Horiz 6" - 29½" = 23½"

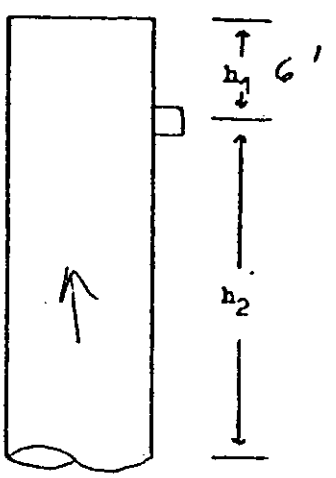
3 Vert - 6¼" - 29½" = 24'

Figure II

Round Stack



Sample Port Elevation



Notes:

1. Stack diameter 2'.
2. Sampling port is 6' feet upstream (h_1) of any disturbance and 10'4" feet downstream (h_2) of any disturbance.
3. Sampling port is not 8 diamters downstream and 2 diameters upstream. The following was done to compensate for this: 16' 4'

```
            XROM "NOP"

DOWNSTREAM DIA?
          3.0638    RUN
UPSTREAM DIA?
          1.0213    RUN
STK DIA INCHES?
         23.5000    RUN

TOTAL POINTS = 24.
```

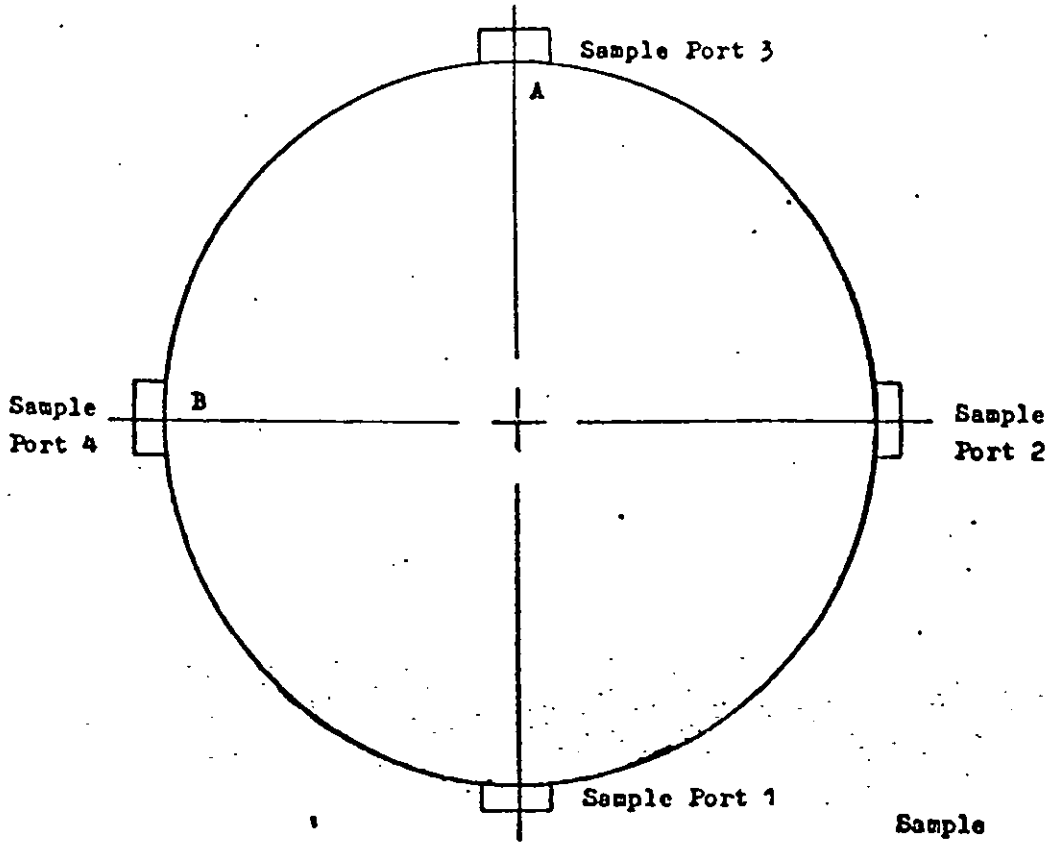
Nipple Nipple Dia.

4 H = 4 1/4 - 30 1/2 = 26".

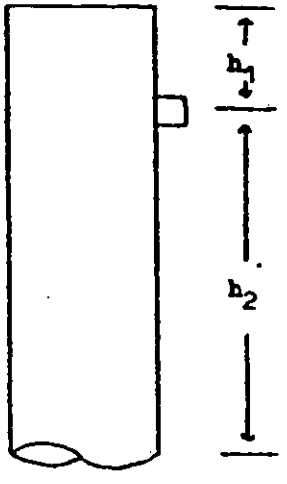
4 y = 6 1/4" - 32 1/4 = 26"

Figure II

Round Stack



Sample Port Elevation



Notes:

1. Stack diameter 26".
2. Sampling port is 6' feet upstream (h_1) of any disturbance and 9' feet downstream (h_2) of any disturbance.
3. Sampling port is not 8 diamters downstream and 2 diameters upstream. The following was done to compensate for this: _____

```
                XROM "NOP"

DOWNSTREAM DIA?
            4.1538    RUN
UPSTREAM DIA?
            2.7692    RUN
STK DIA INCHES?
           26.0000    RUN

TOTAL POINTS = 24.
```

Chromal Plating Company
Total and Hexavalent Chromium Emissions
From Chromium Plating Tanks 3 and 4

SUMMARY

The Air Resources Board (ARB) has identified hexavalent chromium as a toxic air contaminant. Because of this, sampling was requested by the ARB Toxic Pollutants Branch to determine chromium emissions from a "hard" chromium plater. Samples were collected at Chromal Plating Co. on December 16 through 18, 1986, by the staff of the Engineering Evaluation Branch (EEB) of the Air Resources Board (ARB). The samples were analyzed by the Department of Health Services (DOHS) Air and Industrial Hygiene Laboratory (AIHL) for total chromium and hexavalent chromium.

Chromium is applied by electroplating from a plating solution in which it is present as hexavalent chromium, an anion in a high oxidation state. Electroplating is accomplished by applying a high amperage, low voltage direct current (dc) through the plating solution. The material to be plated is hung from the negative, or cathode, bus bars of the plating tank. Anodes are hung from the positive bus bars. Chromium plating is only 8-20% efficient. A major reason for the inefficiency is the breakdown of water molecules in the plating solution by the electric current. This results in the release of hydrogen gas at the cathode and oxygen at the anode. A portion of the plating solution is entrained with these released gases, which are vented for safety reasons. At Chromal, these gases are passed through a scrubber and then vented to the atmosphere. The scrubber is used to recover some of the vented plating solution and return it to the plating tank.

Sampling and analysis for hexavalent and total chromium samples was conducted in accordance with the ARB's Draft Test Method 425 (Determination of Total Chromium and Hexavalent Chromium Emissions from Stationary Sources). The results of the sampling and analysis and other data are shown in the Summary Table. Emissions from plating tank 3 ranged between 20.5×10^{-3} lb/hr and 33.3×10^{-3} lb/hr for total chromium and 5.2×10^{-3} and 26.6×10^{-3} lb/hr for hexavalent chromium. Emissions from plating tank 4 ranged between 14.6×10^{-3} lb/hr and 38.0×10^{-3} lb/hr for total chromium and 19.3×10^{-3} lb/hr and 33.5×10^{-3} lb/hr for hexavalent chromium.

Summary Table

Test Data For
Chromal Plating Co.

	Tank 3						Tank 4							
1. Run Number	1		2		3		1		2		3		4	
2. Chromium Emissions	Total [a/]	Hex. [b/]	Hex.	Hex.	Total	Hex.	Total	Hex.	Hex.	Hex.	Total	Hex.	Total	Hex.
a. Before Scrubber, 10^{-3} lb/hr	20.5	5.2	9.9	10.4	33.3	26.6	14.6	21.2	28.3	27.3	22.6	19.3	38.0	33.5
3. Chromium in Scrubber Water														
a. Total, mg/ml	4.9		4.8		5.8		4.7		4.8		4.8		5.5	
b. Hexavalent, mg/ml	4.3		4.3		4.2		3.9		4.3		4.3		4.2	
4. Plating Tank Data														
a. Tank Temperature, degrees F	120		120		120		120		120		120		120	
b. Tank Surface Area, sq. ft.	43.5		43.5		43.5		57		57		57		57	
c. Electroplating Amps	6000		6000		4500		1000		1000		500		1000	
d. Chromic Acid Conc., oz/gal	32		32		32		32		32		32		32	

a/ Total - Total chromium, including hexavalent chromium.

b/ Hex. - Hexavalent chromium.

Chromal Plating Company
Total and Hexavalent Chromium Emissions
for Chromium Plating Tanks 3 and 4

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APPENDICES

I. INTRODUCTION

The Air Resources Board (ARB) has identified hexavalent chromium as a toxic air contaminant. Subsequently, the Toxic Pollutants Branch of the ARB requested the Engineering Evaluation Branch (EEB) of the ARB conduct an emissions test to evaluate hexavalent chromium emissions from a "hard" chromium plating operation. The Chromal Plating Company in Los Angeles was selected for testing and testing was conducted on December 16 through 18, 1986. The samples were analyzed for total and hexavalent chromium by the Air and Industrial Hygiene Laboratory (AIHL) of the Department of Health Services. The objectives of this test were to:

1. Determine total and hexavalent chromium emissions from a hard chromium plater.
2. Determine if it is necessary to stabilize the sample filters immediately after sampling as part of the test method development.

After sampling on the last day of testing, additional samples were collected from tank 3 by Truesdail Laboratories. Truesdail Laboratories is a contract laboratory commissioned for the Metal Finishing Association of Southern California Inc. Matt Dunn of Dames and Moore, Santa Barbara, observed the evaluation test for the Metal Finishing Association.

II. CONCLUSIONS

Emissions of total chromium (including hexavalent chromium) at Chromal ranged from 20.5×10^{-3} lb/hr to 33.3×10^{-3} lb/hr for tank 3 and 14.6×10^{-3} lb/hr to 38.1×10^{-3} lb/hr for tank 4. Emissions of hexavalent chromium at Chromal ranged from 5.2×10^{-3} lb/hr to 26.6×10^{-3} lb/hr for tank 3 and 19.3×10^{-3} lb/hr to 33.5×10^{-3} lb/hr from tank 4.

The number of samples was too limited to determine if treating the sample filters on site had any effect on the hexavalent chromium analytical results.

III. PROCESS DESCRIPTION

Chromal is classified as a "hard" chromium plater. In "hard" chromium plating chromium is applied to steel surfaces in thicknesses of 0.0001-0.010 inches to build up worn parts and provide abrasion resistant surfaces such as those seen on hydraulic rams and cylinders. "Decorative" chromium plating is the other classification where a much thinner layer (0.00001-0.000002 inches) of chromium is applied to produce a bright and decorative, as well as corrosion and abrasion resistant, surface.

The chromium is deposited onto the surface of the base material by electroplating. Electroplating operations, including cleaning, rinsing, plating, and post plating treatments, can be manual or with any degree of automation that is desired. Chromal's operation is basically manual to accommodate the wide variation in the parts that are plated.

The part to be plated can either be suspended by wires or racks before being submerged into a tank containing the plating solution. At Chromal, the parts are suspended by wires. The chromium is deposited onto the material surface from a solution in which it is present as hexavalent chromium, an anion in a high oxidation state. Along with chromium acid, the aqueous solution usually contains a small and carefully controlled amount of catalyst ion, such as sulfate. The necessary direct current (dc) power for electroplating is supplied by rectifiers or a generator. The current is applied to the plating tank by bus bars. Anodes are hung from positive bus bars and the item to be plated is hung from the negative or cathode bus bars. Tank voltage and current are monitored with voltmeters and ammeters.

Chromium plating is one of the most difficult electroplating operations; temperature, current density, and bulk composition are kept within a relatively narrow range. With respect to electric current, chromium plating is only 8-20% efficient. Most of the electric current is spent converting water in the plating solution into hydrogen and oxygen gases. This results in the off gassing of hydrogen at the cathode and oxygen at the anode. The release of these gases from the plating tank causes a spray that carries some of the plating solution with the gases. For safety reasons the spray must be vented. For economic reasons, the spray is usually vented through a scrubber to recover some of the plating solution. Part of the scrubber water is then used as makeup to replace some of the lost plating solution.

During the three days of emissions sampling, Chromal maintained a relatively consistant plating operation in tank 3. In tank 4, the plating operations were varied over the three test days. Table 1 shows the operating parameters and conditions during the 3 days of testing.

IV. SAMPLING LOCATIONS AND METHODS

Hexavalent and total chromium samples were collected according to a draft of ARB's Stationary Source Test Method 425 (Determination of Total Chromium and Hexavalent Chromium Emissions from Stationary Sources). A type S pitot tube was used to determine stack gas velocity. Moisture content was determined as specified by ARB Method 4 (Determination of Moisture Content in Stack Gases). Dry molecular weight (CO, CO_2, O_2, N_2) was estimated based upon atmospheric concentrations. Figure 1 shows the sampling locations before the scrubber.

Draft Method 425 is similar to ARB Test Method 5 but with special requirements. Those special requirements for sampling Chromal included the

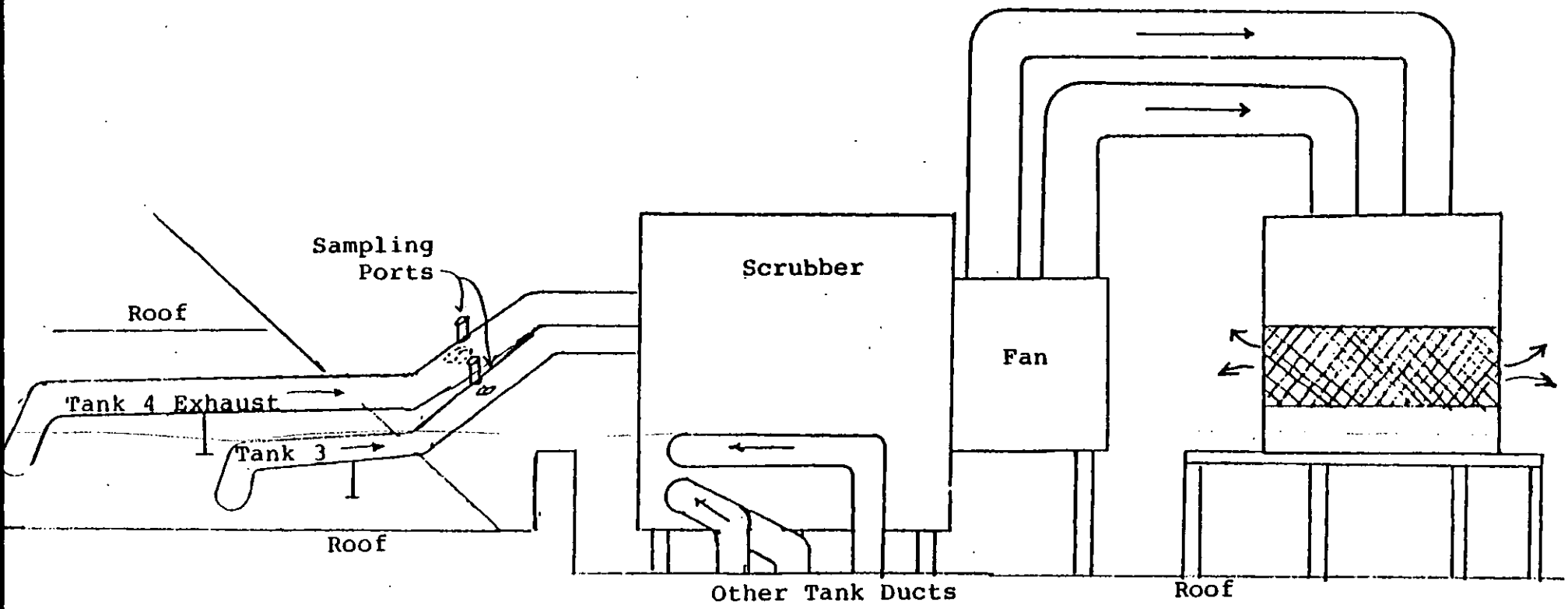
Table 1

Operation Data During Emissions Testing
At Chromal Plating Company

1.	Tank Number	3	4
2.	Plating Tank Data		
	a. Tank Temp, °F	120	120
	b. Surface Area, sq. ft.	44	60
	c. Dimensions, ft. x ft.	4 x 11	4 x 15
3.	Plating Solution Data		
	a. Chromic Acid, oz./gal.	32	32
	b. Sulfuric Acid, oz./gal.	0.32	0.32

Figure 1

Chromal Plating Co.
Source Test Port Locations



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use of glass-lined sampling probes, special teflon coated glass-fiber filters, and specially prepared acetone and distilled water. Hexavalent chromium is very reactive and the purpose of these special requirements was to prevent the loss of hexavalent chromium after it was collected. Also, the acetone and deionized distilled water used for sample recovery were analyzed before and after sampling to document their chromium content and the presence of impurities that would react with the hexavalent chromium. Appendix A contains a copy of Draft Method 425.

Parallel samples were collected for all test runs. One sample was analyzed for hexavalent chromium and the other half for total chromium or a parallel hexavalent chromium sample. For the sample runs where parallel hexavalent samples were collected, one of the hexavalent filters was placed in an extraction solution (sodium hydroxide and sodium carbonate in water) immediately after it was collected. For each tank, another hexavalent filter from another run was placed in an extraction immediately after it was collected. The remaining hexavalent filters were not placed in an extraction solution until they arrived at AIHL in Berkeley. This was done to determine if the delay affected the hexavalent chromium results.

V. TEST RESULTS

The analytical results and other test data are shown in Table 2 for tank 3 and Table 3 for tank 4. The sample analytical results are presented according to the parts of the sampling train that were analyzed separately. In general, the larger particles are collected in the sampling probe before the sample filter. Finer particles pass through the probe to be collected by the filter. And still finer particles can pass through the filter to be collected in the impingers and sample lines after the filter.

Table 2

Emissions Data For
Chromal Plating Co.
Tank 3

1 Run Number	1		2		3	
2 Test Date	12/17/86		12/17/86		12/18/86	
3 Chromium Sample	Total [a/]	Hexavalent [a/]	Hexavalent	Hexavalent	Total	Hexavalent
4 Sample Location	BS [b/]	BS	BS	BS	BS	BS
5 Concentration, 10^{-2} ug/DSCF						
a. Before Filter Sample	8.83	6.54	12.08	13.20	33.91	60.21
b. Filter Sample	22.10	1.29	2.99	2.60	6.60	9.83
c. After Filter Sample	0.02	<0.01	<0.01	<0.01	<0.01	<0.24
Total	30.95	7.83	15.07	15.80	40.51	70.04
5 Stack Flow Rate, DSCFM	4998	4995	4964	4967	4974	4970
6 Emission Rate, 10^{-3} lb/hr	20.5	5.2	9.9	10.4	33.3	26.6
7 Plating Amperage, Amps	6800		6800		4500	
8 Scrubber Water Chromium Concentration, mg/ml						
a. Total (incl. hex.)	4.5		4.5		5.5	
b. Hexavalent	4.3		4.3		4.2	

a/ Total-Total chromium, including hexavalent chromium. Hexavalent-Hexavalent chromium

b/ BS-Before scrubber

Table 3

Emissions Data For
Chromal Plating Co.
Tank 4

1 Run Number	1		2		3		4	
2 Test Date	12/16/86		12/17/86		12/17/86		12/18/86	
3 Chromium Sample	Total [a]	Hexavalent [a]	Hexavalent	Hexavalent	Total	Hexavalent	Total	Hexavalent
4 Sample Location	BS [b]	BS	BS	BS	BS	BS	BS	BS
5 Concentration, 10^{-2} ug/DSCF								
a. Before Filter Sample	18.36	13.00	24.29	23.34	18.34	16.64	33.61	29.30
b. Filter Sample	3.15	1.91	3.82	3.75	4.27	2.72	6.74	6.23
c. After Filter Sample	0.03	<0.01	<0.01	0.02	0.01	<0.01	0.01	<0.01
Total	21.54	14.91	28.11	27.11	22.62	19.36	40.36	35.53
5 Stack Flow Rate, DSCFM	7410	7414	7606	7612	7539	7534	7121	7118
6 Emission Rate, 10^{-3} lb/hr	14.6	21.2	28.3	27.3	22.6	19.3	38.0	33.5
7 Plating Amperage, Amps	1000		1000		500		1000	
8 Scrubber Water Chromium Concentration, mg/ml								
a. Total (incl. hex.)	4.7		4.5		4.5		5.5	
b. Hexavalent	3.9		4.3		4.3		4.2	

a/
Total-Total chromium, including hexavalent chromium. Hexavalent-Hexavalent chromium

b/
BS-Before scrubber

Results of the study to determine if treating the filters on site is effective in reducing hexavalent chromium loss are presented Table 4. Table 4 compares the concentration (ug/dscf) of hexavalent chromium collected on the treated and untreated filters. The hexavalent filters for the parallel samples do not indicate there is a difference between the treated and untreated filters. However, with the exception of the parallel hexavalent chromium samples, the filter samples do indicate that the untreated filters may be losing hexavalent chromium. Because of the difference between parallel and non-parallel filter samples and the limited number of samples, no specific conclusions can be made.

VI. QUALITY CONTROL

Hexavalent chromium is very reactive and collected in very low concentrations. The emphasis of the various quality control techniques is to prevent the loss or contamination of hexavalent chromium samples. For that reason all sample containers both in the field and the laboratory were made of glass or teflon and prewashed with specially prepared detergents, acids, and deionized distilled water. Other quality control techniques are discussed below.

A. SAMPLING

When collecting samples the only recommended probes are quartz or glass-lined probes. Any other probe material, including stainless steel, could contaminate the collected sample. Teflon coated glass-fiber filters are the recommended filter media. During laboratory sample recovery and preparation, the uncoated glass fiber-filter can release silicate from the filter material which, when acidified, becomes silicic acid. The silicic acid exists in the recovered sample as a suspended particulate that interfers with the colormetric analysis of the sample. The teflon coating greatly reduces the amount of silicate that is released from the glass fibers.

Table 4

Comparison of Filter Results For
Hexavalent Chromium

	RUN #	1	2	3	4	Avg
I.	Concentration, ug/DSCF					
	A. Tank 3					
	1. Treated Filter[a/]		0.03	0.07		0.05
	2. Untreated Filter[a/]	0.01	0.03			0.02
	B. Tank 4					
	1. Treated Filter		0.04		0.06	0.05
	2. Untreated Filter	0.02	0.04	0.03		0.03

a/ In the field, after sampling, the hexavalent chromium half of the treated filter was treated with the sodium hydroxide and sodium carbonate extract solution. The untreated filters were not treated until later in the test week at the laboratory.

The deionized, distilled water used for impinger catches and the acetone used to rinse samples from the probes and impingers were provided by AIHL. Both were pre-analyzed for hexavalent chromium and other impurities by AIHL and stored in glass or teflon containers.

B. SAMPLE RECOVERY AND ANALYSIS

The laboratory method for recovering and analyzing the samples for hexavalent and total chromium is similar to that for ARB Method 5 samples. However, AIHL determined that parts of the Method 5 sample recovery and analysis will cause some of the hexavalent chromium to be lost from the sample because of the reactivity of hexavalent chromium. To prevent this, the following changes were made. All solvents containing samples are reduced in volume at room temperature rather than in an oven at 105°C because the reactivity of hexavalent chromium increases with temperature. Some of the analytical reagants were treated with potassium permanganate to remove the reducing agents that would react with hexavalent chromium during sample recovery and analysis.

APPENDIX A

ARB DRAFT TEST METHOD 425

State of California
AIR RESOURCES BOARD

Method 425

Determination of Total Chromium and Hexavalent Chromium Emissions from Stationary Sources

Adopted _____, 1986

METHOD 425: DETERMINATION OF TOTAL CHROMIUM AND HEXAVALENT CHROMIUM EMISSIONS FROM STATIONARY SOURCES

1. APPLICABILITY AND PRINCIPLE

1.1 Applicability.

This method applies to the determination of hexavalent chromium (Cr^{+6}) and total chromium emissions from stationary sources.

1.2 Principle.

Particulate emissions are collected from the source by use of CARB METHOD 5. The collected sample is divided into two equal portions with one portion used for total chromium analysis and the other portion for hexavalent chromium analysis.

1.2.1 For the hexavalent chromium analysis the collected sample portions are extracted in an alkaline solution and analyzed by the diphenylcarbazide colorimetric method.

1.2.2 For the total chromium analysis the collected samples must be prepared in order to convert organic forms of chromium to inorganic forms, to minimize organic interferences, and to convert the sample to a suitable solution for analysis. Samples are then subjected to an acid digestion procedure. Following the appropriate dissolution of the sample, a representative aliquot is placed manually or by means of an automatic sampler into a graphite tube furnace. The sample aliquot is then slowly evaporated to dryness, charred (ashed), and atomized. The absorption of hollow cathode radiation during atomization will be proportional to the chromium concentration.

2. RANGE, SENSITIVITY, PRECISION, AND INTERFERENCES

2.1 Range.

2.1.1. Hexavalent chromium. A straight line response curve was obtained in the range 1 ug Cr^{+6}/100 mL to 20 ug Cr^{+6}/100 mL. For a minimum analytical accuracy of $\pm$ 10 percent, the lower limit of the

range is 2 ug/100mL. The upper limit can be extended by appropriate dilution.

2.2 Sensitivity.

2.2.1. Hexavalent Chromium. A minimum detection limit of 1 ug Cr^{+6}/100 mL has been observed (9.1).

2.3 Precision for hexavalent chromium. The overall precision for sample collection and analysis for Cr^{+6} was determined at a ferrochrome smelter, a chemical plant, and a refractory brick plant. Replicate Method 5 filters with both high and low particulate loadings were analyzed. The relative standard deviations were less than 10 percent in all cases.

2.4 Interferences.

2.4.1. Interferences of hexavalent chromium. Molybdenum, mercury and vanadium react with diplhenylcarbazide to form a color; however, approximately 20 mg of elements can be present in a sample without creating a problem. Iron produces a yellow color, but this effect is not measured photometrically at 540 nm. No interference was observed at the sources listed in Section 2.3.

2.4.2 Interferences for total chromium.

2.4.2.1. The long residence time and high concentrations of the atomized sample in the optical path of the graphite furnace can result in severe physical and chemical interferences. Furnace parameters must be optimized to minimize these effects. If the analyte is not completely volatilized and removed from the furnace during atomization, memory effects will occur. If this situation is detected, the tube should be cleaned by operating the furnace at higher atomization temperatures.

2.4.2.2. Nitrogen should not be used as the purge gas because of a possible CN band interference.

2.4.2.3. Low concentrations of calcium may cause interferences; at concentrations above 200 mg/L calcium's effect is constant. Calcium nitrate is therefore added to ensure a known constant effect.

2.5 If other techniques or conditions are used in the

analysis of total chromium and/or hexavalent chromium then the tester is required to substantiate the data through an adequate quality assurance program approved by the Executive Officer.

3. APPARATUS

Any other sampling apparatus which, after review by the Executive Officer, is deemed equivalent for the purposes of this test method, may be used.

3.1 Sampling Train. Same as CARB Method 5, Section 2.1. except use a glass lined stainless steel probe.

3.2 Sample Recovery. Same as CARB Method 5, Section 2.2.

3.3 Analysis. The following apparatus and materials are needed.

3.3.1. Analysis of hexavalent chromium.

3.3.1.1. Philips Beakers. Borosilicate, 125mL, with watchglass covers.

3.3.1.2. Filtration Apparatus. Vacuum unit constructed of glass, to accommodate sintered glass funnels.

3.3.1.3. Volumetric Flasks. 100-mL and other appropriate volumes.

3.3.1.4. Hot Plate.

3.3.1.5. Pipettes. Assorted sizes, as needed.

3.3.1.6. Spectrophotometer. To measure absorbance at 540nm.

3.3.2. Analysis of total chromium.

3.3.2.1 Atomic absorption spectrophotometer: Single or dual channel, single- or double-beam instrument having a grating monochromator, photomultiplier detector, adjustable slits, a wavelength range of 190 to 800 nm and provisions for simultaneous background correction and interfacing with a strip chart recorder.

3.3.2.2. Chromium hollow cathode lamp or electrodeless discharge lamp.

3.3.2.3. Graphite furnace: Any graphite furnace device with the appropriate temperature

and timing controls.

3.3.2.4. Strip chart recorder: A recorder is strongly recommended for furnace work so that there will be a permanent record and so that any problems with the analysis such as drift, incomplete atomization, losses during charring, changes in sensitivity, etc., can easily be recognized.

4. REAGENTS

Unless otherwise indicated, all reagents must conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society. Where such specifications are not available, use the best available grade.

4.1 Sampling. Same as CARB method 5, Section 3.1. except Teflon-coated glass fiber filters are used. Any other sampling method which, after review of the Executive Officer, is deemed equivalent for the purposes of this test method, may be used.

4.2 Sample Recovery. Same as CARB Method 5, Section 3.2.

4.3 Reagents for hexavalent chromium.

4.3.1 Water. Deionized distilled, meeting American Society for Testing and Materials (ASTM) specification for type reagent - ASTM Test Method D 1193-77. The water should be monitored for impurities.

4.3.2. Extraction solution. Dissolve 20.0 g NaOH and 30.0 g anhydrous Na_2CO_3 in water in a 1-liter volumetric flask, and dilute to the mark. Store the solution in a tightly capped polyethylene bottle. Prepare fresh monthly.

4.3.3. Potassium Dichromate Stock Solution. Dissolve 2.829 g of analytical reagent grade $K_2Cr_2O_7$ in water, and dilute to 1 liter (1 mL = 1000 ug Cr^{+6}).

4.3.4. Potassium Dichromate Standard Solution. Dilute 10.00mL potassium dichromate stock solution to 100 mL (1 mL = 100 ug Hexavalent Chromium) with water.

4.3.5. Sulfuric Acid, 6N. Dilute 166 mL sulfuric acid to 1000 mL in water.

4.3.6. Acetone. Acetone will be of spectroscopic grade.

4.3.6. Acetone. Acetone will be of spectroscopic grade.

4.3.7 Diphenylcarbazide Solution. Dissolve 0.5 mg of 1, 5-diphenycarbazide in 100 mL acetone. Store in a brown bottle. Discard when the solution becomes discolored.

4.3.8 0.1% Potassium Permanganate Solution

4.3.9 0.01% Potassium Permanganate Solution

4.4. Reagents for total chromium

4.4.1. ASTM Type II water (ASTM D1193): refer to section 4.3.1.

4.4.2. Concentrated nitric acid: Acid should be analyzed to determine level of impurities. If impurities are detected, all analyses should be blank-corrected.

4.4.3. Hydrogen peroxide (30%) optional.

4.4.4. Calcium nitrate solution: Dissolve 11.8 g of calcium nitrate, $Ca(NO_3)_2.4H_2O$ (analytical reagent grade), in Type II water and dilute to 1 liter. If the instrument manufacturer recommends a different matrix modifier then use that reagent.

4.4.5. Chromium standard stock solution (1000mg/L): Either procure a certified aqueous standard from a supplier (Spex Industries, Alpha Products, or Fisher Scientific) and verify by comparison with a second standard, or dissolve 2.829 g of Potassium Dichromate ($K_2Cr_2O_7$, analytical reagent grade) in Type II water and dilute to 1 liter.

4.4.6. Chromium working standards: These standards should be prepared to contain 1.0% (v/v) HNO_3; 1mL of 30% H_2O_2 and 1mL of the calcium nitrate solution may be added to lessen interferences.

5. SAMPLE COLLECTION, PRESERVATION, AND HANDLING

5.1 Sample collection. All samples are collected from the source by use of CARB Method 5.

5.2 Sample handling and preservation. All sample containers must be prewashed with detergents, acids and Type II water. Glass containers are suitable.

6. PROCEDURES

6.1 SAMPLE PREPARATION

6.1.1. The sample is collected in the probe, impingers and filters. The filter is placed in container number 1. The probe is rinsed with acetone solvent and the rinse is placed in container number 2. Place half the contents of Container Number 2 (the acetone probe rinse) in a 125-mL Philips beaker A. Place the other half of the contents of Container Number 2 in a second 125 mL Philips beaker B. Rinse Container Number 2 with acetone and transfer half the rinse to beaker A and the other half of the rinse to beaker B. Evaporate both beakers to dryness. Place half the contents of the impingers in beaker C and the other half in beaker D. Rinse the impingers and place half of the rinse into beaker C and the other half into beaker D. Evaporate to dryness. Take the filter from Container Number 1 and divide it into quarters. Take the quarters that are diagonal to each other and place them into beaker E. Then place the other two quarters of the filter from Container Number 1 into beaker F. Cut each filter quarter into small pieces. Save beaker A,C and E for hexavalent chromium analysis. Save beaker B,D and F for total chromium analysis.

6.1.2. If the particulate matter is not homogeneously distributed on the filter, one of the following alternative procedures may be followed.

6.1.2.1 The first option is to simultaneously use two method 5 sampling trains. The sample filter from one of the sample trains is to be used for total chromium analysis and the other filter from the other sample train will be used for hexavalent chromium analysis.

6.1.2.2 The second option is to change the extraction procedure. The entire filter is subjected first to the alkaline extraction, followed by filtering and then by acid extraction. Then both extracts are halved and one acid extract portion is combined with one alkaline extract portion for the total chromium analysis. The other alkaline extract

portion is used for hexavalent chromium determination. The extraction and analysis procedures are in Sections 6.3 and 6.4.

6.2 Removal of reducing agents in the reagents. The extraction solution (4.3.2) and the 6N sulfuric acid solution may contain small amounts of reducing agents that can react with the hexavalent chromium. Potassium permanganate is added to these reagents in order to neutralize these reducing agents.
Pipette 3 mL of the extraction solution into cuvettes A and B. Use cuvette A as a sample cell and cuvette B as a reference cell. Zero the instrument at 528 nm with both cuvettes. Wait 10 minutes. Add an adequate amount (uL) of 0.01% potassium permanganate solution to (4.3.9) cuvette A. Enough should be added so that after 10 minutes a slight change in absorbance is observed. This step may have to be repeated a number of times in order to determine the required amount of potassium permangante that is required. From the change in absorbance, calculate the amount of potassium permanganate that is needed to nuetralize the reducing agents found in the reagents. Then pipette the proper volume of higher concentration 0.1% potassium permanganate solution into the reagents. This is done by assuming that the number of milliequivalents of reducing agents in the reagents are equal to the number of milliequivalents of 0.1% potassium permanganate pipetted. This procedure is repeated with the 6N sulfuric acid solution.

6.3 Hexavalent Chromium sample preparation.
Sample digestion and preparation. To beaker (A) add 25 mL of alkaline digestion solution (Section 4.3.2). Shake solution at room temperature for 30 minutes.
Quantitatively transfer the solution to the filtration apparatus with water. Filter the solution through the sintered glass funnel into a 150mL recieving beaker. Transfer the filtrate from the filter flask quantitatively to a 100mL volumetric flask. Fill to a volume of approximately 75mL to 85mL.

Adjust the pH to 1 ± 0.2 with 6N percent sulfuric acid. Shake carefully to release carbon dioxide. Add 2.0 ml of diphenylcarbazide solution, and dilute to volume with water. Allow the solution to stand about 10 minutes for color development. For each set of samples analyzed, treat an identical aliquot of reagent blank solution in the same way. Transfer a portion of the sample to a 5-cm absorption cell, and measure the absorbance at the optimum wavelength of 540 nm. Measure and subtract the reagent blank absorbance reading, if any, to obtain a net reading. If the absorbance of the sample exceeds the absorbance of the 100 ug Cr^{+6} standard as determined in

Section 7.2.2, dilute the sample and the reagent blank with equal volumes of water. Repeat this procedure for beakers C and E.

6.3.1 Reagent Blank Preparation. Take a representatative amount of acetone and a blank Method 5 filter and proceed as in Section 6.3.

6.3.2 Silica Gel Weighing. Weigh the spent silica gel (Container Number 3) or silica gel plus impinger to the nearest 0.5 g using a balance. This step may be conducted in the field.

6.3.3 Analysis.

6.3.4 Check for Matrix Effects on the Cr^{+6} Results. Since the analysis for Cr^{+6} by colorimetry is sensitive to the chemical composition of the sample (matrix effects), the analyst shall check at least one sample from each source using the method of additions as follows: Obtain two equal volume aliquots of the same sample solution. The aliquots should each contain between 6 and 10 ug of Cr^{+6} (less if not possible). Spike one of the aliquots with an aliquot of standard solution that contains between 6 and 10 ug of Cr^{+6}. Now treat both the spiked and unspiked sample aliquots as described in Section 6.3. Next, calculate the Cr^{+6} mass Cs, in ug in the aliquot of the unspiked sample solution by using the following equation:

$$Cs = Ca \frac{As}{At-As} \qquad \text{Eq. 1}$$

where:

Ca = Cr^{+6} in the standard solution, ug.

As = Absorbance of the unspiked sample solution.

At = Absorbance of the spiked sample solution.

Volume corrections will not be required since the solutions as analyzed have been made to the same final volume. If the results of the method of standard additions procedure used on the single source sample do not agree to within 10 percent of the value obtained by the routine spectrophotometric analysis, then reanalyze all samples from the source using this method of standard additions procedure.

6.4 Total Chromium Sample Preparation.

6.4.1 Add 10ml of conc. nitric acid to the sample in the beaker(B). Cover the beaker with a watch glass. Place the beaker on a hot plate and reflux the sample down to 2-3mL. Add another 5mL nitric acid to complete digestion. Reflux the sample volume down to 1mL.

6.4.2. Wash down the beaker walls and watch glass with distilled water and filter the sample to remove silicates and other insoluble material that could clog the nebulizer. Filtration should be done only if there is concern that insoluble materials may clog the nebulizer. Adjust the volume to 50 mL or a predetermined value based on the expected metal concentrations. The sample is now ready for analysis. The applicability of a sample preparation technique must be demonstrated by analyzing spiked samples and/or relevant standard reference materials.

6.4.3 The 357.9-nm wavelength line shall be used.

6.4.4 Follow the manufacturer's operating instructions for all other spectrophotometer parameters.

6.4.5 Furnace parameters suggested by the manufacturer should be employed as guidelines. Since temperature-sensing mechanisms and temperature controllers can vary between instruments or with time, the validity of the furnace parameters must be periodically confirmed by systematically altering the furnace parameters while analyzing a standard. In this manner, losses of analyte due to higher than necessary temperature settings or losses in sensitivity due to less than optimum settings can be minimized. Similar verification of furnace parameters may be required for complex sample matices.

6.4.6 Inject a measured uL aliquot of sample into the furnace and atomize. If the concentration found is greater than the highest standard, the sample should be diluted in the same acid matrix and reanalyzed. The use of multiple injections can improve accuracy and help detect furnace pipetting errors.

6.4.7 Repeat procedure (6.4) for beakers D and F.

7. CALIBRATION

7.1 Sampling Train. Perform all of the calibrations described in CARB Method 5, Section 5.

7.2 Calibration Hexavalent Chromium

7.2.1 Optimum Wavelength Determination. Calibrate the wavelength scale of the spectrophotometer every 6 months. The calibration may be accomplished by using an energy source with an intense line emission such as a mercury lamp, or by using a series of glass filters spanning the measuring range of the spectrophotometer. Calibration materials are available commercially and from the National Bureau of Standards. Specific details on the use of such materials should be supplied by the vendor; general information about calibration techniques can be obtained from general reference books on analytical chemistry. The wavelength scale of the spectrophotometer must read correctly within ± 5 nm at all calibration points; otherwise, the spectrophotometer shall be repaired and recalibrated. Once the wavelength scale of the spectrophotometer is in proper calibration, use 540 nm as the optimum wavelength for the measurement of the absorbance of the standards and samples.

Alternatively, a scanning procedure may be employed to determine the proper measuring wavelength. If the instrument is a double-beam spectrophotometer, scan the spectrum between 530 and 550 nm using a 50 ug Cr^{+6} standard solution in the sample cell and a blank solution in the reference cell. If a peak does not occur, the spectrophotometer is malfunctioning and should be repaired. When a peak is obtained within the 530 to 550 nm range, the wavelength at which this peak occurs shall be the optimum wavelength for the measurement of absorbance of both the standards and the samples. For a single-beam spectrophotometer, follow the scanning procedure described above, except that the blank and standard solutions shall be scanned separately. The optimum wavelength shall be the wavelength at which the maximum differences in absorbance between the standard and the blank occurs.

7.2.2 Spectrophotometer Calibration. Either (1) run a series of chromium standards and construct a calibration curve by plotting the concentrations of the standards against the absorbances or (2) for the method of standard additions, plot added

concentration versus absorbance. See section 6.3.4 for the use of the method of standard additions.

7.2.2.1 Spectrophotometer Calibration Quality Control. Multiply the absorbance value obtained for each standard by the Kc factor (least squares slope) to determine the distance each calibration point lies from the theoretical calibration line. These calculated concentration values should not differ from the actual concentrations (i.e., 5, 10, 25, 50, 75, and 100 ug Cr^{+6}) by more than _ percent (to be determined) for five of the six standards.

7.3 Calibration of Total Chromium

7.3.1. Either (1) run a series of chromium standards and construct a calibration curve by plotting the concentrations of the standards against the absorbances or (2) for the method of standard additions, plot added concentration versus absorbance. For instruments that read directly in concentration, set the curve corrector to read out the proper concentration.

7.3.2. Run a check standard after approximately every 10 sample injections. Standards are run in part to monitor the life and performance of the graphite tube. Lack of reproducibility or significant change in the signal for the standard indicates that the tube should be replaced.

7.3.3. Duplicates, spiked samples, and check standards should be routinely analyzed.

7.3.4 Calculate metal concentrations by (1) the method of standard additions, or (2) from a calibration curve, or (3) directly from the instrument's concentration readout. All dilution or concentration factors must be taken into account. Concentrations reported for multiphased or wet samples must be appropriately qualified (e.g., 5 ug/g dry weight).

7.3.5. Calibration curves must be composed of a minimum of a blank and three standards. A calibration curve should be made for every hour of continuous sample analysis.

7.3.6. Dilute samples if they are more concentrated than the highest standard or if they fall on the plateau of a calibration curve.

7.3.7 Employ a minimum of one blank per sample batch to determine if contamination or any memory effects are occurring.

The blanks are prepared in the following manner. Obtain a clean unused filter and follow the procedure in Sections 6.4.1 and 6.4.2.

7.3.8. Analyze check standards after approximately every 15 samples.

7.3.9. Run one duplicate sample for every 10 samples. A duplicate sample is a sample brought through the whole sample preparation.

7.3.10 Spiked samples or standard reference materials shall be periodically employed to ensure that correct procedures are being followed and that all equipment is operating properly.

7.3.11 The method of standard additions shall be used for the analysis of all EP extracts, or whenever a new sample matrix is being analyzed.

7.3.12 The concentration of all calibration standards should be verified against a quality control check sample obtained from an outside source.

7.3.13 All quality control data should be maintained and available for easy reference or inspection.

7.4 Emission Calculations

Carry out the calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculations.

7.4.1 Total Cr^{+6} in Sample. Calculate m_{ch}, the total ug Cr^{+6} in sample. This can be obtained from the calibration curve or from the method of standard additions. Note that m_{ch} is the sum of the masses of hexavalent chromium analyses performed on the contents of beakers B, D and F. Also take in account the dilutions when calculating m_{ch}.

7.4.2 Total Chromium in the Sample. Calculate m_{ct}, the total ug of Chromium in the sample. This can be obtained from the calibration curve or from the method of standard additions. Note that m_{ct} is the sum of the masses of total chromium analyses performed on the contents of beakers A,C and E.

Also take into account the necessary dilutions when calculating out m_{ct}.

7.4.3 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop. Same as Method 5, Section 6.2.

7.4.4 Dry Gas Volume, Volume of Water Vapor, Moisture Content. Same as Method 5, Sections 6.3, 6.4, and 6.5, respectively.

7.4.5 Cr^{+6} Emission Concentration. Calculate c_s (g/dscm), the Cr^{+6} concentration in the stack gas, dry basis, corrected to standard conditions, as follows:

$$c_s = (10^{-6}g/ug)(m_{ch}/V_{m(std)})$$

7.4.6 Total Chromium Emission Concentration. Calculate c_{st} (g/dscm), the total chromium concentration in the stack gas, dry basis, corrected to standard conditions as follows:

$$c_{st} = (10^{-6}g/ug)(m_{ct}/V_{m(std)})$$

7.4.7 Isokinetic Variation, Acceptable Results. Same as Method 5, Sections 6.11 and 6.12, respectively.

8. OTHER METHODS.

8.1 Total chromium determination by atomic absorption spectroscopy. This method uses the direct aspiration method.

8.2 Hexavalent chromium by flameless atomic absorption spectroscopy. This method complexes hexavalent chromium with ammonium pyrrolidine dithiocarbamate. This chromium complex is then measured by atomic absorbtion spectrophotometer equipped with a flameless accessory.

9. REFERENCES.

9.1 US. Environmental Protection Agency/Office of Solid Waste, Washington, D.C., "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, "SW-846 (1980), SW-846 Revision A (August 8, 1980), and SW-846 Revision B (July 1981).

9.2 Cox, X.B., R.W., R.W. Linton, and F.E. Butler. Determination of Chromium Speciation in Environmental Particles- A Multitechnique Study of Ferrochrome Smelter Dust. Accepted for publication in Environmental Science and Technology.

9.3 Same as in Bibliography of Method 5, Citations 2 to 6 and 7.

9.4 California Air Resources Board, Aerometric Data Division. Method ADD1 006.

APPENDIX B

DATA AND CALCULATIONS

PARTICULATE EMISSIONS TEST SUMMARY AND RESULTS

AEL-ESCD-Engr. Eval. Branch

File No. C-_____

Project Name: Chrome/

Remarks: 1-3T Tank 3

Total Cr

SUMMARY OF TEST DATA

Metered Sample Volume	106.60 cubic feet
Meter Temperature:	60 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. Delta H Orifice Pressure:	2.64 inches H2O
Avg. $\sqrt{}$(Delta P Pitot Pressure):	0.49 $\sqrt{}$(inches H2O)
H2O in Impingers and Silica Gel:	21.4 milliliters
Particulate Catch:	3354.0 $\times 10^{-3}$ milligrams
Stack Area:	3.142 square feet
Stack Temperature:	58 deg.F
Barometric Pressure:	29.740 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	100.3 percent
Corrected Sample Volume:	100.37 DSCF(68 deg.F)
Particulate Concentration:	0.47766 $\times 10^{-3}$ grain/DSCF(68 deg.F)
Particulate Emissions:	20.46 $\times 10^{-3}$ lb/hr
Stack Flow:	4998 SCFM(dry,68 deg.F)
Stack Velocity:	26.4 feet/second
H2O Vapor In Stack:	0.9 percent
(H2O In Stack is BLICK Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.75

Verified by: _____

PARTICULATE EMISSIONS TEST SUMMARY AND RESULTS

MD-ESCD-Engr. Eval. Branch

File No. C-_____

Project Name: Chrome I

Remarks: 1-3H Tank 3

Hex Cr

SAMPLING DATA	
Metered Sample Volume	112.80 cubic feet
Meter Temperature:	60 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. Delta P Orifice Pressure:	2.83 inches H2O
Avg. √(Delta P Pitot Pressure):	0.48 √(inches H2O)
H2O in Impingers and Silica Gel:	24.9 milliliters
Particulate Catch:	697.5 $\times 10^{-3}$ milligrams
Stack Diameter:	24.000 inches
Stack Area:	3.142 square feet
Stack Temperature:	58 deg.F
Barometric Pressure:	29.740 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent
CALCULATED RESULTS:	
Isokinetic Ratio:	112.5 percent
Corrected Sample Volume:	114.61 DSCF(68 deg.F)
Particulate Concentration:	0.12063 $\times 10^{-3}$ Grain/DSCF(68 deg.F)
Particulate Emissions:	3.17 $\times 10^{-3}$ LB/HR
Stack Flow:	4995 SCFM(dry,68 deg.F)
Stack Velocity:	26.4 feet/second
H2O Vapor In Stack:	1.0 percent
(H2O In Stack is SATURATION)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.74

Verified By: _____

PARTICULATE EMISSIONS FROM STATIONARY SOURCES

MRI-ESED-Engr. Eval, Branch

File No. C-_____

Project Name: Chromal

Remarks: 2-3F Tank 3

Hex Cr

QUALITY OF DATA

Metered Sample Volume	1.2.00 cubic feet
Meter Temperature:	6[illegible] deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.81C
Sampling Time:	120.00 minutes
Avg. Delta H Orifice Pressure: H2O	
Avg. √(Delta P Pitot Pressure): s H2O)	
H2O in Impingers and Silica Gel: ters	
Particulate Catch:	1061.6 $\times 10^{-3}$ milligrams
Stack Diameter:	24.000 inches
Stack Area:	3.142 square feet
Stack Temperature:	64 deg.F
Barometric Pressure:	29.700 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	108.9 percent
Corrected Sample Volume: 68 deg.F)	110.25 DSCF (68 °F)
Particulate Concentration: n/DSCF(68 deg.F)	
Particulate Emissions:	9.90 $\times 10^{-3}$ lb/hr
Stack Flow:	4964 SCFM(dry,60 deg.F)
Stack Velocity:	28.0 feet/second
~~H2O vapor~~ In Stack:	1.0 percent
(H2O In Stack is SLICA Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.75

Verified by: _____

PARTICULATE SAMPLING TEST SUMMARY AND RESULTS

AFL-TECH-Mgr. Level Branch

File No. C-_____

Project Name: Chromal

Remarks: 2-3H Tank 3

Hex Cr

SUMMARY OF TEST DATA

Metered Sample Volume	112.28 cubic feet
Meter Temperature:	66 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. Delta H Orifice Pressure:	2.03 inches H2O
Avg. √(Delta P Pitot Pressure):	0.46 √(inches H2O)
H2O in Impingers and Silica Gel:	22.0 milliliters
Particulate Catch:	1800.4 $^{*10^{-3}}$ milligrams
Stack Diameter:	24.000 inches
Stack Area:	3.142 square feet
Stack Temperature:	64 deg.F
Barometric Pressure:	29.700 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	112.4 percent
Corrected Sample Volume:	113.93 DSCF(68 deg.F)
Particulate Concentration:	0.24384 $^{*10^{-3}}$ grain/DSCF(68 deg.F)
Particulate Emissions:	10.38 $^{*10^{-2}}$ LB/Hr
Stack Flow:	4967 SCFM(dry,68 deg.F)
Stack Velocity:	26.6 feet/second
H2O Vapor In Stack:	0.9 percent
(H2O In Stack is Under Saturation)	
Stack Gas Mole Weight(Dry):	28.85
Stack Gas Mole Weight(Wet):	28.75

Verified By: _____

PARTICULATE EMISSIONS CALCULATION SHEET

ATR-EECB-Engr. Eval. Branch

File No. C-_____

Project Name: Chrome I

Remarks: 3-3H Tank 3

Total Cr

STACK GAS FLOW DATA

Metered Sample Volume	117.40 cubic feet
Meter Temperature:	60 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. Delta H Orifice Pressure:	2.64 inches H2O
Avg. √(Delta P Pitot Pressure):	0.49 √(inches H2O)
H2O in Impingers and Silica Gel:	28.5 milliliters
Particulate Catch:	0030.1 $\times 10^{-1}$ milligrams
Stack Diameter:	24.000 inches
Stack Area:	3.142 square feet
Stack Temperature:	63 deg.F
Barometric Pressure:	29.820 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	117.9 percent
Corrected Sample Volume:	119.66 DSCF(68 deg.F)
Particulate Concentration:	0.78013 $\times 10^{-3}$ grain/DSCF(68 deg.F)
Particulate Emissions:	33.20 $\times 10^{-3}$ lb/hr
Stack Flow:	4974 SCFM(dry,68 deg.F)
Stack Velocity:	26.5 feet/second
H2O Vapor In Stack:	1.1 percent
(H2O In Stack is ESTIMATED Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.73

Verified by: _____

PARTICULATE EMISSIONS TEST SUMMARY AND RESULTS

AIR-SSCD-Engr. Eval. Branch

File no. C-_____

Project Name: Chromal

Remarks: 3-3T Tank 3

Total Cr

SUMMARY OF TEST DATA

Metered Sample Volume	109.50 cubic feet
Meter Temperature:	60 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. delta H Orifice Pressure:	2.64 inches H2O
Avg. √(delta P Pitot Pressure):	0.49 √(inches H2O)
H2O in Impingers and Silica Gel:	28.5 milliliters
Particulate Catch:	4521.6 milligrams
Stack Diameter:	24.000 inches
Stack Area:	3.142 square feet
Stack Temperature:	63 deg.F
Barometric Pressure:	29.820 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	110.1 percent
Corrected Sample Volume:	111.61 DSCF(68 deg.F)
Particulate Concentration:	0.62510 grain/DSCF(68 deg.F)
Particulate Emissions:	26.63 lb/hr
Stack Flow:	4970 SCFM(dry,68 deg.F)
Stack Velocity:	26.5 feet/second
H2O Vapor In Stack:	1.2 percent
(H2O In Stack is BELOW Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.72

Verified by: _____

PARTICULATE EMISSIONS TEST SUMMARY RESULTS

ARL-ESCL-Engr. Eval. Branch

File No. C-_____

Project Name: Chromal

Remarks: 1-4T Tank 4

Total Cr

SUMMARY OF TEST DATA

Metered Sample Volume	130.65 cubic feet
Meter Temperature:	60 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. delta H Orifice Pressure:	4.10 inches H2O
Avg. √(delta P Pitot Pressure):	0.83 √(inches H2O)
H2O in Impingers and Silica Gel:	
ters	
Particulate Catch:	1990.1 $\times 10^{-3}$ milligrams
Stack Diameter:	26.000 inches
Stack Area:	3.687 square feet
Stack Temperature:	75 deg.F
Barometric Pressure:	29.740 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	103.6 percent
Corrected Sample Volume:	133.43 DSCF(68 deg.F)
Particulate Concentration:	0.23014 $\times 10^{-3}$ grain/DSCF(68 deg.F)
Particulate Emissions:	14.62 $\times 10^{-3}$ lb/hr
Stack Flow:	7410 SCFM(dry,68 deg.F)
Stack Velocity:	34.5 feet/second
H2O Vapor In Stack:	1.1 percent
(H2O In Stack is DRIER Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.73

Verified by: _____

PARTICULATE EMISSIONS TEST SUMMARY AND RESULTS

AFE-SSCD-Engr. Eval. Branch

File No. C-_____

Project Name: Chromal

Remarks: 1-4H Tank 4

Hefcr

SUMMARY OF TEST DATA

Metered Sample Volume	125.10 cubic feet
Meter Temperature:	60 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. delta H Orifice Pressure:	4.30 inches H2O
Avg. √(delta P Pitot Pressure):	0.63 √(inches H2O)
H2O in Impingers and Silica Gel:	
ters	
Particulate Catch:	2749.5 $\times 10^{-3}$ milligrams
Stack Diameter:	26.000 inches
Stack Area:	3.687 square feet
Stack Temperature:	75 deg.F
Barometric Pressure:	29.700 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	98.9 percent
Corrected Sample Volume:	127.46 DSCF(68 deg.F)
Particulate Concentration:	0.33205 $\times 10^{-3}$ grain/DSCF(68 deg.F)
Particulate Emissions:	21.15 $\times 10^{-3}$ LB/hr
Stack Flow:	7414 SCFM(dry,68 deg.F)
Stack Velocity:	34.5 feet/second
H2O Vapor In Stack:	1.0 percent
(H2O In Stack is BELOW Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.75

Verified By: _____

PARTICULATE EMISSIONS TEST SUMMARY AND RESULTS

MRE-SSCD-Engr. Eval. Branch

File No. C-_____

Project Name: Chromal

Remarks: 2-4T Tank 4

Hex Cr

SUMMARY OF TEST DATA

Metered Sample Volume	130.72 cubic feet
Meter Temperature:	61 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. Delta H Orifice Pressure:	3.02 inches H2O
Avg. √(delta P Pitot Pressure):	0.64 √(inches H2O)
H2O in Impingers and Silica Gel:	20.3 milliliters
Particulate Catch:	3738.0 $\times 10^{-3}$ milligrams
Stack Diameter:	20.000 inches
Stack Area:	3.087 square feet
Stack Temperature:	64 deg.F
Barometric Pressure:	29.700 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	100.6 percent
Corrected Sample Volume:	133.03 DSCF(68 deg.F)
Particulate Concentration:	0.43366 $\times 10^{-3}$ grain/DSCF(68 deg.F)
Particulate Emissions:	20.27 $\times 10^{-3}$ LB/HR
Stack Flow:	7000 SCFM(dry,68 deg.F)
Stack Velocity:	34.7 feet/second
H2O Vapor In Stack:	1.0 percent
(H2O In Stack is BELOW Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.74

Verified by: _____

EPA METHOD 5 STACK SAMPLING DATA AND RESULTS

APTI-ESED-Engr. Eval. Branch

File No. C-_____

Project Name: Chromal

Remarks: 2-4H Tank 4

Hex Cr

SUMMARY OF TEST DATA

Metered Sample Volume	127.65 cubic feet
Meter Temperature:	60 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. delta H Orifice Pressure:	4.16 inches H2O
Avg. √(delta P Pitot Pressure):	0.64 √(inches H2O)
H2O in Impingers and Silica Gel:	26.2 milliliters
Particulate Catch:	3524.8 Milligrams
Stack Diameter:	26.000 inches
Stack Area:	3.687 square feet
Stack Temperature:	64 deg.F
Barometric Pressure:	29.700 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	98.3 percent
Corrected Sample Volume:	130.01 DSCF(68 deg.F)
Particulate Concentration:	0.41833 Milligrain/DSCF(68 deg.F)
Particulate Emissions:	27.29 Milligrain/hr
Stack Flow:	7612 SCFM(dry,68 deg.F)
Stack Velocity:	34.7 feet/second
H2O Vapor In Stack:	0.9 percent
(H2O In Stack is BELOW Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.75

Verified by: _____

PARTICULATE EMISSIONS TEST SUMMARY AND RESULTS

APE-SSCD-Engr. Eval. Branch

File No. C-_____

Project Name: Thermal

Remarks: 3-4 ~~B~~ T Tank 4

Hex Cr

SUMMARY OF TEST DATA

Metered Sample Volume	129.82 cubic feet
Meter Temperature:	60 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. Delta H Orifice Pressure:	3.93 inches H2O
Avg. √(delta P Pitot Pressure):	0.64 √(inches H2O)
H2O in Impingers and Silica Gel:	24.0 milliliters
Particulate Catch:	2554.5 $\times 10^{-1}$ milligrams
Stack Diameter:	26.000 inches
Stack Area:	3.687 square feet
Stack Temperature:	75 deg.F
Barometric Pressure:	29.660 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	100.8 percent
Corrected Sample Volume:	131.97 DSCF(68 deg.F)
Particulate Concentration:	0.29867 $\times 10^{-3}$ grain/DSCF(68 deg.F)
Particulate Emissions:	19.29 $\times 10^{-2}$ lb/hr
Stack Flow:	7534 SCFM(dry,68 deg.F)
Stack Velocity:	35.1 feet/second
H2O Vapor In Stack:	0.8 percent
(H2O In Stack is BELOW Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.76

Verified by: _____

PARTICULATE EMISSIONS TEST SUMMARY AND RESULTS

AFB-SSCD-Engr. Eval. Branch

File No. C-_____

Project Name: Chromal

Remarks: 3-4H Tank 4

Total Cr

SUMMARY OF TEST DATA:

Metered Sample Volume	119.90 cubic feet
Meter Temperature:	60 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. Delta H Orifice Pressure:	3.95 inches H2O
Avg. √(Delta P Pitot Pressure):	0.84 √(inches H2O)
H2O in Impingers and Silica Gel:	20.0 milliliters
Particulate Catch:	2756.4 $\times 10^{-6}$ milligrams
Stack Diameter:	26.000 inches
Stack Area:	3.687 square feet
Stack Temperature:	75 deg.F
Barometric Pressure:	29.660 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	93.0 percent
Corrected Sample Volume:	121.89 DSCF(68 deg.F)
Particulate Concentration:	0.34892 $\times 10^{-3}$ Grain/DSCF(68 deg.F)
Particulate Emissions:	22.55 $\times 10^{-3}$ lb/hr
Stack Flow:	7539 SCFM(dry,68 deg.F)
Stack Velocity:	35.1 feet/second
H2O Vapor In Stack:	0.8 percent
(H2O In Stack is BELOW Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.77

Verified by: _____

PARTICULATE EMISSIONS TEST SUMMARY AND RESULTS

EPA-SSCD-Engr. Eval. Branch

File No. C-_____

Project Name: Chromal

Remarks: 4-4H Tank 4

Flex Cr

SUMMARY OF FIELD DATA

Metered Sample Volume	120.55 cubic feet
Meter Temperature:	68 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. Delta P Orifice Pressure:	4.19 inches H2O
Avg. √(Delta P Pitot Pressure):	0.66 √(inches H2O)
H2O in Impingers and Silica Gel:	29.0 milliliters
Particulate Catch:	4870.3 $\times 10^{-3}$ Milligrams
Stack Diameter:	24.000 inches
Stack Area:	3.687 square feet
Stack Temperature:	68 deg.F
Barometric Pressure:	29.820 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	106.3 percent
Corrected Sample Volume:	131.16 DSCF(68 deg.F)
Particulate Concentration:	0.54817 $\times 10^{-3}$ grain/DSCF(68 deg.F)
Particulate Emissions:	33.45 $\times 10^{-3}$ LB/hr
Stack Flow:	7116 SCFM(dry,68 deg.F)
Stack Velocity:	32.6 feet/second
H2O Vapor In Stack:	1.0 percent
(H2O In Stack is BELOW Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.74

Verified by: _____

PARTICULATE EMISSIONS TEST SUMMARY AND RESULTS

MRP-SSCD-Engr. Eval. Branch

File No. C-_____

Project Name: Chromal

Remarks: 4-4T Tank 4

Total Cr

SUMMARY OF TEST DATA

Metered Sample Volume	129.89 cubic feet
Meter Temperature:	60 deg.F
Nozzle Diameter:	0.313 inches
Pitot Tube C-Factor:	0.810
Sampling Time:	120.00 minutes
Avg. delta P Orifice Pressure:	3.86 inches H2O
Avg. √(delta P Pitot Pressure):	0.60 √(inches H2O)
H2O in Impingers and Silica Gel:	28.1 milliliters
Particulate Catch:	5356.5 milligrams
Stack Diameter:	26.000 inches
Stack Area:	3.687 square feet
Stack Temperature:	68 deg.F
Barometric Pressure:	29.820 inches Hg
O2 In Stack:	20.90 percent
CO2 In Stack:	0.00 percent
CO In Stack:	0.00 percent

CALCULATED RESULTS:

Isokinetic Ratio:	107.2 percent
Corrected Sample Volume:	132.73 DSCF(68 deg.F)
Particulate Concentration:	0.62274 grain/DSCF(68 deg.F)
Particulate Emissions:	38.01 lb/hr
Stack Flow:	7121 SCFM(dry,68 deg.F)
Stack Velocity:	32.6 feet/second
H2O Vapor In Stack:	1.0 percent
(H2O In Stack is BELOW Saturation)	
Stack Gas Mole Weight(dry):	28.85
Stack Gas Mole Weight(wet):	28.74

Verified by: _____

APPENDIX C

AIHL ANALYTICAL RESULTS

ATE	RUN ID	FILTER #	TREATMENT	ANALYSIS
-16-86	1-I4-T	18	U	Cr VI
	1-I4-H	19	U	TOT Cr
2-17-86	1-I3-T	16	U	TOT Cr
	1-I3-H	17	U	Cr VI
	2-I4-T	29	T	Cr VI
	2-I4-H	30	U	Cr VI
	2-I3-T	31	U	Cr VI
	2-I3-H	32	T	Cr VI
	3-I4-T	33	U	Cr VI
	3-I4-H	34	U	TOT Cr
-18-86	3-I3-T	35	T	Cr VI
	3-I3-H	36	U	TOT Cr
	4-I4-T	38	U	TOT Cr
	4-I4-H	39	T	Cr VI
	BLANK	37	T	Cr VI
	BLANK	40	U	Cr VI
	BLAN	41	U	TOT Cr

U - UNTREATED

T - TREATED WITH 25 mL 2% NaOH / 3% Na_2CO_3

C86-125

AMBIENT 2" FILTERS

#1 } TOT Cr
#2 } Cr VI

#3 } TOT Cr
#4 } Cr VI

#5 BLANK

#6 BLANK

LABORATORY REPORT

CD ☐
SSD ☒
OTHER ☐ _____

I.D. No.

STUDY OR CONTROL NUMBER C 8 6 - 1 2 5

PROJECT ENGINEER David Todd

of Establishment Chromal Plating Company

1728 Workman

Los Angeles, CA.

Date this Report:

Mo.	Day	Yr.

Lab. No. Lab. Use Only	SAMPLE NUMBER	Laboratory Results
754	BF	Total chromium, ug per sample
	1-I4-H	2,343.7
	3-I3-H	5,243.0
	1-I3-T	956.8
	4-I4-T	4,460.9
	3-I4-H	2,235.1
	AF	
	1-I4-H	3.7
	3-I3-H	4.1
	1-I3-T	2.3
	4-I4-T	1.0
	3-I4-H	1.4
	Scrubber H2O	ug per mL
	1S	4,740.5
	2S	4,473.0
	3S	5,513.5

Signatures of Chemists Involved: | Date

PAUL WONG 2/3/87

Signature of Supervising Chemist | Date

E Leung 2/6/87

AIHL/ARB
LABORATORY REPORT

TO: ADD ☐
CD ☐
SSD ☒
OTHER ☐ _____

I.D. No.
DY OR CONTROL NUMBER C 8 6 - 1 2 5

PROJECT ENGINEER David Todd

stablishment Chromal Plating Company
1728 Workman
Los Angeles, CA.

Date this Report:

Mo.	Day	Yr
0 2	0 6	8 7

No. Use Only	SAMPLE NUMBER	Laboratory Results
154	Filter #	Total Chromium, ug per filter
	16	(1-I3-T) 2,395.5
	19	(1-I4-H) 402.1
	34	(3-I4-H) 519.9
	36	(3-I3-H) 806.0
	38	(4-I4-T) 895.0
	41	(BLANK) < 1.0
	A-1	($2\frac{1}{2}$") 80.5
	A-3	($2\frac{1}{2}$") 2.1
	A-5	($2\frac{1}{2}$") < 1.0
		Detection Limit 1.0 ug per filter

s of Chemists Involved: Date

UL WANG 2/3/87

Signature of Supervising Chemist Date

E. Young 2/6/87

AIHL/ARB
LABORATORY REPORT

TO: ADD ☐ CD ☐ SSD ☒ OTHER ☐ _____

I.D. No.

LB STUDY OR CONTROL NUMBER C 8 6 - 1 2 5

PROJECT ENGINEER David Todd

ne of Establishment Chromal Plating Co

ress 1728 Workman, Los Angeles, CA.

Date this Report:

Mo.	Day	Yr
0 1	0 9	8 7

Lab. No. *Lab. Use Only*	SAMPLE NUMBER	Laboratory Results	
51755	Run #	Filter #	Chromium (VI) per filter, ug
	A-2	2	12.2 ✓
	A-4	4	< 1.0 ✓
	A-6	BLANK	< 1.0 ✓
	1-I4-T	18	254.9 ✓
	1-I3-H	17	147.9 ✓
	2-I4-T	29	508.1 ✓
	2-I4-H	30	488.0 ✓
	2-I3-T	31	329.4 ✓
	2-I3-H	32	296.6 ✓
	3-I4-T	33	358.3 ✓
	3-I3-T	35	736.8 ✓
	4-I4-H	39	818.8 ✓
	Filter BLK	37	< 1.0 ✓
	Filter BLK	40	< 1.0 ✓
	Reagent BLK	—	< 1.0 ✓

atures of Chemists Involved: Date

PAUL WONG 12/24/86

Signature of Supervising Chemist Date

▶ Mike Amada 12/26/86

LABORATORY REPORT

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OTHER ☐

I.D. No.
/ OR CONTROL NUMBER C 8 6 - 1 2 5

PROJECT ENGINEER David Todd

Establishment Chromal Plating Company
1728 Workman
Los Angeles, CA.

Date this Report:

Mo.	Day	Yr
01	29	87

Lab. No. Use Only	SAMPLE NUMBER	Laboratory Results
55	After Rinse	Chromium (6+), ug per Sample
	1-I4-H	< 1.0
	3-I3-H	< 1.0
	1-I3-H	< 1.0
	4-I4-T	< 1.0
	3-I4-H	4.0
	1-I4-T	< 1.0
	1-I3-T	< 1.0
	2-I4-T	< 1.0
	3-I3-T	< 1.0
	4-I4-H	< 1.0
	2-I3-T	< 1.0
	3-I4-T	< 1.0
	2-I4-H	2.0
	2-I3-H	< 1.0

Names of Chemists Involved: JL WONG — Date 1/23/87

Signature of Supervising Chemist: E Leung — Date 1/27/87

LABORATORY REPORT

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CD ☐
SSD ☒
OTHER ☐

I.D. No.
STUDY OR CONTROL NUMBER C 8 6 - 1 2 5

PROJECT ENGINEER David Todd

f Establishment Chromal Plating Company
1728 Workman
Los Angeles, CA.

Date this Report:

Mo.	Day	Yr
0 1	2 9	8 7

Lab. No. / Use On.	SAMPLE NUMBER	Laboratory Results
755	Probe Rinse	Chromium (6+), ug per sample
	1-I4-H	1,462.9 ✓
	3-I3-H	4,250.0 ✓
	1-I3-H	749.6 ✓
	4-I4-T	3,203.6 ✓
	3-I4-H	2,218.0 ✓
	1-I4-T	1,735.2 ✓
	1-I3-T	854.0 ✓
	2-I4-T	3,230.8 ✓
	3-I3-T	3,784.8 ✓
	4-I4-H	3,851.5 ✓
	2-I3-T	1,332.2 ✓
	3-I4-T	2,196.2 ✓
	2-I4-H	3,034.8 ✓
	2-I3-H	1,503.8 ✓

ures of Chemists Involved: — Date
HUL WONG 1/21/87

Signature of Supervising Chemist — Date
▶ E Young 1/27/87

AIHL/ARB 3/84 8001-008
State of California - Department of Health Services

AIHL/ARB
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TO: ADD ☐
CD ☐
SSD ☒
OTHER ☐ _____

I.D. No.
TUDY OR CONTROL NUMBER C 8 6 - 1 2 5

PROJECT ENGINEER David Todd

f Establishment Chromal Plating Company
1728 Workman
Los Angeles, CA.,

Date this Report:

Mo.	Day	Yr
01	29	87

ab. No. b. Use Only	SAMPLE NUMBER	Laboratory Results
		scrubber water — Chromium (6+), ug per mL
243	1S	3,925.1
	2S	4,319.8
	3S	4,183.7

es of Chemists Involved: Date

UL WONG 1/21/87

Signature of Supervising Chemist: E Jung Date: 1/27/87