

AP-42 Section 12.20
Reference
Report Sect. 4
Reference 81

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**MEASUREMENT OF HEXAVALENT CHROMIUM EMISSIONS
FROM HARD CHROME PLATING OPERATIONS**

at

**Multichrome Company Inc.
1100 Mercantile Street
Oxnard, Ca 93030**

**01/29/93
PES Job Number 4334.002**

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The field testing described in this report was conducted by Siya Mokh, and Michael Kearney of PES. Study direction and report preparation were under the supervision of S. Hugh Brown, Director of Air Quality at Pacific Environmental Services, Incorporated.

Approved: S. Hugh Brown
S. Hugh Brown



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SECTION 1

INTRODUCTION

Multichrome Company Inc., Oxnard division, is in the business of hard chrome plating of industrial and aerospace components.

Ventura County APCD Rule 62.2, adopted June 27, 1989, required all chrome plating and chromic acid anodizing operations in the District which generated hexavalent chromium emissions of 2 lbs/year or less to reduce them by 95% or meet a stack emission limit of 0.15 mg/amp-hr. Facilities which discharged more than two pounds per year were to reduce emissions by 99% or meet a stack emission limit of 0.03 mg/amp-hr.

Pacific Environmental Services, Inc. (PES) a participant in CARB's Independent Contractor Program, was hired by Multichrome Company Inc., (Oxnard) to perform required source testing to determine the hexavalent chromium emission rate of a scrubber serving the their 3 hard chrome plating tanks. PES and its analytical laboratory, West Coast Analytical Service, qualify as independent testing laboratories (no conflict of interest).

PES conducted three 2-hour source tests on the outlet duct of the above mentioned scrubber on the 5th of January 1993. The tests were conducted by Siya Mokh and Michael Kearney of PES under the direction of M. Dean High, Vice President and S. Hugh Brown Director of Air Quality at PES.

Section 2 of this report describes the tested emission control systems and hard chrome plating processes. Section 3 describes the testing methodology. The summary and discussion of the test results appear in Section 4, and Section 5 addresses the project quality assurance.

Appendix A contains the field data sheets, calculations, and process data records. Appendix B contains the lab results of each sample analysis, and Appendix C contains the calibration records for the sampling equipment.



SECTION 2

PROCESS DESCRIPTION

Multichrome Company Inc. (Oxnard), is a hard chrome plating job shop located at 1100 Mercantile Street in Oxnard, California. The 3 tanks operated during the test and their sizes are as follows:

<u>TANK #</u>	<u>SIZE (WxLxH)</u>	<u>FREEBOARD</u>
1	23 x 52 x 48"	6"
2	36 x 76 x 48"	6"
3	36 x 76 x 48"	6"

Chromic acid emissions were collected by slot type hoods on each plating tank. The hoods were connected by various ducts to a single scrubber unit outside the building. The scrubber was exhausted by an integral type blower unit up to and across the roof to the atmosphere. The exhaust duct at the test location was "egg-shaped" instead of circular and therefore measured at three different radial diameters in order to get an average value. Figure 1 shows the diagram of the system including the sampling locations. Appendix A contains a copy of Permit to Operate #1169 issued by the Ventura Air Pollution Control District which covers this equipment.

During each test, all three plating tanks were operated at an above-average amperage load using dummy parts. The applied amperage and voltage for each tank was monitored and recorded by PES personnel at the start, at intervals of 30 minutes during the test, and at the end of the test (see process data in Appendix B). There were no polyballs or additives used in the tanks whose temperatures were around 130 degrees Fahrenheit during the test. The chromium fumes generated by the tanks were quite visible and the test crew noted no fugitive leakage uncollected by the hoods.

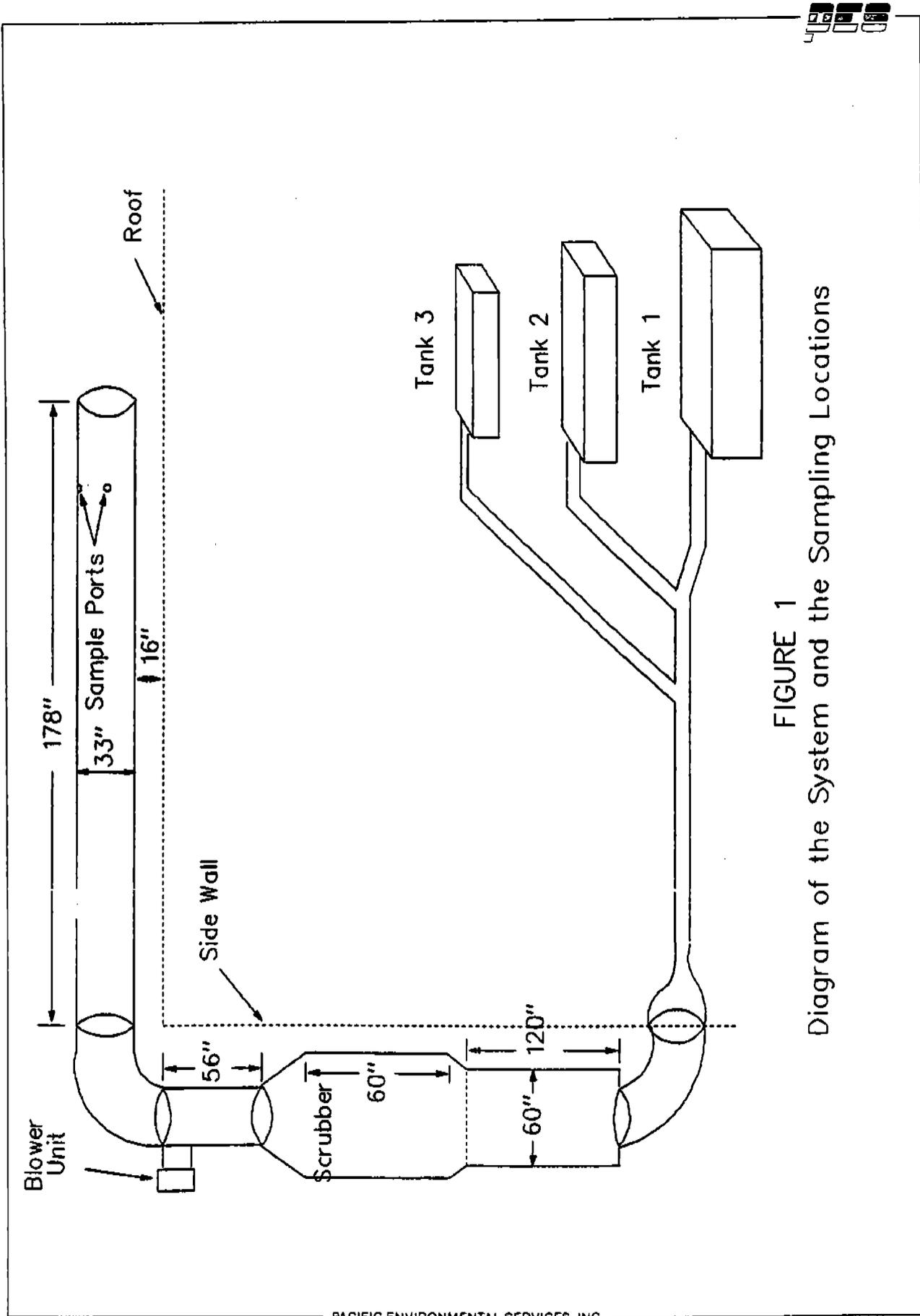


FIGURE 1
Diagram of the System and the Sampling Locations



SECTION 3

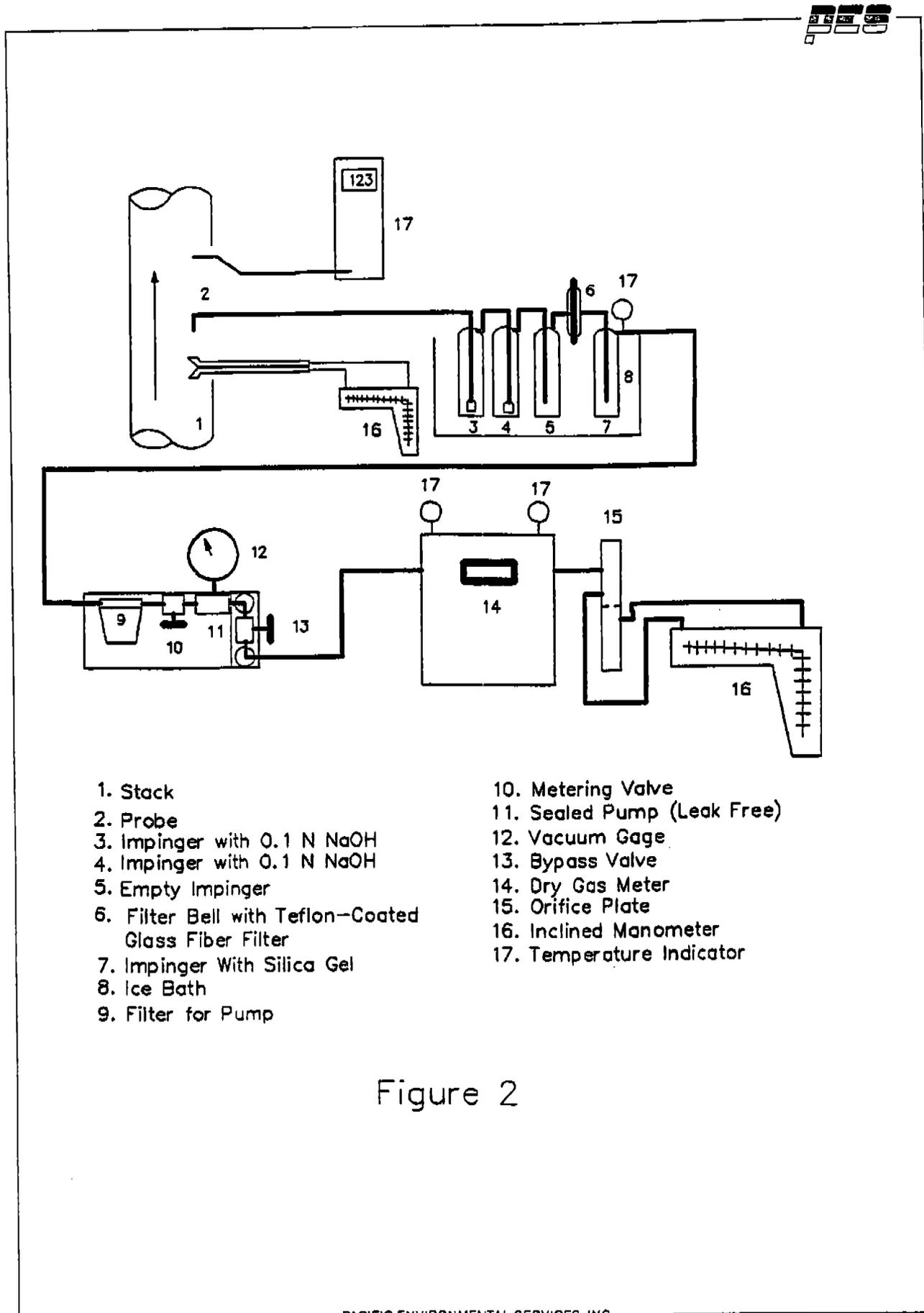
TESTING METHODOLOGY

Prior to testing, PES used smoke generation tubes to verify that all chromic acid mist was being collected by the hood and collection system.

Samples were collected by using CARB method 425 which is specified in Rule 62.2 as an acceptable compliance test method. The sampling train was set up as shown in Figure 2. The samples were extracted through a glass nozzle, a Teflon union, a 48" glass-lined stainless steel probe, a 6-foot Teflon hose from the probe to the first impinger, two Greenburg-Smith impingers each charged with 100 mls of 0.1N sodium hydroxide solution, an empty impinger, a glass filter holder, an impinger filled with silica gel, a 30-foot umbilical line, a vacuum pump, a dry gas meter and a calibrated orifice connected to an inclined oil manometer. Teflon-coated glass fiber filters were used in the filter holders.

The sampling port locations are shown in Figure 1. CARB method 1 was used to determine the sampling port locations and traverse point layout. Prior to sampling, duct velocity, static pressure and temperature were measured by CARB Method 2 to define sampling rates and nozzle size. The weight of the impinger solution and the weight of the silica gel were recorded before and after the test in order to obtain the moisture content of the stack gas stream. All sample volumes and weights were recorded immediately on sample recovery sheets during charging and sample recovery. Leak checks were performed before and after each test.

After the test, the contents of the first three impingers were placed in a 1000 ml. polyethylene container. The sampling train was then rinsed three times from the nozzle to the filter holder with a 0.1N sodium hydroxide solution and these rinses were added to the same container. The Teflon-coated glass fiber filter from the filter holder was added to the impinger solution. Some 0.1 normal nitric acid solution was then used as a final rinse and placed in a separate polyethylene container. This rinse was analyzed separately for total chromium. The chromium samples were kept chilled until analysis to retard breakdown of hexavalent chromium to trivalent chromium. Disposable vinyl gloves were worn during sample retrieval to help reduce contamination.



- | | |
|---|-----------------------------|
| 1. Stack | 10. Metering Valve |
| 2. Probe | 11. Sealed Pump (Leak Free) |
| 3. Impinger with 0.1 N NaOH | 12. Vacuum Gage |
| 4. Impinger with 0.1 N NaOH | 13. Bypass Valve |
| 5. Empty Impinger | 14. Dry Gas Meter |
| 6. Filter Bell with Teflon-Coated
Glass Fiber Filter | 15. Orifice Plate |
| 7. Impinger With Silica Gel | 16. Inclined Manometer |
| 8. Ice Bath | 17. Temperature Indicator |
| 9. Filter for Pump | |

Figure 2



Laboratory analyses were conducted by West Coast Analytical Service in Sante Fe Springs, California. Analyses for hexavalent chromium utilized ion chromatography (IC) and analyses for total chromium utilized inductively coupled plasma with mass spectrometry (ICP/MS). The detection level of the analytical procedures for hexavalent chromium, Cr+6, and total chromium were 1.0 ug/L and 0.010 ug/L respectively. Total chromium analyses serve as a back-up and quality control check for hexavalent chromium concentrations. A sample submittal/chain of custody sheet was completed when the samples were submitted to the laboratory for analysis (see Appendix B). Appendix C contains a copy of the lab report.

SECTION 4

RESULTS

Calculations were made from the field data sheets to determine sample volume, molecular weight, velocities, flow rates, and isokinetic variation for each test. Copies of the field data and calculation sheets are shown in Appendix B.

Analyses of chromium emissions included both total and hexavalent chromium. Results of the test are summarized in Table 1. Hexavalent chromium is considered carcinogenic and is heavily regulated. However, hexavalent chromium is highly unstable and source test data are sometimes unreliable. The total chromium analysis serves as a back-up and quality control check for hexavalent chromium concentrations. Emphasis should be placed on the hexavalent chromium results except in those cases where a large discrepancy is noted between the total and hexavalent chromium data.

VCAPCD Rule 62.2, defines legal hexavalent chrome emissions for hard chrome platers in three categories shown below:

<u>Annual Facility Emissions</u>	<u>Required Control Efficiency</u>	<u>Maximum Stack Emission Limit</u>
<2 lb/yr	95.0%	0.15 mg/a-h
2-10 lb/yr	99.0%	0.03 mg/a-h
>10 lb/yr	99.8%	0.006 mg/a-h

Based on amp-hour totals provided by Pete Faxon of Multichrome for 12/27/91 to 12/29/92, Multichrome had a yearly total of 4,637,788 amp-hours. The source tests indicated emissions of total chromium to be 0.024 mg/amp-hr, and emissions of hexavalent chromium to be 0.015 mg/amp-hr. This calculates to yearly emissions of 0.24 lbs/yr, and 0.15 lbs/yr, respectively.

A review of table 1 indicates that Multichrome Company Inc. is well in compliance with the requirements of VCAPCD Rule 62.2.

TABLE 1

MULTICHROME OXNARD
CHROMIUM EMISSIONS
SCRUBBER EXHAUST
1-5-93

Process Conditions: Loads in all three tanks; no additives or polyballs used.

<u>Flue Gas</u>	<u>Test #1</u>	<u>Test #2</u>	<u>Test #3</u>
Temperature, °F	58	58	57
Velocity, ft/sec	21.2	21.6	21.3
Static Pressure, in. H ₂ O	-0.08	-0.09	-0.07
Duct Inside Diameter, in.	34	34	34
Duct Area, sq. ft.	6.31	6.31	6.31
Flow Rate, ACFM	8,030	8,180	8,060
Flow Rate, DSCFM	8,100	8,100	7,970
Moisture, % v/v	1.3	1.4	1.7
<u>Load</u>			
Total amp-hrs/hr	4,063	4,000	4,084
<u>Chromium</u>			
Sampling Start	11:25	13:45	15:57
Sampling Stop	13:30	15:47	18:00
Sampling Time, min.	120	120	120
Sample Volume, DSCF	82.8	74.6	80.7
Isokinetic Rate, %	102.7	99.3	101.5
Concentration, mg/m ³			
Total Cr	0.0067	0.0081	0.0054
Hexavalent Cr	0.0048	0.0042	0.0043
Emission Rate, mg/hr			
Total Cr	91.7	111.7	73.7
Hexavalent Cr	65.8	58.1	58.5
Emission Rate, mg/amp-hr			
Total Cr	0.023	0.028	0.018
Hexavalent Cr	0.016	0.014	0.014
Emission Rate, lbs/yr			
Total Cr		0.24	
Hexavalent Cr		0.15	



SECTION 5

PROJECT QUALITY ASSURANCE

Source tests are performed to determine the types and amounts of pollutants emitted by a source. Information from this source test program may be used for obtaining permits, evaluating control equipment performance, updating emission inventories, and determining compliance with present and future emission regulations. For these purposes, reliable data are required. PES provides this reliability by using the following work practices:

Use of Standard Test Procedures

CARB Methods were used to determine the emission rates. A procedure must be thoroughly studied under various conditions in order to be designated as a CARB test method. Results of many executions of the procedure are compared to demonstrate accuracy and repeatability before adoption of the procedure as a source testing method. Method 425 uses many aspects of EPA method 5 which outlines the most common method of source testing.

Use of Trained Test Personnel

Because of the complexity of typical source testing methods, testers should be trained and experienced with the test procedures in order to assure reliable results. PES personnel have had professional training and routinely conduct source tests.

Knowledge of Source's Operation

The source testing team should have sufficient knowledge of the process to be tested in order to properly document the process parameters during the tests. Without documentation of the process parameters used, results are much less meaningful. PES has previously tested many chrome plating shops and is familiar with the various types of plating processes.



Equipment Maintenance and Calibration

Use of properly maintained and calibrated test equipment is essential for minimizing systematic errors in results. All sampling devices were constructed and maintained as suggested in EPA documents APTD-0576, and AOTD-0581 (These are commonly accepted construction and maintenance manuals for source testing equipment). The dry gas meter was calibrated before the tests using a transfer gas meter with NBS traceability. All equipment calibrations are included in Appendix D.

Thorough Record Keeping

All data relating to the operation of the sampling train must be immediately recorded to ensure that it is not lost or misinterpreted. PES accomplishes thorough record keeping by use of field data sheets. The PES test team is familiar with these sheets and the information required to complete them. Any unusual occurrences in the process operation, unusual test instrument readings, or any other items that may have affected the test results were also noted.

Proper Sample Handling Procedures

Inaccurate source test results can be caused by delays in retrieving samples, contamination of the samples, insufficient sample identification, tampering, and mishandling of samples. The chances of these errors are greatly increased when too many people are permitted to handle the samples. For this reason, a chain of custody procedure was used. The samples were retrieved immediately after the test and kept in a secure area until analysis. The samples were chilled until analysis to minimize breakdown from hexavalent to trivalent chromium. A sample submittal/chain of custody form was completed and submitted with all samples to document that the sample analyzed was taken under the conditions reported (see Appendix B).

Use of thoroughly Cleaned Glassware

All glassware and probe lines were cleaned prior to the test with hot tap water and then with 40% nitric acid solution. The trains were then rinsed with 0.1N NaOH, laboratory grade distilled water, air dried, and sealed until the tests.

Use of Standardized Data Reduction Techniques

Data reduction was accomplished by the use of step by step calculation sheets. The calculations followed a defined format which is easy to understand. All calculations are shown in Appendix B.

Submission of Blank Samples

Filter and reagent samples from an unused charged train carried to the field (train blank) were submitted to the laboratory and analyzed with the other samples to detect any possible contamination of sampling media or problems with lab analyses. No corrections were made to the measured concentrations of the collected samples but the blank values were reported on the calculation sheets.



APPENDIX A
EQUIPMENT PERMITS

PERMIT TO OPERATE
Number 1169

Valid January 1, 1991 to December 31, 1991

This Permit Has Been Issued To The Following:

Company Name / Address:	Facility Name / Address:
Multichrome Co. Inc. 1100 Mercantile Street Oxnard, CA 93030	Multichrome Co. Inc. 1100 Mercantile Street Oxnard, CA 93030

Permission Is Hereby Granted To Operate The Following:

Chrome Plating Operation consisting of the following:

- 2 - 583 gallon tanks
 - 1 - 269 gallon tank
- The above tanks are controlled by a 10,000 CFM capacity Tellkamp Wet Fume Scrubber.
- 1 - 50 gallon cold degreaser with a freeboard ratio of 0.75

This Permit Has Been Issued Subject To The Following Conditions:

- | 1. Permitted Emissions: | Tons/Year | Pounds/Hour |
|----------------------------|-----------|-------------|
| Reactive Organic Compounds | 0.68 | 0.65 |
| Chromic Acid | <0.01 | <0.01 |
- 2. Permitted emissions from the degreaser are based on the annual loss (consumed less reclaimed) of 100 gallons of perchloroethylene. Prior to exceeding this limit, permittee shall apply for a change in permitted emissions.
 - 3. The chromic acid threshold limit value (TLV) of 0.05 milligrams per cubic meter shall not be exceeded at any time during operation of the Chrome Plating system.
 - 4. The degreaser shall comply with all the applicable requirements of APCD Rule 74.6, Surface Cleaning and Degreasing.
 - 5. Permittee shall maintain records showing the amount each time make-up solvent is added to the degreaser. Permittee shall also, on a quarterly basis or shorter, record the facilitywide total of make-up solvent. These records shall be kept for two years and shall be made available to APCD personnel upon request.
 - 6. Compliance with the emissions limits of APCD Rule 62.2, Hexavalent Chromium - Chrome Plating and Acid Anodizing shall be demonstrated by source testing on or before January 1, 1991.

Permit to Operate Number 1169
Issued To Multichrome Co. Inc.
Valid January 1, 1991 to December 31, 1991

7. Permittee shall also maintain weekly records of current integrated over time (ampere-hours) for all plating tanks. Current integrated over time shall be continuously monitored. All records including all pertinent information relative to the operation of the plating tanks, all source testing, and all information relative to the emissions collection system and the control equipment shall be maintained for two years and shall be made available to the APCD upon request.

Within ten days after receipt of this permit, the applicant may petition the Hearing Board to review any condition that has been modified or added to the permit (Rule 22).

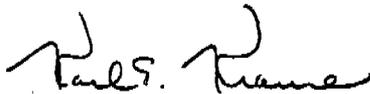
This permit, or a copy, shall be posted reasonably close to subject equipment and shall be readily accessible to inspection personnel from the Air Pollution Control District (Rule 19).

This permit is not transferable from one location to another unless the equipment is specifically listed as being portable (Rule 20).

In reliance upon the statement of the applicant that the operation of the equipment described herein shall meet the requirements as specified in the Rules and Regulations of the Air Pollution Control District, permission is hereby granted to operate; provided, however, the permission granted hereby shall not be construed to permit said equipment to operate in violation of any applicable State or Federal emission standard or Rules and Regulations of the District.

Richard H. Baldwin
Air Pollution Control Officer

by:



Karl E. Krause, Manager
Engineering Section

Came with 92 permit

**Rule 62.2 Hexavalent Chromium - Chrome Plating and Chromic Acid Anodizing
(Adopted 6/27/89)**

A. Applicability

This rule applies to the chrome plating and the chromic acid anodizing of metallic and non-metallic parts.

B. Requirements

1. Decorative chrome plating

A person shall not operate any decorative chrome plating tank unless one of the following control measures is used in a manner which has been demonstrated to and approved by the Air Pollution Control Officer (APCO) as reducing chromium emissions by 95 percent or more relative to the uncontrolled chromium emissions:

- a. An anti-mist additive is continuously maintained, or;
- b. Control equipment is installed and used.

2. Hard chrome plating and chromic acid anodizing

a. A person shall not operate any hard chrome plating tank or chromic acid anodizing tank unless the tank has an emissions collection system that meets one of the following requirements:

- 1. The chromium emissions from the emissions collection system serving the plating tank must be reduced by at least 95 percent from the uncontrolled chromium emissions, or;
- 2. The chromium emissions from the emissions collection system serving the plating tank must be reduced to less than 0.15 milligrams (mg) of chromium per ampere-hour of electrical charge applied to the plating tank.

b. A person shall not operate any hard chrome plating tank or chromic acid anodizing tank at a stationary source where the sourcewide chromium emissions from hard chrome plating or chromic acid anodizing are greater than 2 pounds per year, but less than 10 pounds per year, unless the tank has an emissions collection system that meets one of the following requirements:

- 1. The chromium emissions from the emissions collection system serving the plating tank must be reduced by at least 99 percent from the uncontrolled chromium emissions, or;
- 2. The chromium emissions from the emissions collection system serving the plating tank must be reduced to less than 0.03 mg of chromium per ampere-hour of electrical charge applied to the plating tank.

*EPA SAYS
MIST ELIMINATOR
DOES THIS*

- c. A person shall not operate any hard chrome plating tank or chromic acid anodizing tank at a stationary source where the sourcewide chromium emissions from hard chrome plating or chromic acid anodizing are greater than or equal to 10 pounds per year, unless the tank has an emissions collection system that meets one of the following requirements:
 1. The chromium emissions from the emissions collection system serving the plating tank must be reduced by at least 99.8 percent from the uncontrolled chromium emissions, or;
 2. The chromium emissions from the emissions collection system serving the plating tank must be reduced to less than 0.006 mg of chromium per ampere-hour electrical charge applied to the plating tank.
- d. Compliance shall be verified by source testing every 24 months.

C. Recordkeeping Requirements

A person subject to the provisions of section B of this rule shall meet the following applicable requirements:

1. A weekly record of anti-mist additive concentrations or any other measurements recommended by the manufacturer's specification and the APCO shall be maintained. Recordkeeping shall begin on the date of final compliance.
2. A weekly record of current integrated over time (ampere-hours) for all plating tanks used at a chrome plating or chromic acid anodizing stationary source shall be maintained. Current integrated over time shall be continuously monitored. Recordkeeping shall begin on June 27, 1989.
3. All records including all pertinent information relative to the operation of the plating tanks, all source testing, and all information relative to the emissions collection system and the control equipment shall be maintained for two years and shall be made available to the APCO upon request.

D. Test Methods

Compliance with the chromium emissions requirements in subsection B.2 of this rule shall be determined by ARB Test Method 425.

E. Compliance Schedule

1. A person subject to the provisions of subsection B.1 shall be in final compliance with the requirements of subsection B.1, and shall submit to the APCO an application for a Permit to Operate, no later than January 1, 1990.

2. A person subject to the provisions of subsection B.2, except a person subject to the provisions of subsection B.2.b, shall meet the following compliance schedule:
 - a. Submit to the APCO an application for an Authority to Construct for the equipment necessary to comply with the requirements of subsection B.2.a, no later than July 1, 1990, and;
 - b. Achieve final compliance with the requirements of subsection B.2.a, and submit to the APCO an application for a Permit to Operate, no later than January 1, 1991.
3. A person subject to the provisions of subsection B.2.b shall meet the following compliance schedule:
 - a. Submit to the APCO an application for an Authority to Construct for the equipment necessary to comply with the requirements of subsection B.2.b, no later than January 1, 1991, and;
 - b. Achieve final compliance with the requirements of subsection B.2.b, and submit to the APCO an application for a Permit to Operate, no later than July 1, 1991.
4. A person subject to the provisions of subsection B.2.c shall, in addition, meet the following compliance schedule:
 - a. Submit to the APCO an application for an Authority to Construct for the equipment necessary to comply with the requirements of subsection B.2.c, no later than January 1, 1992, and;
 - b. Achieve final compliance with the requirements of subsection B.2.c, no later than July 1, 1993.

F. Definitions

For the purposes of this rule the following definitions shall apply:

1. "Ampere-hours": The integral of electrical current (amperes) applied to a plating tank over a period of time (hours).
2. "Anti-mist additive": A chemical which reduces the emission rate from the tank when added to and maintained in the plating tank.
3. "Chrome": Metallic chrome.
4. "Chrome plating": Hard or decorative chrome plating.
5. "Chromic acid": An aqueous solution of chromium trioxide (CrO_3) or a commercial solution containing chromic acid, dichromic acid (H_2CrO_7), or trichromic acid ($\text{H}_2\text{Cr}_3\text{O}_{10}$).

6. "Chromic acid anodizing": The electrolytic process by which a metal surface is converted to an oxide surface coating in a solution containing chromic acid.
7. "Chromium": Hexavalent chromium.
8. "Control equipment": Any device which reduces emissions from the emissions collection system.
9. "Decorative chrome plating": The process by which chromium is electrodeposited from a solution containing compounds of chromium onto an object resulting in a chrome layer 1 micron (0.04 mil) thick or less.
10. "Emission factor": The mass of chromium emitted during a test conducted in the emissions collection system in accordance with ARB Test Method 425, divided by the ampere-hours consumed by the tanks in the tested emissions collection system, expressed as the mass of chromium emitted per ampere-hour of electrical current consumed.
11. "Emissions collection system": A device or apparatus used to gather chromium emissions from the surface of a chrome plating or chromic acid anodizing tank or tanks.
12. "Stationary Source": As defined in Rule 2 of these Rules.
13. "Sourcewide emissions from hard chrome plating or chromic acid anodizing": The total emissions from all hard chrome plating or chromic acid anodizing at the stationary source over a calendar year. Emissions shall be calculated as the sum of emissions from the emissions collection system at the stationary source. The emissions from an emissions collection system shall be calculated by multiplying the emission factor for that emissions collection system by the sum of ampere-hours consumed during that year for all of the tanks served by the emissions collection system.
14. "Hard chrome plating": The process by which chromium is electrodeposited from a solution containing compounds of chromium onto an object resulting in a chrome layer thicker than 1 micron (0.04 mil).
15. "Plating tank": Any container used to hold a chromium or chromic acid solution for the purposes of chrome plating or chromic acid anodizing.
16. "Uncontrolled chromium emissions from the hard chrome plating or chromic acid anodizing stationary source": The chromium emissions from the emissions collection systems at the stationary source calculated as if no control equipment is in use. For the purpose of determining compliance with this rule, the uncontrolled chromium emissions shall be calculated using an emission factor based on tests conducted in accordance with ARB Test Method 425 or 14 mg/ampere-hour, whichever is less.



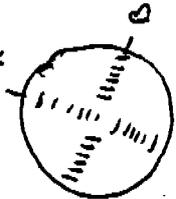
APPENDIX B
FIELD DATA AND CALCULATION SHEETS

Plant MULTICHRD ME

Date 1-5-93
 Sampling location SCRUBBER OUTLET
 Sample Type 425
 Run Number MC-1
 Operator MOKH/KEARNEY
 Ambient Temperature 60°F
 Barometric Pressure 30.01
 Static Pressure (P_s) -0.08
 Filter Number(s) MC-1F
 Pretest Leak Rate = 0.012 cfm @ 10.0 in. Hg
 Pretest Pitot Leak Check ✓
 Pretest Orat Leak Check ✓
 Read and Record all Data Every 5 Minutes

FIELD DATA

TOP VIEW



FLOW OUT OF PAPER

Schematic of Traverse Point Layout

Probe Length and Type 48" Glass lined SS
 Pitot Tube I.D. No. S-1A
 Nozzle I.D. No. { DIAMETER 0.310 } K-1
 Assumed Moisture, % 2

Meter Box Number 1A
 Meter ΔHg 1.953
 C Factor 1.15
 Meter Gamma 1.005
 Heater Box Setting
 Reference ΔP 1.60
 Post Test Leak Rate = 0.012 cfm @ 5.0 in. Hg
 Post Test Pitot Leak Check ✓
 Post Test Orat Leak Check ✓

Impeller Box No. 38 ; BLANK Box No. 4B

Traverse Point Number	Sampling / Clock Time, / (24-hour) (min) / (clock)	Gas Meter Reading (V) ft	Velocity Head (ΔP _v) in. H ₂ O	Orifice Pres. Differential (ΔH) in. H ₂ O	Stack Temp. (T _g) °F	Dry Gas Meter Temp. Inlet (T _{m,in}) °F	Outlet (T _{m,out}) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter °F	Im-pinger Temp. °F
A-1	0 / 11:25	287.164	0.050-0.00 MK	0.69	60	62	60	1.0	-	50
A-2	5 / 11:30	283.4	0.050-0.00 MK	0.92	59	66	62	2.0	-	49
A-3	10 / 11:35	286.9	0.101-0.00 MK	1.15	60	71	63	2.0	-	48
A-4	15 / 11:40	288.9	0.101-0.00 MK	1.15	60	73	64	2.0	-	49
A-5	20 / 11:45	291.6	0.114-0.00 MK	1.25	61	76	66	2.0	-	54
A-6	25 / 11:50	294.7	0.14	1.60	60	78	68	2.5	-	60
A-7	30 / 11:55	297.9	0.14	2.20	60	79	69	3.0	-	62
A-8	35 / 12:00	301.0	0.20	2.35	59	81	70	3.5	-	63
A-9	40 / 12:05	305.8	0.20	2.35	59	82	71	3.5	-	59
A-10	45 / 12:10	309.3	0.21	2.40	60	84	73	4.0	-	59
A-11	50 / 12:15	314.1	0.20	2.35	59	84	73	3.5	-	61
A-12	55 / 12:20	318.1	0.21	2.40	59	85	75	4.0	-	66
END / B-1	60 / 12:25:30	322.3	0.17	1.30	57	85	76	3.0	-	66
B2	65 / 12:35	325.3	0.12	1.40	57	85	76	3.0	-	66
B3	70 / 12:40	328.7	0.13	1.50	57	86	76	3.0	-	67
B4	75 / 12:45	331.9	0.15	1.75	57	84	77	3.0	-	68
B5	80 / 12:50	335.5	0.14	1.60	57	84	77	3.0	-	66
B6	85 / 12:55	339.0	0.15	1.75	57	85	77	3.0	-	66
B7	90 / 13:00	342.5	0.15	1.75	57	85	77	3.0	-	66
B8	95 / 13:05	347.9	0.16	1.85	57	85	78	3.0	-	65
B9	100 / 13:10	349.6	0.17	1.95	57	85	78	3.0	-	64
B10	105 / 13:15	353.3	0.17	1.95	57	86	79	3.0	-	64
B11	110 / 13:20	357.0	0.16	1.85	57	86	79	3.0	-	66
B12	115 / 13:25	360.7	0.17	1.95	57	87	79	3.0	-	67
END	120 / 13:30	364.402	-	-	57	86	79	3.0	-	68

θ = 12.0

V_m = 83.258

√ΔP = 0.382

ΔH = 1.73

T_g = 518

T_m = 537

≤ 68



SAMPLE RECOVERY DATA

Plant: MULTICHROME
 Date: 1-5-93
 Sampling Location: Scrubber Outlet
 Sample Type: 425
 Run Number: MC-1
 Sample Box Number: 3B
 Clean-up Man: Mokit
 Job Number: _____
 Comments: 1A: 1004.5 - 142.0 = 862.5
1B: 237.5 - 61.0 = 176.5

FRONT HALF

Filter Number: _____
 Description of Filter: Clear

MOISTURE

Impingers

Final Volume:	<u>634.0</u> ml	<u>664.5</u> ml	<u>474.0</u> ml
Initial Volume:	<u>626.0</u> ml	<u>664.0</u> ml	<u>473.0</u> ml
Net Volume:	<u>8.0</u> ml	<u>0.5</u> ml	<u>1.0</u> ml
Total H ₂ O:	_____	_____	_____

Silica Gel

Final Volume:	<u>664.5</u> g	_____ g	_____ g
Initial Volume:	<u>650.0</u> g	_____ g	_____ g
Net Volume:	<u>14.5</u> g	_____ g	_____ g
Total Moisture:	_____	_____	_____

Description of Impinger Catch: Clear 24.0

EMISSION TEST CALCULATIONS

Definiton of Symbols:

- A : cross-sectional area of stack, ft²
- A_n : cross-sectional area of nozzle, ft²
- B_w : water vapor in gas stream, proportional by volume
- C_p : pitot tube coeficient
- I : percent of isokinetic sampling
- M_d : dry molecular weight, lb/lb-mole
- M_s : molecular weight of stack gas, lb/lb-mole
- P_{bar} : barometric pressure at the sampling site, in. of Hg
- P_s : stack gas pressure, in. of Hg
- Q_s : stack volumetric flow rate , actual condition acfm
- Q_{std} : stack volumetric flow rate, standard conditions dscfm
- T_m : average dry gas meter temperature , R = 460 + °F
- T_s : average stack gas temperature, R = 460 + °F
- V_l : total volume of liquid collected in impingers & silica gel, in ml
- V_m : Volume of gas sample as measured by dry gas meter, dscf
- V_{m, std} : Vm corrected to standard conditions, dscf
- V_{w, std} : volume of water vapor in gas sample corrected to standard conditions, scf
- V_s : stack gas velocity, ft/sec
- γ : dry gas meter calibration factor
- ΔH : average pressure differential across the orifice meter, in. of H₂O
- θ : total sampling time, in minutes
- 13.6 : specific gravity of mercury

Plant: MULTICHROME COMPANY INC

Date: 1-5-93

Source/Sample Number: MC-1

1. $V_m(\text{std}) = (17.64)(V_m)(Y) \left[\frac{P_{\text{bar}} + (\Delta H/13.6)}{T_m} \right]$

$V_m(\text{std}) = (17.64)(83.238)(1.005) \left[\frac{(30.0) + (1.73/13.6)}{(537)} \right]$

$V_m(\text{std}) = \underline{82.8} \text{ dscf.}$

2. Volume water vapor collected (standard conditions).

$V(10) = \underline{24.0} \text{ condensate from impingers and silica gel.}$

$V_w(\text{std}) = (0.04707) V(10) = (0.04707)(24.0)$

$V_w(\text{std}) = \underline{1.13} \text{ scf.}$

3. Percent moisture, by volume.

$Bw_s = \frac{V_w(\text{std})}{V_w(\text{std}) + V_m(\text{std})} = \frac{(1.13)}{(1.13) + (82.8)} = \underline{0.013}$

$Bw_s = \underline{1.3\%}$

4. Molecular weight, stack gas.

Dry molecular weight.

$M_d = 0.440(\% \text{ CO}_2) + 0.320(\% \text{ O}_2) + 0.280(\% \text{ N}_2 + \% \text{ CO})$

$M_d = 0.440(\text{---}) + 0.320(\text{---}) + 0.280(\text{---})$

$M_d = \underline{29.0} \text{ lb/lb-mole.}$

$M_s = M_d + Bw_s (18 - M_d) = (29) + (0.013)(18 - 29)$

$M_s = \underline{28.9} \text{ lb/lb-mole.}$

Plant: MULTICHROME COMPANY INC

Date: 1-5-93

Source/Sample Number: MC-1

5. Stack gas velocity average.

$$V_s(\text{avg}) = (85.49)(C_p)(\sqrt{\Delta P}) \left[\text{avg} \sqrt{\frac{(T_s)}{(P_s)(M_s)}} \right]$$

$$V_s(\text{avg}) = (85.49)(0.84)(0.382) \left[\sqrt{\frac{(518)}{(30.0)(28.9)}} \right]$$

$$V_s(\text{avg}) = \underline{21.2} \text{ ft/sec.}$$

6. Stack volumetric flow rate, actual conditions (stack temperature and pressure).

$$Q_s = (60)(V_s)(A) = (60)(21.2)(6.31)$$

$$Q_s = \underline{8030} \text{ acfm.}$$

7. Stack volumetric flow rate, standard conditions (68 degrees F, 29.92 Hg).

$$Q(\text{std}) = (17.64)(Q_s)(1 - B_{w_s}) \left[\frac{(P_s)}{(T_s)} \right]$$

$$Q(\text{std}) = (17.64)(8030)(1 - 0.013) \left[\frac{(30.0)}{(518)} \right]$$

$$Q(\text{std}) = \underline{8100} \text{ dscfm.}$$

8. Isokinetic variation.

$$\%I = (K) \left[\frac{(T_s)(V_m(\text{std}))}{(P_s)(V_s)(A_n)(\theta)(1 - B_{w_s})} \right]$$

$$\%I = (0.0945) \left[\frac{(518)(82.8)}{(30.0)(21.2)(0.00524)(120)(1 - 0.013)} \right]$$

$$\%I = \underline{102.7} \%$$

CLIENT: MULTICHROME COMPANY

Project No. _____

Sampling Location: SCRUBBER OUTLET Test Date: 1-5-93

Sample Volume: 82.8 DSCF Stack Flow Rate: 8100 DSCFM

Chromium Test No. MC-1

Blank: Sample No. MC-4

$$\begin{aligned} \text{Total Cr: } & \frac{0.0044 \text{ ug/ml} \times 611.0 \text{ mls}}{2.69 \text{ ug Cr}} \\ \text{acid wash: } & \frac{0.0009 \text{ ug/ml} \times 95.5 \text{ mls}}{0.09 \text{ ug Cr}} \\ & \text{Total} = \frac{2.69 \text{ ug Cr}}{2.78 \text{ ug Cr}} \end{aligned}$$

$$\text{Cr}^{+6}: \frac{0.00654 \text{ ug/ml} \times 611.0 \text{ mls}}{0.33 \text{ ug Cr}^{+6}}$$

Total Chromium

Source: Sample No. MC-1

$$\begin{aligned} \text{Total Cr: } & \frac{0.0176 \text{ ug/ml} \times 862.5 \text{ mls}}{15.18 \text{ ug Cr}} \\ \text{acid wash: } & \frac{0.0025 \text{ ug/ml} \times 176.5 \text{ mls}}{0.44 \text{ ug Cr}} \\ & \text{Total} = \frac{15.18 \text{ ug Cr}}{15.62 \text{ ug Cr}} \end{aligned}$$

$$\frac{(15.62) \text{ ug} \times 35.3 \text{ SCF/m}^3}{(82.8) \text{ DSCF} \times 1000 \text{ ug/mg}} = \frac{0.0067 \text{ mg/m}^3 \text{ Cr}}$$

$$\frac{(15.62) \text{ ug} \times 60 \text{ min/hr} \times (8100) \text{ DSCFM}}{(82.8) \text{ DSCF} \times 1000 \text{ ug/mg}} = \frac{91.7 \text{ mg/hr Cr}}$$

$$\frac{(91.7) \text{ mg/hr}}{(4063) \text{ amp-hr/hr}} = \frac{0.023 \text{ mg/amp-hr Cr}}$$

Hexavalent Chromium

Source: Sample No. MC-1

$$\text{Cr}^{+6}: \frac{0.013 \text{ ug/ml} \times 862.5 \text{ mls}}{11.21 \text{ ug Cr}^{+6}}$$

$$\frac{(11.21) \text{ ug} \times 35.3 \text{ SCF/m}^3}{(82.8) \text{ DSCF} \times 1000 \text{ ug/mg}} = \frac{0.0048 \text{ mg/m}^3 \text{ Cr}^{+6}}$$

$$\frac{(11.21) \text{ ug} \times 60 \text{ min/hr} \times (8100) \text{ DSCFM}}{(82.8) \text{ DSCF} \times 1000 \text{ ug/mg}} = \frac{65.8 \text{ mg/hr Cr}^{+6}}$$

$$\frac{(65.8) \text{ mg/hr}}{(4063) \text{ amp-hr/hr}} = \frac{0.016 \text{ mg/amp-hr Cr}^{+6}}$$

Plant MULTICHRISME

Date 1-5-93
 Sampling location SCRUBBER INLET
 Sample Type 42S
 Run Number MC-2
 Operator MOXH/KEARNEY
 Ambient temperature 66°F
 Barometric Pressure 29.5
 Static Pressure (Pa) +0.09
 Filter Number(s) MC-2F
 Pretest Leak Rate = 0.00 cfm @ 9.0 in. Hg
 Pretest Pitot Leak Check ✓
 Pretest Great Leak Check ✓
 Read and Record all Data Every 5 Minutes

FIELD DATA

Probe Length and Type 48" GLASS LINED SS
 Pitot Tube I.D. No. S-2A
 Nozzle I.D. No. & Diameter 0.27" x 0.299
 Assumed Moisture, % 2

Meter Box Number HA
 Meter Dial 1-953
 C Factor 1.15
 Meter Gamma 1.705
 Heater Box Setting ✓
 Reference Ap ΔL = 0.190

Post Test Leak Rate = 0.00 cfm @ 5.0 in. Hg
 Post Test Pitot Leak Check ✓
 Post Test Great Leak Check ✓

SAME AS
 MC-1

Schematic of
 Traverse Point Layout

Impinger Box No. 5B ; Blank Box No. 4B

Traverse Point Number	Sampling Time (min) / 124-hour (min) / clock	/clock	Gas Meter Reading (V) ft	Velocity Head (AP _v) in. H ₂ O	Orifice Pres. Differential (ΔH) in. H ₂ O Desired/Actual	Stack Temp. (T _g) °F	Dry Gas Meter Temp. Inlet (T _m) °F / Outlet (T _m) °F	Pump Vacuum In. Hg	Sample Box Temp. Filter Temp. °F	Im-pinger Temp. °F
B1	0	13:45	304.582	0.11	1.05	57	78	2.0	NA	62
B2	5	13:50	367.6	0.12	1.15	57	80	2.0	—	63
B3	10	13:55	370.3	0.15	1.45	57	81	2.5	—	64
B4	15	14:00	373.5	0.15	1.45	58	82	2.5	—	65
B5	20	14:05	376.7	0.16	1.55	57	83	3.0	—	64
B6	25	14:10	379.9	0.17	1.65	58	84	3.0	—	62
B7	30	14:15	383.3	0.17	1.65	58	85	3.0	—	64
B8	35	14:20	386.7	0.18	1.75	58	85	3.0	—	66
B9	40	14:25	390.2	0.18	1.75	58	86	3.0	—	63
B10	45	14:30	394.2	0.17	1.65	58	86	3.0	—	64
B11	50	14:35	397.5	0.15	1.45	58	86	3.0	—	66
B12	55	14:40	400.5	0.15	1.45	58	86	3.0	—	67
END/A1	60	14:45/14:50	403.6	0.07	0.69	59	87	1.5	—	67
A2	65	14:52	407.7	0.08	0.76	59	87	1.0	—	63
A3	70	14:57	408.3	0.09	0.86	59	87	1.0	—	62
A4	75	15:02	410.8	0.10	0.95	58	87	2.0	—	66
A5	80	15:07	413.5	0.12	1.15	58	87	2.0	—	67
A6	85	15:12	416.3	0.14	1.35	58	87	2.0	—	68
A7	90	15:17	419.3	0.19	1.80	58	87	2.0	—	64
A8	95	15:22	423.0	0.21	2.00	58	85	3.0	—	68
A9	100	15:27	426.8	0.20	1.90	59	85	3.0	—	68
A10	105	15:32	430.5	0.20	1.90	59	86	3.0	—	68
A11	110	15:37	434.2	0.20	1.90	59	86	3.0	—	67
A12	115	15:42	437.8	0.19	1.80	59	86	3.0	—	66
END	120	15:47	441.512	—	—	—	85	3.0	—	66

θ = 120 V_m = 76.930 √AP = 0.386 AH = 1.46 T_s = 518 T_m = 541 ΔL = 60



**Chrome Plating or Anodizing Process Data
/ Amp-Hour Reading Summary**

Company: MULTICHROME

Date: 1-5-43
Job: _____

- Start Time: 13:45 End Time: 15:45
- Load Conditions: NORMAL TO MAXIMUM
- Testers: MCKM/KEFENEI
- Test Location: SCURFER OUTLET

Time:	Tank/ Rect. #	Amp Meter	A-H totalizer	Notes:
13:45	1	740	623240	4.8 ✓ 128°F
	2	1500	692470	6.0 / 128°F
	3	1480	790990	6.0 / 131°F
14:15	1	740	623760	137°F
	2	1500	693175	129°F
	3	1480	791700	131°F
14:45	1	740	624340	137°F
	2	1500	693905	129°F
	3	1480	792425	132°F
15:15	1	740	624890	137°F
	2	1500	694630	130°F
	3	1480	793175	132°F
15:45	1	740	625460	137°F
	2	1500	695350	131°F
	3	1480	793890	132°F
		793890 - 790990 =	2900 +	
		695350 - 692470 =	2880	
		625460 - 623240 =	2220	
			8000 ÷ 2 hrs =	4000

TOTALIZER READINGS:

Tank	Start	End	Total /	= Av. A-H	Notes:

* Smoke test was / was not performed.



SAMPLE RECOVERY DATA

Plant: MULTICHROME
 Date: 1-5-93
 Sampling Location: SCRUBBER INLET
 Sample Type: 425
 Run Number: MC-2
 Sample Box Number: 5B
 Clean-up Man: MOKH
 Job Number: _____
 Comments: 2A: 1045.0 - 144.0 = 901.0
2B: 240.5 - 61.0 = 179.5

FRONT HALF

Filter Number: _____
 Description of Filter: _____

MOISTURE

<u>Impingers</u>			
Final Volume:	<u>607.0</u> ml	<u>583.0</u> ml	<u>463.0</u> ml
Initial Volume:	<u>597.7</u> ml	<u>581.4</u> ml	<u>462.0</u> ml
Net Volume:	<u>9.3</u> ml	<u>1.6</u> ml	<u>1.0</u> ml
Total H ₂ O:	_____	_____	_____
<u>Silica Gel</u>			
Final Volume:	<u>684.5</u> g	_____ g	_____ g
Initial Volume:	<u>674.0</u> g	_____ g	_____ g
Net Volume:	<u>10.5</u> g	_____ g	_____ g
Total Moisture:	_____	_____	<u>72.4</u>

Description of Impinger Catch: _____

EMISSION TEST CALCULATIONS

Definiton of Symbols:

A	: cross-sectional area of stack, ft ²
A _n	: cross-sectional area of nozzle, ft ²
B _w	: water vapor in gas stream, proportional by volume
C _p	: pitot tube coefficient
I	: percent of isokinetic sampling
M _d	: dry molecular weight, lb/lb-mole
M _s	: molecular weight of stack gas, lb/lb-mole
P _{bar}	: barometric pressure at the sampling site, in. of Hg
P _s	: stack gas pressure, in. of Hg
Q _s	: stack volumetric flow rate , actual condition acfm
Q _{std}	: stack volumetric flow rate, standard conditions dscfm
T _m	: average dry gas meter temperature , R = 460 + °F
T _s	: average stack gas temperature, R = 460 + °F
V _k	: total volume of liquid collected in impingers & silica gel, in ml
V _m	: Volume of gas sample as measured by dry gas meter, dscf
v _{mstd}	: Vm corrected to standard conditions, dscf
v _{wstd}	: volume of water vapor in gas sample corrected to standard conditions, scf
V _s	: stack gas velocity, ft/sec
γ	: dry gas meter calibration factor
ΔH	: average pressure differential across the orifice meter, in. of H ₂ O
θ	: total sampling time, in minutes
13.6	: specific gravity of mercury

Plant: MULTICHROME COMPANY INC

Date: 1-5-93

Source/Sample Number: MC-2

$$1. Vm(std) = (17.64)(Vm)(Y) \left[\frac{P_{bar} + (\Delta H/13.6)}{Tm} \right]$$

$$Vm(std) = (17.64)(76.930)(1.005) \left[\frac{(29.5) + (1.46/13.6)}{(54)} \right]$$

$$Vm(std) = \underline{74.6} \text{ dscf.}$$

2. Volume water vapor collected (standard conditions).

$$V(10) = \underline{22.4} \text{ condensate from impingers and silica gel.}$$

$$Vw(std) = (0.04707) V(10) = (0.04707)(22.4)$$

$$Vw(std) = \underline{1.05} \text{ scf.}$$

3. Percent moisture, by volume.

$$Bw_s = \frac{Vw(std)}{Vw(std) + Vm(std)} = \frac{(1.05)}{(1.05) + (74.6)} = \underline{0.014}$$

$$Bw_s = \underline{1.47} \%$$

4. Molecular weight, stack gas.

Dry molecular weight.

$$Md = 0.440(\% CO_2) + 0.320(\% O_2) + 0.280(\% N_2 + \% CO)$$

$$Md = 0.440 (\text{ / }) + 0.320 (\text{ / }) + 0.280 (\text{ / })$$

$$Md = \underline{29.0} \text{ lb/lb-mole.}$$

$$Ms = Md + Bw_s (18 - Md) = (29) + (0.014)(18 - 29)$$

$$Ms = \underline{28.8} \text{ lb/lb-mole.}$$

Plant: MULTICHROME COMPANY INC

Date: 1-5-93

Source/Sample Number: MC-2

5. Stack gas velocity average.

$$V_s(\text{avg}) = (85.49)(C_p)(\sqrt{\Delta P}) \left[\text{avg} \sqrt{\frac{(T_s)}{(P_s)(M_s)}} \right]$$

$$V_s(\text{avg}) = (85.49)(0.84)(0.386) \left[\sqrt{\frac{(518)}{(29.5)(28.8)}} \right]$$

$$V_s(\text{avg}) = \underline{21.6} \text{ ft/sec.}$$

6. Stack volumetric flow rate, actual conditions (stack temperature and pressure).

$$Q_s = (60)(V_s)(A) = (60)(21.6)(6.3)$$

$$Q_s = \underline{8180} \text{ acfm.}$$

7. Stack volumetric flow rate, standard conditions (68 degrees F, 29.92 Hg).

$$Q(\text{std}) = (17.64)(Q_s)(1 - B_{w_s}) \left[\frac{(P_s)}{(T_s)} \right]$$

$$Q(\text{std}) = (17.64)(8180)(1 - 0.014) \left[\frac{(29.5)}{(518)} \right]$$

$$Q(\text{std}) = \underline{8100} \text{ dscfm.}$$

8. Isokinetic variation.

$$\%I = (K) \left[\frac{(T_s)(V_m(\text{std}))}{(P_s)(V_s)(A_n)(\theta)(1 - B_{w_s})} \right]$$

$$\%I = (0.0945) \left[\frac{(518)(74.6)}{(29.5)(21.6)(0.99488)(120)(1 - 0.014)} \right]$$

$$\%I = \underline{99.3} \%$$



CLIENT: MULTICHROME COMPANY

Project No. _____

Sampling Location: SCRUBBER OUTLET Test Date: 1-5-93

Sample Volume: 74.6 DSCF Stack Flow Rate: 8100 DSCFM

Chromium Test No. MC-2

Blank: Sample No. MC-4

Total Cr: $\frac{0.0044 \text{ ug/ml} \times 611.0 \text{ mls}}{1000} = 2.69 \text{ ug Cr}$
 acid wash: $\frac{<0.0009 \text{ ug/ml} \times 95.5 \text{ mls}}{1000} = <0.09 \text{ ug Cr}$
 Total = $\frac{2.69 + <0.09}{1000} = <2.78 \text{ ug Cr}$

Cr⁺⁶: $\frac{0.00054 \text{ ug/ml} \times 611.0 \text{ mls}}{1000} = 0.33 \text{ ug Cr}^{+6}$

Total Chromium

Source: Sample No. MC-2

Total Cr: $\frac{0.0182 \text{ ug/ml} \times 901.0 \text{ mls}}{1000} = 16.40 \text{ ug Cr}$
 acid wash: $\frac{0.0041 \text{ ug/ml} \times 179.5 \text{ mls}}{1000} = 0.74 \text{ ug Cr}$
 Total = $\frac{16.40 + 0.74}{1000} = 17.14 \text{ ug Cr}$

$\frac{(17.14) \text{ ug} \times 35.3 \text{ SCF/m}^3}{(74.6) \text{ DSCF} \times 1000 \text{ ug/mg}} = 0.0081 \text{ mg/m}^3 \text{ Cr}$

$\frac{(17.14) \text{ ug} \times 60 \text{ min/hr} \times (8100) \text{ DSCFM}}{(74.6) \text{ DSCF} \times 1000 \text{ ug/mg}} = 111.7 \text{ mg/hr Cr}$

$\frac{(111.7) \text{ mg/hr}}{(4000) \text{ amp-hr/hr}} = 0.028 \text{ mg/amp-hr Cr}$

Hexavalent Chromium

Source: Sample No. MC-2

Cr⁺⁶: $\frac{0.0099 \text{ ug/ml} \times 901.0 \text{ mls}}{1000} = 8.92 \text{ ug Cr}^{+6}$

$\frac{(8.92) \text{ ug} \times 35.3 \text{ SCF/m}^3}{(74.6) \text{ DSCF} \times 1000 \text{ ug/mg}} = 0.0042 \text{ mg/m}^3 \text{ Cr}^{+6}$

$\frac{(8.92) \text{ ug} \times 60 \text{ min/hr} \times (8100) \text{ DSCFM}}{(74.6) \text{ DSCF} \times 1000 \text{ ug/mg}} = 58.1 \text{ mg/hr Cr}^{+6}$

$\frac{(58.1) \text{ mg/hr}}{(4000) \text{ amp-hr/hr}} = 0.014 \text{ mg/amp-hr Cr}^{+6}$

Plant MULTICHRROME

Date 1-5-93

Sampling location SCRUBBER outlet

Sample Type 425

Run Number MC-3

Operator MOKH/KEARNEY

Ambient Temperature 65°F

Barometric Pressure 29.5

Static Pressure (Pa) -0.03

Filter Number(s) MC-3F

Pretest Leak Rate = 0.016 cfm @ 9.0 in. Hg

Pretest Pitot Leak Check

Pretest Orsat Leak Check

Read and Record all Data Every 5 Minutes

FIELD DATA

SAME AS

MC-1

Probe Length and Type 48" GLASS LINED SS

Pitot Tube I.D. No. 5-1A

Nozzle I.D. No. (DIAMETER) X-1 @ 0.310

Assumed Moisture, % 2

Meter Box Number 1A

Meter ΔHg 1.953

C Factor 1.15

Meter Gamma 1.005

Meter Box Setting

Reference ΔP 0.16

Post Test Leak Rate = 0.008 cfm @ 10 in. Hg

Post Test Pitot Leak Check

Post Test Orsat Leak Check

Schematic of Traverse Point Layout

JAMESA Box No. 3B ; BLANK Box No. 4B

Traverse Point Number	Sampling / Time (min) / (24-hour clock)	Gas Meter Reading (V) ft	Velocity Head (ΔP _v) in. H ₂ O	Orifice Pres. Differential (ΔH) in. H ₂ O	Stack Temp. (T _S) °F	Dry Gas Meter Inlet (T _{M,in}) °F	Dry Gas Meter Outlet (T _{M,out}) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Im-pinger Temp. °F
A1	0 / 15:57	444.655	0.07	0.82	59	79	78	1.0	NA	68
A2	5 / 16:02	444.3	0.07	0.82	59	80	78	1.0		66
A3	10 / 16:07	446.7	0.08	0.94	58	81	78	1.0		63
A4	15 / 16:12	449.3	0.10	1.15	58	82	78	2.0		63
A5	20 / 16:17	452.1	0.11	1.30	58	83	78	2.0		65
A6	25 / 16:22	455.2	0.14	1.60	59	83	78	2.5		66
A7	30 / 16:27	458.6	0.19	2.20	58	82	78	3.5		68
A8	35 / 16:32	462.5	0.19	2.20	58	85	78	3.5		67
A9	40 / 16:37	466.7	0.22	2.50	58	85	78	4.0		67
A10	45 / 16:42	470.0	0.22	2.50	58	85	78	4.0		66
A11	50 / 16:47	475.0	0.20	2.30	58	86	79	4.0		66
A12	55 / 16:52	478.9	0.20	2.30	58	85	78	4.0		65
B1	60 / 16:57	483.0	0.11	1.30	57	82	78	2.0		65
B2	65 / 17:02	486.1	0.13	1.55	56	83	78	2.0		64
B3	70 / 17:07	489.3	0.17	1.40	56	82	78	2.0		65
B4	75 / 17:12	492.4	0.14	1.60	56	82	77	3.0		62
B5	80 / 17:20	495.9	0.16	1.85	56	83	77	3.0		63
B6	85 / 17:25	499.3	0.16	1.85	56	83	77	3.0		63
B7	90 / 17:30	502.9	0.17	1.95	55	83	77	3.0		64
B8	95 / 17:35	506.6	0.18	2.10	55	83	76	3.0		64
B9	100 / 17:40	510.4	0.16	1.85	55	82	76	3.5		64
B10	105 / 17:45	514.0	0.15	1.80	55	82	76	3.0		65
B11	110 / 17:50	517.5	0.15	1.80	55	81	75	3.0		65
B12	115 / 17:55	521.0	0.15	1.80	55	81	75	3.0		65
END	120 / 18:00	524.5915				81	75	3.0		65

θ = 120

V_m = 82.440

√ΔP = 0.381

ΔH = 1.73

T_S = 517

T_m = 540

Σ = 68



SAMPLE RECOVERY DATA

Plant: MULTICHROME
 Date: 1-5-93
 Sampling Location: SCRUBBER OUTLET
 Sample Type: 425
 Run Number: MC-3
 Sample Box Number: 3B
 Clean-up Man: MOKIT
 Job Number: _____
 Comments: 3A: 1127.0 - 140.0 = 987.0
3B: 246.5 - 61.0 = 185.5

FRONT HALF

Filter Number: _____
 Description of Filter: _____

MOISTURE

Impingers			
Final Volume:	<u>632.7</u> ml	<u>646.5</u> ml	<u>477.0</u> ml
Initial Volume:	<u>620.0</u> ml	<u>644.0</u> ml	<u>476.0</u> ml
Net Volume:	<u>12.7</u> ml	<u>2.5</u> ml	<u>1.0</u> ml
Total H ₂ O:	_____	_____	_____

Silica Gel			
Final Volume:	<u>653.0</u> g	_____ g	_____ g
Initial Volume:	<u>640.0</u> g	_____ g	_____ g
Net Volume:	<u>13.0</u> g	_____ g	_____ g
Total Moisture:	_____	_____	_____

Description of Impinger Catch: _____ 29.2

EMISSION TEST CALCULATIONS

Definiton of Symbols:

- A : cross-sectional area of stack, ft²
- A_n : cross-sectional area of nozzle, ft²
- E_w : water vapor in gas stream, proportional by volume
- C_p : pitot tube coeficient
- I : percent of isokinetic sampling
- M_d : dry molecular weight, lb/lb-mole
- M : molecular weight of stack gas, lb/lb-mole
- P_{bar} : barometric pressure at the sampling site, in. of Hg
- P_s : stack gas pressure, in. of Hg
- Q_s : stack volumetric flow rate , actual condition acfm
- Q_{std} : stack volumetric flow rate, standard conditions dscfm
- T_m : average dry gas meter temperature , R = 460 + °F
- T_s : average stack gas temperature, R = 460 + °F
- V_{lc} : total volume of liquid collected in impingers & silica gel, in ml
- V_m : Volume of gas sample as measured by dry gas meter, dscf
- V_{m, std} : Vm corrected to standard conditions, dscf
- V_{w, std} : volume of water vapor in gas sample corrected to standard conditions, scf
- V_s : stack gas velocity, ft/sec
- γ : dry gas meter calibration factor
- ΔH : average pressure differential across the orifice meter, in. of H₂O
- θ : total sampling time, in minutes
- 13.6 : specific gravity of mercury

Plant: MULTICHROME COMPANY INC

Date: 1-5-93

Source/Sample Number: MC-3

$$1. Vm(std) = (17.64)(Vm)(Y) \left[\frac{P_{bar} + (\Delta H/13.6)}{T_m} \right]$$

$$Vm(std) = (17.64)(82.940)(1.005) \left[\frac{(29.5) + (1.73/13.6)}{(540)} \right]$$

$$Vm(std) = \underline{80.7} \text{ dscf.}$$

2. Volume water vapor collected (standard conditions).

$$V(10) = \underline{29.2} \text{ condensate from impingers and silica gel.}$$

$$Vw(std) = (0.04707) V(10) = (0.04707)(29.2)$$

$$Vw(std) = \underline{1.37} \text{ scf.}$$

3. Percent moisture, by volume.

$$Bw_s = \frac{Vw(std)}{Vw(std) + Vm(std)} = \frac{(1.37)}{(1.37) + (80.7)} = \underline{0.017}$$

$$Bw_s = \underline{1.77} \text{ .}$$

4. Molecular weight, stack gas.

Dry molecular weight.

$$Md = 0.440(\% CO_2) + 0.320(\% O_2) + 0.280(\% N_2 + \% CO)$$

$$Md = 0.440(\text{---}) + 0.320(\text{---}) + 0.280(\text{---})$$

$$Md = \underline{29.0} \text{ lb/lb-mole.}$$

$$Ms = Md + Bw_s (18 - Md) = (29) + (0.017)(18 - 29)$$

$$Ms = \underline{28.8} \text{ lb/lb-mole.}$$

Plant: MULTICHROME COMPANY INC

Date: 1-5-93

Source/Sample Number: MC-3

5. Stack gas velocity average.

$$V_s(\text{avg}) = (85.49)(C_p)(\sqrt{\Delta P}) \left[\text{avg} \sqrt{\frac{(T_s)}{(P_s)(M_s)}} \right]$$

$$V_s(\text{avg}) = (85.49)(0.84)(0.381) \left[\sqrt{\frac{(517)}{(29.5)(28.8)}} \right]$$

$$V_s(\text{avg}) = \underline{21.3} \text{ ft/sec.}$$

6. Stack volumetric flow rate, actual conditions (stack temperature and pressure).

$$Q_s = (60)(V_s)(A) = (60)(21.3)(6.31)$$

$$Q_s = \underline{8060} \text{ acfm.}$$

7. Stack volumetric flow rate, standard conditions (68 degrees F, 29.92 Hg).

$$Q(\text{std}) = (17.64)(Q_s)(1 - Bw_s) \left[\frac{(P_s)}{(T_s)} \right]$$

$$Q(\text{std}) = (17.64)(8060)(1 - 0.017) \left[\frac{(29.5)}{(517)} \right]$$

$$Q(\text{std}) = \underline{7970} \text{ dscfm.}$$

8. Isokinetic variation.

$$\%I = (K) \left[\frac{(T_s)(V_m(\text{std}))}{(P_s)(V_s)(A_n)(\theta)(1 - Bw_s)} \right]$$

$$\%I = (0.0945) \left[\frac{(517)(807)}{(29.5)(21.3)(0.00524)(120)(1 - 0.017)} \right]$$

$$\%I = \underline{101.5} \%$$

CLIENT: MULTICHROME COMPANY

Project No. _____

Sampling Location: SCRUBBER OUTLET Test Date: 1-5-93

Sample Volume: 80.7 DSCF Stack Flow Rate: 7970 DSCFM

Test No. MC-3

Chromium

Blank: Sample No. MC-4

Total Cr: 0.0044 ug/ml x 611.0 mls = 2.69 ug Cr
acid wash: 0.0009 ug/ml x 95.5 mls = 0.09 ug Cr
Total = 2.78 ug Cr

Cr⁺⁶: 0.00054 ug/ml x 611.0 mls = 0.33 ug Cr⁺⁶

Total Chromium

Source: Sample No. MC-3

Total Cr: 0.0118 ug/ml x 987.0 mls = 11.65 ug Cr
acid wash: 0.0042 ug/ml x 185.5 mls = 0.78 ug Cr
Total = 12.43 ug Cr

$\frac{(12.43) \text{ ug} \times 35.3 \text{ SCF/m}^3}{(80.7) \text{ DSCF} \times 1000 \text{ ug/mg}} = 0.0054 \text{ mg/m}^3 \text{ Cr}$

$\frac{(12.43) \text{ ug} \times 60 \text{ min/hr} \times (7970) \text{ DSCFM}}{(80.7) \text{ DSCF} \times 1000 \text{ ug/mg}} = 73.7 \text{ mg/hr Cr}$

$\frac{(73.7) \text{ mg/hr}}{(4084) \text{ amp-hr/hr}} = 0.018 \text{ mg/amp-hr Cr}$

Hexavalent Chromium

Source: Sample No. MC-3

Cr⁺⁶: 0.010 ug/ml x 987.0 mls = 9.87 ug Cr⁺⁶

$\frac{(9.87) \text{ ug} \times 35.3 \text{ SCF/m}^3}{(80.7) \text{ DSCF} \times 1000 \text{ ug/mg}} = 0.0043 \text{ mg/m}^3 \text{ Cr}^{+6}$

$\frac{(9.87) \text{ ug} \times 60 \text{ min/hr} \times (7970) \text{ DSCFM}}{(80.7) \text{ DSCF} \times 1000 \text{ ug/mg}} = 58.5 \text{ mg/hr Cr}^{+6}$

$\frac{(58.5) \text{ mg/hr}}{(4084) \text{ amp-hr/hr}} = 0.014 \text{ mg/amp-hr Cr}^{+6}$



SAMPLE RECOVERY DATA

Plant: MULTICHROME
 Date: 1-5-93
 Sampling Location: BLANK
 Sample Type: 425
 Run Number: MC-4
 Sample Box Number: 4B
 Clean-up Man: MOKH
 Job Number: _____
 Comments: 9A: 745.5 - 134.5 = 611.0
4B: 156.5 - 61.0 = 95.5

FRONT HALF

Filter Number: _____
 Description of Filter: CLEAN

MOISTURE

Impingers				
Final Volume:	<u>606.5</u> ml	<u>574.3</u> ml	<u>460.4</u> ml	
Initial Volume:	<u>606.5</u> ml	<u>574.5</u> ml	<u>460.3</u> ml	
Net Volume:	<u>0</u> ml	<u>-0.2</u> ml	<u>0.1</u> ml	
Total H ₂ O:	_____	_____	_____	

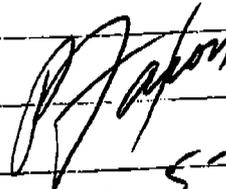
Silica Gel				
Final Volume:	<u>665.0</u> g	_____ g	_____ g	
Initial Volume:	<u>665.0</u> g	_____ g	_____ g	
Net Volume:	_____ g	_____ g	_____ g	
Total Moisture:	_____	_____	_____	

Description of Impinger Catch: CLEAR

MULTICHROME ACTUAL TOTAL AMP HOURS
FROM 12-27-91 TO 12-29-92

	# 1 TANK	# 2 TANK	# 3 TANK
12-27-91	449736	289401	077415
12-29-92	616837	1292246 2071647	2588444 2765856
TOTALS	167101	1782246	2688441

TOTAL COMBINED AMP HOURS FOR YEAR 4,637,788


1-5-93



APPENDIX C
LABORATORY REPORTS

January 12, 1993

WCAS
WEST COAST
ANALYTICAL
SERVICE, INC.
ANALYTICAL CHEMISTS

PACIFIC ENVIRONMENTAL SERVICES
13100 Brooks Dr.
Baldwin Park, CA 91706

Attn: S. Hugh Brown

JOB NO. 23117

D

LABORATORY REPORT

Samples Received: Eight (8) Liquids
Date Received: 1-6-93
Project No: 4334.002

The samples were analyzed as follows:

<u>Samples Analyzed</u>	<u>Analysis</u>	<u>Results</u>
Five (5) liquids	Hexavalent Chromium by EPA 218.6	Data Sheets
Eight (8) liquids	Total Chromium by ICPMS	Data Sheets

Page 1 of 4


Michael Shelton
Technical Director


D.J. Northington, Ph.D.
President

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WEST COAST ANALYTICAL SERVICE, INC.

PACIFIC ENVIRONMENTAL SERVICES
Mr. Hugh Brown

Job # 23117
January 12, 1993

LABORATORY REPORT

Hexavalent Chromium by EPA 218.6

<u>Sample ID</u>	<u>Parts Per Billion (ug/L)</u>	<u>Volume (L)</u>	<u>Total Micrograms</u>
MC-1A	13	0.860	11.2
MC-2A	9.9	0.900	8.9
MC-3A	10	0.610	6.1
MC-4A	0.54	0.985	0.53
Detection Limit	0.01		
Date Analyzed:	1-6-93		

Matrix Spike/Matrix Spike Duplicate Recovery Summary

Sample:MC-3A
Matrix:Impinger
Units :ppb (ug/L)
Method:EPA 218.6

<u>Analyte</u>	<u>Sample Amount</u>		<u>MS % Rec</u>		<u>MSD % Rec</u>		<u>RPD</u>
	<u>Result</u>	<u>Spiked</u>	<u>Result</u>	<u>MS</u>	<u>Result</u>	<u>MSD</u>	
Hexavalent Chromium	10	100	115	105	114	104	1

QC Limits

<u>Analyte</u>	<u>Warning</u>	<u>RPD</u>	<u>Control</u>	<u>% Recovery</u>	
				<u>Warning</u>	<u>Control</u>
Hexavalent Chromium	9		13	86 108	74 117

Date Analyzed: 1/6/93

WEST COAST ANALYTICAL SERVICE, INC.

PACIFIC ENVIRONMENTAL SERVICES
Mr. Hugh Brown

Job # 23117
January 12, 1993

LABORATORY REPORT

Total Chromium
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry

Sample	Chromium (ug/L)	Volume (L)	Chromium (tot ug)
MC-1A	17.6	0.86	15.14
MC-2A	18.2	0.9	16.38
MC-3A	11.8	0.985	11.62
MC-4A	4.4	0.61	2.68
MC-1B	2.5	0.18	0.45
MC-2B	4.1	0.185	0.76
MC-3B	4.2	0.19	0.8
* MC-4B	ND<0.9	0.095	ND<0.09
Detection Limit	0.9		

Date Analyzed: 1/7/93

WEST COAST ANALYTICAL SERVICE, INC.

PACIFIC ENVIRONMENTAL SERVICES
Mr. Hugh Brown

Job # 23117
January 12, 1993

LABORATORY REPORT

Sample: MC-3A
Matrix: Impinger Solution

Parts Per Billion (ug/L)

Sample	Spike Conc (ppb)	MS	% Recovery	MSD	% Recovery	RPD %
Chromium	11.8	100	92.2	112	100.2	7.4

Date Analyzed: 1/7/93

Abbreviation Summary

General Reporting Abbreviations:

- B** Blank - Indicates that the compound was found in both the sample and the blank. The sample value is reported without blank subtraction. If the sample value is less than 10X the blank value times the sample dilution factor, the compound may be present as a laboratory contaminant.
- D** Indicates that the sample was diluted, and consequently the surrogates were too dilute to accurately measure.
- DL** Detection Limit - Is the minimum value which we believe can be detected in the sample with a high degree of confidence, taking into account dilution factors and interferences. The reported detection limits are equal to or greater than Method Detection Limits (MDL) to allow for day to day and instrument to instrument variations in sensitivity.
- J** Indicates that the value is an estimate.
- ND** Not Detected - Indicates that the compound was not found in the sample at or above the detection limit.
- ppm** parts per million (billion) in liquids is usually equivalent to mg/l (ug/l), or in solids to mg/kg, (ug/kg). In the gas phase it is equivalent to ul/l (ul/m³).
- ppb**
- TR** Trace - Indicates that the compound was observed at a value less than our normal reported Detection Limit (DL), but we feel its presence may be important to you. These values are subject to large errors and low degrees of confidence.

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

QC Abbreviations:

- Control** Control Limits are determined from historical data for a QC parameter. The test value must be within this acceptable range for the test to be considered in control. Usually this range corresponds to the 99% confidence interval for the historical data.
- % Error** Percent Error - This is a measure of accuracy based on the analysis of a Laboratory Control Standard (LCS). An LCS is a reference sample of known value such as an NIST Standard Reference Material (SRM). The % Error is expressed in percent as the difference between the known value and the experimental value, divided by the known value. The LCS may simply be a solution based standard which confirms calibration (ICV or CCV - initial or continuing calibration verification), or it may be a reference sample taken through preparation and analysis.



APPENDIX D
CALIBRATION DATA

PITOT TUBE CALIBRATION DATA SHEET

Calibrated By: Arya Miller

Date: 12-31-92

Pitot I.D. No.: S-1A

Effective Length: 3'

Pitot Tube Assembly Level? Yes No

Pitot Tube Openings Damaged? Yes (explain below) No

$\alpha_1 = \underline{\theta} \cdot (<10^\circ)$ $\alpha_2 = \underline{\theta} \cdot (<10^\circ)$

$\beta_1 = \underline{\theta} \cdot (<5^\circ)$ $\beta_2 = \underline{\theta} \cdot (<5^\circ)$

$\gamma = \underline{3} \cdot$ $\theta = \underline{\theta} \cdot$ $\lambda = \underline{0.939''} \cdot$

$Z = \lambda \sin \gamma = \underline{0.0491} \text{ in.}$ $0.32 \text{ cm } (<1/8 \text{ in.})$

$W = \lambda \sin \theta = \underline{\theta} \text{ cm}$ $0.08 \text{ cm } (<1/32 \text{ in.})$

$P_A = \underline{0.470} \text{ in.}$

$P_B = \underline{0.470} \text{ in.}$

$D_t = \underline{0.375} \text{ in.}$

Comments: _____

Calibration Required? Yes _____ No

0 6 2 3 5

SOURCE SAMPLING NOZZLE CALIBRATION

CALIBRATED/UPDATED BY: *Andy M...*

DATE: 10/29/92

NOZZLE ID #	READING (INCHES)			AVERAGE DIAMETER	SHAPE	COMMENTS
	1	2	3			
02P	0.296	0.300	0.300	0.299	CURVED	
04P	0.295	0.297	0.299	0.297	CURVED	
05P	0.238	0.235	0.236	0.236	CURVED	
06P	0.503	0.500	0.502	0.502	B.H.	
08P	0.366	0.365	0.365	0.365	CURVED	
100	0.384	0.382	0.383	0.383	90	
120	0.377	0.380	0.380	0.379	90	
13	0.262	0.260	0.262	0.261	CURVED	
16	0.491	0.491	0.492	0.491	CURVED	
18P	0.493	0.494	0.494	0.494	CURVED	
21S	0.366	0.366	0.367	0.366	B.H.	
22S	0.495	0.496	0.496	0.496	B.H.	
23S	0.248	0.247	0.248	0.248	B.H.	
24Q	0.517	0.515	0.515	0.516	90	
26S	0.487	0.486	0.486	0.486	B.H.	
28PB	0.433	0.434	0.430	0.432	B.H.	
40P	0.222	0.223	0.223	0.223	90	
44PB	0.303	0.304	0.303	0.303		
45PB	0.372	0.373	0.370	0.372	B.H.	
46PB	0.382	0.385	0.381	0.383	B.H.	
47PB						
112	0.374	0.375	0.375	0.375	B.H.	
Q	0.140	0.139	0.140	0.140	B.H.	
Q1	0.140	0.140	0.140	0.140	B.H.	
Q2	0.140	0.140	0.140	0.140	B.H.	
X1	0.311	0.310	0.310	0.310	CURVED	
X2	0.368	0.372	0.369	0.370	CURVED	
X3	0.240	0.241	0.241	0.241	CURVED	
X4	0.241	0.242	0.240	0.241	CURVED	
X5	0.239	0.238	0.236	0.238	CURVED	
X6	0.268	0.268	0.268	0.268	CURVED	
X7	0.268	0.268	0.270	0.269	CURVED	
X8	0.332	0.332	0.330	0.331	CURVED	
X9	0.329	0.333	0.333	0.332	CURVED	
X10	0.351	0.352	0.350	0.351	CURVED	
X11	0.354	0.353	0.353	0.353	CURVED	

EVER READY THERMOMETER CO., INC.
401 PARK AVENUE SOUTH
NEW YORK, NY 10016

PAGE 1 OF 1

REPORT OF CALIBRATION
LIQUID-IN-GLASS-THERMOMETER

CALIBRATED BY EVER READY THERMOMETER CO.

MARKED: ERTCO 611-3FC S/N-2269
RANGE: -20 TO +110 DEGREES C IN 1 DEGREE GRADUATIONS.

THERMOMETER READING	CORRECTION (ITS-90)**
0.0 C	0.0 C
37.0	-0.1
56.0	0.0

** ALL TEMPERATURES IN THIS REPORT ARE BASED ON THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90) PUBLISHED IN THE METROLOGIA 27, NO. 1, 3/10/90.

THIS THERMOMETER WAS CALIBRATED AGAINST A STANDARD CALIBRATED AT THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) FORMERLY THE NATIONAL BUREAU OF STANDARDS (NBS).

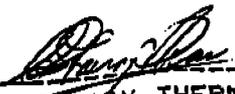
FOR A DISCUSSION OF ACCURACIES ATTAINABLE WITH SUCH THERMOMETERS SEE NBS MONOGRAPH 150.

IF NO SIGN IS GIVEN ON THE CORRECTION, THE TRUE TEMPERATURE IS HIGHER THAN THE INDICATED TEMPERATURE; IF THE SIGN GIVEN IS NEGATIVE, THE TRUE TEMPERATURE IS LOWER THAN THE INDICATED TEMPERATURE. TO USE THE CORRECTIONS PROPERLY, REFERENCE SHOULD BE MADE TO THE NOTES GIVEN BELOW.

THE THERMOMETER WAS TESTED IN A LARGE, CLOSED-TOP, ELECTRICALLY HEATED, LIQUID BATH, BEING "IMMERSED" 76MM. THE TEMPERATURE OF THE ROOM WAS ABOUT 25 DEGREES C (77 DEGREES F). IF THE THERMOMETER IS USED UNDER CONDITIONS WHICH WOULD CAUSE THE AVERAGE TEMPERATURE OF THE EMERGENT LIQUID COLUMN TO DIFFER MARKEDLY FROM THAT PREVAILING IN THE TEST, APPRECIABLE DIFFERENCES IN THE INDICATIONS OF THE THERMOMETER WOULD RESULT.

THE TABULATED CORRECTIONS APPLY PROVIDED THE ICE POINT READING IS 0.0 DEGREES C. IF THE ICE-POINT READING IS FOUND TO BE HIGHER (OR LOWER) THAN STATED, ALL OTHER READINGS WILL BE HIGHER (OR LOWER) TO THE SAME EXTENT.

TEST NUMBER: 140381
DATE: 06/21/90
STANDARD SERIAL NO. 120239
NIST IDENTIFICATION NO. 88024


EVER READY THERMOMETER CO.

THERMOCOUPLE CALIBRATION

CALIBRATED BY: Jing Ma

DATE: 12-31-92

Thermocouple number	Thermocouple reading (°C)	Thermometer reading (°C)
TC-1	0.0	0.0
	23.0	24.0
	98.0	99.0
TC-2	OUT OF SERVICE	
TC-3	0.0	0.0
	23.0	24.0
	97.0	98.0
TC-4	0.0	0.0
	25.5	25.0
	100.5	100.0
TC-5	NOT AVAILABLE	
TC-6	NOT AVAILABLE	
TC-7	NOT AVAILABLE	
TC-8	NOT AVAILABLE	



TC-9	NOT AVAILABLE	
TC-10	0.0 25.5 100.5	0.0 25.0 100.0
TC-11	NOT AVAILABLE	
C-1	NOT AVAILABLE	
C-2	NOT AVAILABLE	
S-1A	1.0 22.0 97.0	0.0 23.0 99.0
S-2A	0.0 25.0 98.5	0.0 25.0 100.0
S-16A	1.0 22.0 97.0	0.0 24.0 99.0
S-17A	1.0 22.0 98.0	0.0 24.0 99.0

Thermometer Standard Serial Number: 128239
Thermometer NIST I.D. Number: 88024



METER BOX TEMPRATURE READOUT CALIBRATION

CALIBRATED BY: Aiya Moku

DATE: 12-31-92

	<u>Inlet (°F)</u>	<u>Outlet (°F)</u>	<u>Thermometer (°F)</u>
BOX 1A	71	71	72 (22° C)
	209	211	212 (100° C)
	31	32	32 (0° C)
BOX 2A	71	71	72 (22° C)
	211	210	212 (100° C)
	34	34	32 (0° C)

NOTE:
Thermometer Standard Serial Number: 128239
Thermometer NIST I.D. Number: 88024

DICK MUNNS COMPANY
Liquid and Gas - Flowmeter Calibration Service
 10571 Calle Lee - 133 • Los Alamitos, California 90720
 Telephone (213) 596-1559 • Telefax (714) 827-0823

CERTIFICATE OF CALIBRATION

Client Name:	PAC. ENVIRON. SERVICES	Calibration Date:	08-05-1992
Reference Number:	25507	Calibration Due:	08-05-1993
Instrument Manufacturer:	ROCKWELL	Calibration Fluid:	AIR 14.7 PSIA 70F
Instrument Description:	PD METER	Test Unit(s):	A-63
Model Number:	190 CFH	NIST Traceability Per:	M-0122
Serial Number:	25507	Ambient Conditions:	29.92"HGA 70F RH.45%
Rated Accuracy:	+/- .5%	Data File:	PACENV25507
Accuracy Given:	WITHIN MFG TOLERANCE		

	IND. SCFM	ACT. SCFM
1	0.100	0.100
2	0.200	0.199
3	0.400	0.398
4	0.714	0.714
5	1.000	1.000
6	1.740	1.731
7	2.500	2.486
8	3.370	3.356

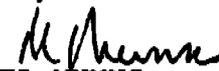
Remarks:

All instruments used in the performance of the above calibration have direct traceability to the National Institute of Standards and Technology (NIST). Calibration has been performed in accordance with MIL-STD-45662A.

Calibration Performed By:

MICHAEL MUNNS

Approved By:


 MICHAEL MUNNS

DRY GAS METER AND ORIFICE CALIBRATION

Dry Gas Meter No. 1042485 Meter Box No. 1A Reference Dry Gas Meter No. 25507 Rockwell

Barometric Pressure 29.9 Calibration Date 12-8-92 Calibration Performed By: *Michael E. Keeney*

Orifice No.	Initial Reference		Reference Gas		Final Reference		Test		Temperature				Run Time Min.	Flow Rate D-C-M	Meter Gamma H ₂	
	DGM Reading V=f ₁	DGM Reading V=f ₂	Volume Vr=f ₁	Volume Vr=f ₂	DGM Reading V=f ₁	DGM Reading V=f ₂	DGM Volume V=f ₁	DGM Volume V=f ₂	Box Inlet t-F	Box Outlet t-F	Box Average td	Box Average td				
0.5	823.289	833.801	10.512	10.512	512.749	522.855	10.106	10.106	77	81	76	78.5	26	0.40	1.042	1.737
1.0	834.451	844.453	10.002	10.002	523.506	533.616	10.110	10.110	78	84	79	81.5	18.5	0.53	0.993	1.939
2.0	845.631	855.650	10.019	10.019	534.790	544.920	10.130	10.130	80	87	81	84	13.6	0.72	0.991	2.094
4.0	856.780	866.786	10.006	10.006	546.069	556.155	10.086	10.086	80	89	82	85.5	9.5	1.03	0.992	2.043

AVERAGE 1.0695 1.953

Source category: Electroplating
 Plant name : Multichrome Company
 Process : Hard chrome plating

Filename: REF 4-81.WQ1
 Location: Oxnard, CA
 Test date: 1/5/93

Date: 04/19/96
 Ref. No.: 4-81
 Process rate basis: production

Source	Type of control	Pollutant	Run No.	Test Method	Samp. time, min	Isokinetic, %	Gas volume, DSCF	Volum. flow rate, DSCFM	Mass, ug	Concen., gr/DSCF	Emission rate, lb/hr	Process rate, A-hr	Emission factor		Rat.		
													mg/A-hr	gr/A-hr			
Electroplating tank 1,2,3	WS	Cr+6	1	CARB	120	102.7	82.80	8,100	11.21	2.1E-06	0.00015	8,126	0.016	0.00025			
		Cr+6	2	425	120	99.3	74.60	8,100	8.92	1.8E-06	0.00013	8,000	0.015	0.00022			
		Cr+6	3		120	101.5	80.70	7,970	9.87	1.9E-06	0.00013	Average	8,168	0.014	0.00022	B	
											1.94E-06			0.015	0.00023	B	
		Total Cr	1	CARB	120	102.7	82.80	8,100	15.62	2.91E-06	0.00020	8,126	0.023	0.00035			
		Total Cr	2	425	120	99.3	74.60	8,100	17.14	3.55E-06	0.00025	8,000	0.028	0.00043			
		Total Cr	3		120	101.5	80.70	7,970	12.43	2.38E-06	0.00016	Average	8,168	0.018	0.00028		
											2.94E-06				0.023	0.00035	B

Basis for rating:
 Problems noted:
 Other notes: