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

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

# MEASUREMENT OF CHROMIUM EMISSIONS FROM CHROMIC ACID ANODIZING OPERATIONS IN BUILDING 2 AT NAVAL AVIATION DEPOT, SAN DIEGO, CA.

= Helo Blade

Report Date April 8, 92; Test Dates: March 17, 18-'92

Prepared For
HHI Corporation
49 N. Main Street
Farmington, UT 84025

PES Job Number 4572.000

Prepared By
Pacific Environmental Services, Inc.
13100 Brooks Drive
Baldwin Park, CA. 91706
(818) 856-1400

4/8/92

S. Hugh Brown

AP-42 Section 12.20
Reference
Report Sect. 4
Reference 84

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S. Hugh Brown

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

Approved: S. Hugh Brown
S. Hugh Brown

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FIGURES

1A,B DIAGRAM OF SAMPLING LOCATIONS - HELO SCRUBBER

2. CHROMIUM SAMPLING TRAIN - CARB METHOD 425

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B: FIELD DATA, CALCULATIONS AND PROCESS DATA

C: LABORATORY ANALYSES REPORT

D: EQUIPMENT CALIBRATIONS

## INTRODUCTION

The North Island Naval Base operates a Helo Blade anodizing tank in Building 2 at the Naval Aviation Depot and the tank is served by a small scrubber. This scrubber was recently source tested for total and hexavalent chromium and the results indicated the need for an overhaul. HHI General Contractors in association with MAPCO Industries performed the overhaul and converted the scrubber to a dry mist eliminator. Information regarding the conversion is in Appendix A. The scrubber then required retesting.

HHI Corporation selected Pacific Environmental Services (PES), a participant in the CARB independent contractor program, to perform the source testing. PES and its analytical laboratory, West Coast Analytical Services, qualify as independent testing laboratories (no conflict of interest).

Section 2 of the report describes the tested emission control system and the anodizing operation. Section 3 describes the testing procedures and analytical methods used. Section 4 provides a summary and discussion of the test results and Section 5 addresses the project quality assurance. Appendix B contains the process data records, field data sheets, and all subsequent calculations; Appendix C contains the lab report showing the resulting sample analyses and QA/QC; and Appendix D contains equipment calibration records.

## EQUIPMENT AND PROCESS DESCRIPTION

The Helo Blade scrubber is used to collect fumes from the chromic acid anodizing operations in Building 2. Two remote anodizing tanks are served by a central reservoir of chromic acid at room temperature. The tests were conducted with only one remote anodizing tank in operation. A helo blade is placed inside the remote tank (which is much shorter than blade), the tank is filled with chromic acid from the reservoir, and the anodizing takes place for one hour on small patches of the blade in need of repair. The blade passes through v-groves in each end of the remote tank which are pneumatically sealed against the blade. The level in the remote tank is maintained by a constant supply of chromic acid from the reservoir. Leakage and overflow from the remote tank are routed back to the reservoir. The remote tank is covered and ducted a short distance to the scrubber which is exhausted through a 12-inch diameter duct to a large stack with a rooftop blower (see Figures 1 and 2). The large stack vents other process areas of Building 2. The reservoir is 24" wide by 34" deep by 168" long and has a capacity of 290 gallons. The remote tank is 24" wide by 12" deep by 188" long.

During the source tests, the tank parameters were recorded by PES engineers. The amp-hour consumption of the anodizing operation was determined by readings taken from a current totalizer for the tank rectifier logged at the beginning and end of each each test period for each helo blade. Production data sheets are included in Appendix B. Prior to the scrubber overhaul, a mist suppressant (ANO-FUME-GO) was used in the chromic acid reservoir to reduce the surface tension during anodizing. However, the source tests were performed with the mist suppressant depleted as indicated by the tank maintenance log included in Appendix B. The surface tension in the six weeks after the overhaul and just prior to the source tests ranged from 71.2 to 74.9. The surface tension during the period of mist suppressant use was 47.4 to 55.9, and prior to the addition of the mist suppressant it was 63.6. Therefore, these readings indicate that the tests were conducted without the benefit of mist suppressant.

HELO BLADE ANODIZING UNIT
PROCESS OVERVIEW
BUILDING 2

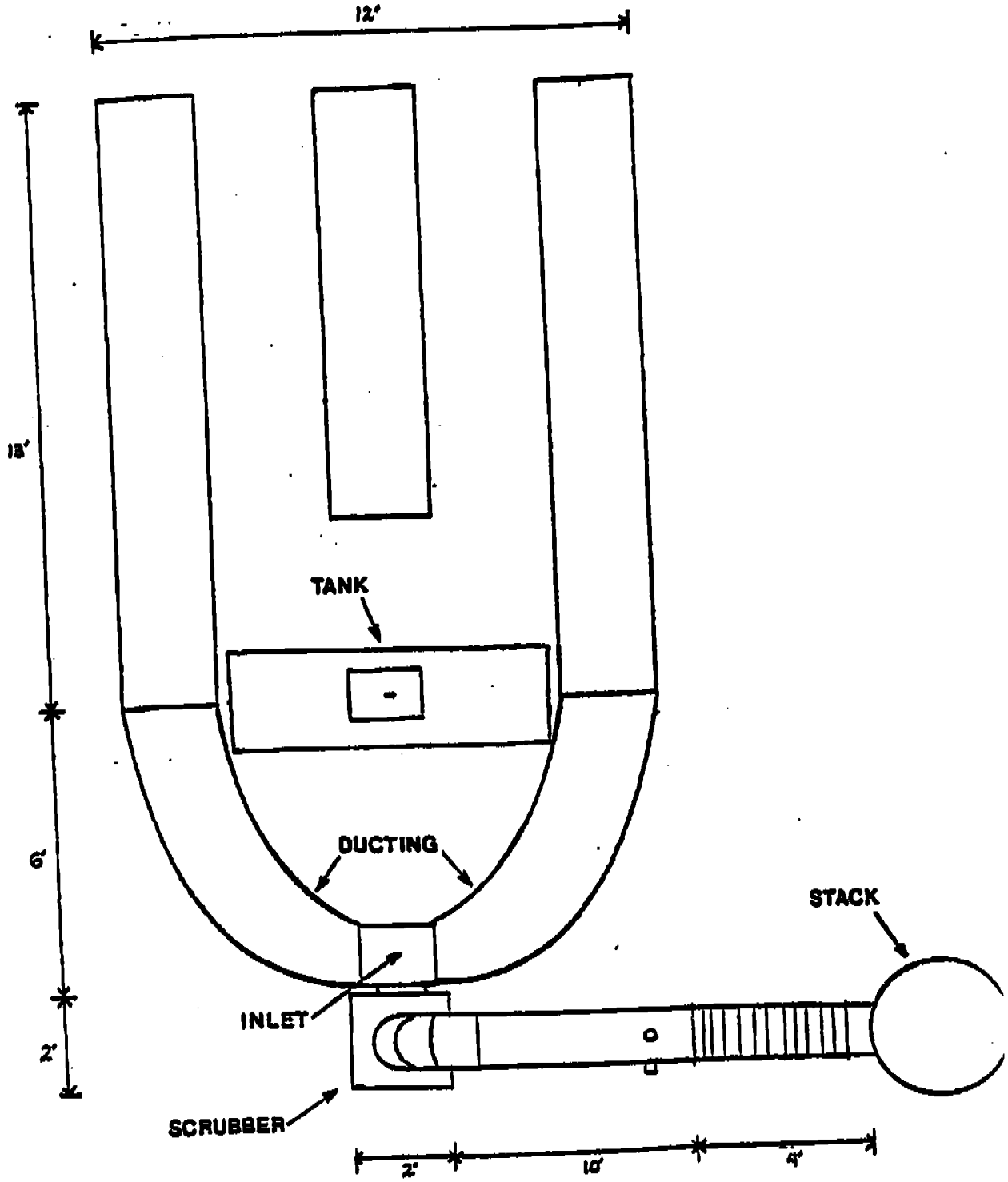



FIGURE 1A

HELO BLADE ANODIZING UNIT
EMISSIONS CONTROL SYSTEM

BUILDING 2

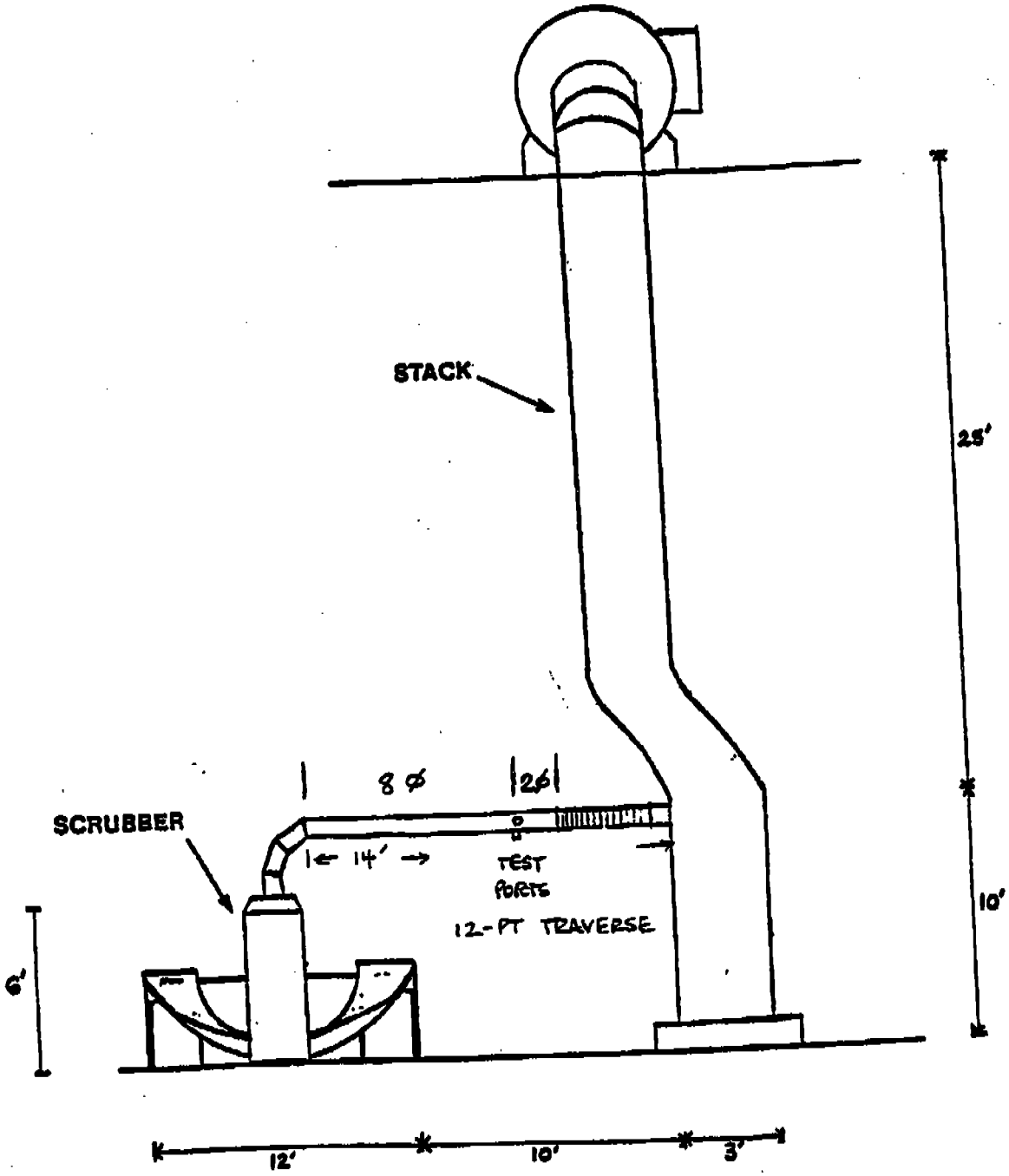



FIGURE 1B

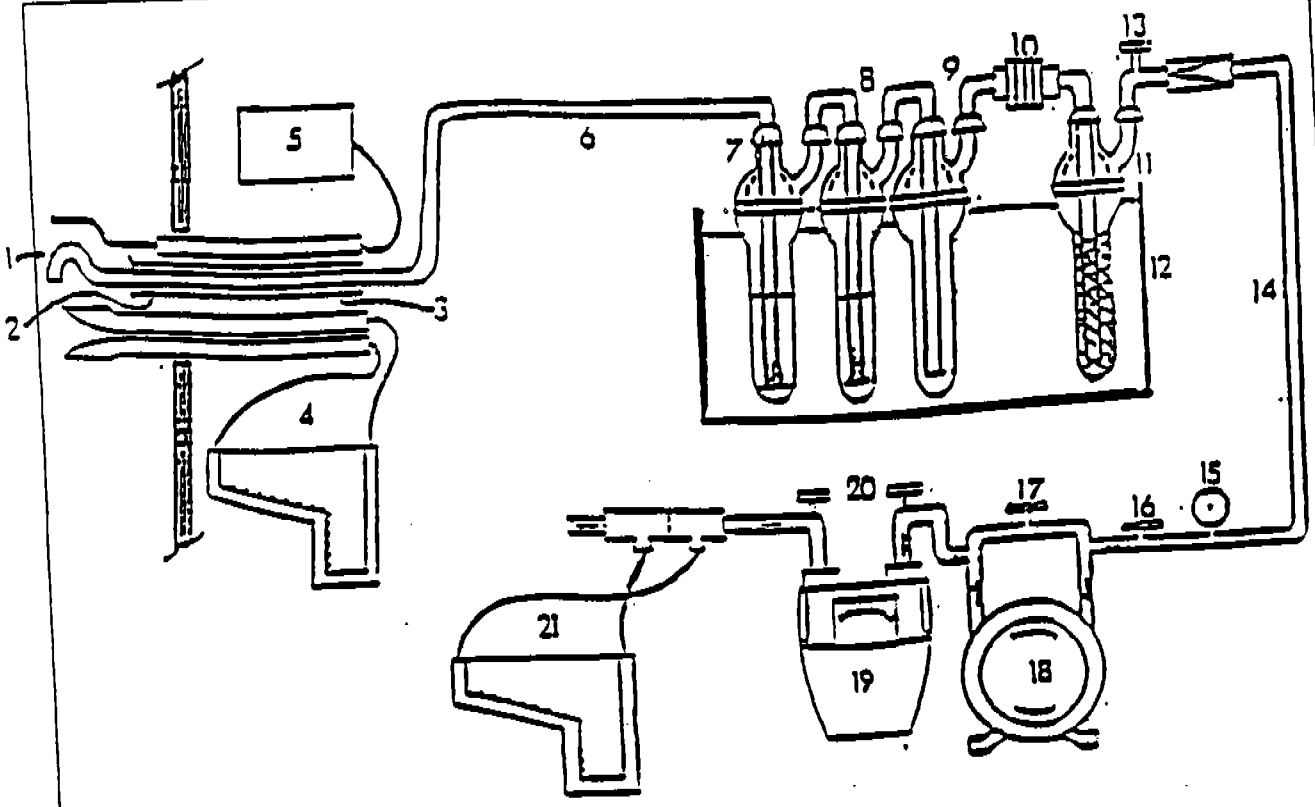
## TESTING METHODOLOGY

The sampling locations, number of traverse points, and location of traverse points were determined as described in CARB Method 1. The sampling was conducted for 2 hours at 12 traverse points on the Helo scrubber exhaust (10 minutes per point). The production interval for each operation was about 1 hour. Three sub-tests were conducted on the scrubber exhaust. Each sub-test was coordinated so that the 1-hour sampling traverse for each of the two ports coincided exactly with 1 hour of production which is the length of time it takes to process one helo blade. The sampling locations for the Helo scrubber are shown in Figures 1A and 1B.

Prior to sampling, the duct velocity, static pressure and temperature were measured to define an estimated average duct velocity for nozzle size selection in order to sample isokinetically. A cyclonic flow check was made during previous testing and therefore not repeated for these tests. A test with a smoke generating tube indicated no leakage of chromic acid fumes from the tank apertures associated with the anodizing operation.

The samples for chromium were collected by CARB Method 425 modified to utilize 0.02N sodium bicarbonate in the impingers and allow analysis of the hexavalent chromium by ion chromatography. The sampling train was manufactured by Nutech and configured as shown in Figure 3. The sample train consisted of a glass nozzle, a teflon union, a 18-inch glass-lined stainless steel probe, a short length of 1/2-inch Teflon tubing, two Greenburg-Smith impingers each charged with 100 mls of 0.02N sodium bicarbonate solution, an empty impinger used as a water trap, 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 manometer. Teflon-coated glass fiber filters with 0.3, 0.1, and 0.035 micron pore layers were used in the filter holders.

Pitot and sampling train leak checks were performed before and after each test. Prior to beginning the source test program, a 10-minute dry gas meter check was conducted on the meter box at the delta H@, and the metered volume was checked against that of the calibration run at the same delta P. The sampling train met the performance criteria of +/-3%.




1. Glass sampling nozzle with teflon union
2. Stainless steel probe sheath
3. Glass-lined probe
4. Type S pitot tube and manometer for velocity determinations
5. Stack temperature sensor
6. 15 ft. teflon probe line with ball and socket connectors
7. Greenburg-Smith impinger with 100 ml. of 0.02 $NaHCO_3$ sol.
8. Greenburg-Smith impinger with 100 ml. of " " " "
9. Modified Greenburg-Smith impinger (dry)
10. Filter holder with teflon-coated glass fiber filter
11. Modified Greenburg-Smith impinger filled with 200 grams of silica gel
12. Impinger case filled with ice
13. Impinger exit gas temperature sensor
14. Umbilical line to meter box
15. Vacuum gauge
16. Coarse adjustment valve
17. Bypass valve to adjust sample volume
18. Leak free vacuum pump
19. Dry gas meter
20. Dry gas meter inlet and outlet temperature sensors
21. Orifice with manometer sample volume metering

Figure 2: Diagram of sampling train.

The source test data was recorded during the tests by PES personnel on the field data sheets which are included in Appendix B. The weights of the impingers were recorded on sample retrieval sheets before and after the tests in order to obtain the moisture content of the stack gas stream. Process data was recorded simultaneously by PES engineers.

After the tests, the contents of the first three impingers were placed in a 1000 ml. polyethylene container. The filters were removed from the filter holder with plastic forceps and placed in the same sample bottle. The sampling train was then rinsed 3 times from the nozzle to the filter holder with the charging solution (0.02N sodium bicarbonate solution) and these rinses were added to the same container. Some 0.1 normal nitric acid solution was then used as a final rinse and these rinses were collected in a separate sample bottle and analyzed for total chromium. The sampling train was kept at 68 degrees Fahrenheit or less during the tests in order to induce condensation in the impingers. The samples remained chilled until analysis.

Laboratory analyses were conducted by West Coast Analytical Service in Sante Fe Springs, California. The total chromium concentration in each sample was measured by inductively coupled plasma (ICP) with detection by mass spectrometry (MS). The hexavalent chromium concentrations were measured by ion chromatography. The detection levels of the analytical procedures for total chromium, Cr T, and hexavalent chromium, $Cr^{+6}$ were 0.5 and 0.01 ug/l respectively. The hexavalent chromium analyses were performed within 48 hours of the end of sampling for each individual sample. Appendix C contains the analysis report and the QA/QC documentation.

## RESULTS

Calculations were made from the field data sheets to determine sample volume, molecular weight, velocities, flow rate, and isokinetic variation for the test. These calculations are shown on the emission test calculation sheets in Appendix B.

Table 1 summarizes the results of the source tests on the Helo scrubber. During test #2, the sampling probe was inadvertently broken so the test was aborted, a new sampling train was prepared, and the test was restarted as the same test number (2).

The blank sample from this test set exhibited essentially no hexavalent chromium (<0.1 ug) and no total chromium (<0.3 ug).

A comparison of the total and hexavalent chromium emissions indicated a slight disagreement on test #3 (the Cr T was lower than the $Cr^{+6}$ by about one-half), however this different is not as significant as it seems because the amount of chromium collected in the sampling trains was less than 1 microgram and very close to the blank level.

Isokinetic sampling rates all fell within the acceptable range of 90 to 110%.

## TABLE 1

### NADEP BUILDING 2
### HELO SCRUBBER EMISSIONS

| | | | |
|---|---|---|---|
| Date: | 3/17/92 | 3/18/92 | 3/18/92 |
| Test Conditions: | 50.6 AH | 35.2 AH | 42.9 AH |
| Test Number: | 1 | 2 | 3 |
| **Flue Gas** | | | |
| Temperature, oF | 68 | 69 | 69 |
| Velocity, ft/sec | 14.4 | 15.1 | 15.5 |
| Static Pressure, in. $H_2O$ | -1.2 | -1.2 | -1.2 |
| Duct Dimension, in. | 12 | 12 | 12 |
| Duct Area, sq. ft. | 0.785 | 0.785 | 0.785 |
| Flow Rate, ACFM | 678 | 711 | 730 |
| , DSCFM | 668 | 699 | 720 |
| Moisture, % v/v | 1.4 | 1.4 | 1.1 |
| **Chromium** | | | |
| Sample Start | 15:13 | 10:53 | 14:20 |
| Sample Stop | 17:53 | 13:44 | 17:01 |
| Sampling Time, min. | 120 | 120 | 120 |
| Sample Volume, DSCF | 98.9 | 85.7 | 86.9 |
| Isokinetic Rate, % | 93.0 | 100.2 | 98.7 |
| Concentration, $mg/m^3$ | | | |
| Total Cr | 0.00133 | 0.00116 | 0.00019 |
| Cr+6 | 0.00133 | 0.00122 | 0.00036 |
| Emission Rate, mg/hr | | | |
| Total Cr | 1.51 | 1.38 | 0.24 |
| Cr+6 | 1.51 | 1.45 | 0.44 |
| Emission Rate, mg/amp-hr | | | |
| Total Cr | 0.0298 | 0.0392 | 0.0056 |
| Cr+6 | 0.0298 | 0.0412 | 0.010 |

## QUALITY ASSURANCE/QUALITY CONTROL

Source tests are performed to determine the types and amounts of pollutants emitted by a source. Information form 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 Method 425 was utilized to determine the chromium emission rates. A procedure must be thoroughly studied under various conditions in order to be designated as a CARB 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 normally specifies hexavalent chromium analysis by the diphenylcarbazide colorimetric method but can be adapted to achieve maximum sensitivity for hexavalent chromium through the utilization of ion chromatography for analysis.

### 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 hexavalent chromium 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 platers and is familiar with the plating process.

## 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, maintained, and calibrated as suggested in EPA documents APTD-0576, and APTD-0581 (These are commonly accepted construction and maintenance manuals for source testing equipment.). The dry gas meters were calibrated before and after the tests using a transfer gas meter with NBS traceability. All equipment calibrations are included in Appendix D of this report.

## Systematic Data Reduction

Data reduction was accomplished by the use of step by step calculation sheets. All calculations are shown in Appendix B.

## 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 could have affected the test results were 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. The samples were retrieved immediately after each test, submitted to the lab, and the $Cr^{+6}$ analyzed within 48 hours of the end of the first test. A sample submittal/chain of custody form (See Appendix B) was completed and submitted with all samples to document that the sample analyzed was taken under the conditions reported.

## Use Of Thoroughly Cleaned Glassware

All glassware was cleaned prior to the tests with 40% nitric acid solution. The trains were then cleaned with 0.02N sodium carbonate solution and laboratory grade distilled water, air dried, and sealed until the tests.

## Submission Of Blank Samples

During the test set, a sample from an unused charged sampling train was carried to the field (train blank), leak-tested, and submitted to the laboratory and analyzed with the other samples to detect any possible contamination of sampling media or equipment or problems with lab analyses. Corrections were not made to the measured concentrations of the collected samples. In addition, an audit sample submitted to PES by the SDAPCD was analyzed along with the source test samples. The audit sample analysis yielded 42 ug/L hexavalent chromium, and 36 ug/L total chromium.

## Analytical Checks

The analyses of each batch of samples included calibration curves, duplicate analyses, spike recoveries, and standard additions. A complete QA/QC package from the analytical lab is included in Appendix C.

Product Description

# APPENDIX A

## Scrubber Overhaul Information

# TECHNICAL DESCRIPTION

## CONVERSION OF BLDG. No. 2 SCRUBBER INTO A MIST ELIMINATOR FOR CONTROL OF HEXAVALENT CHROMIUM EMISSIONS CONTRACT #N00244-92-M-6195

Work Performed For

Naval Aviation Depot North Island
San Diego, California 92135-5112

Work Performed By

HHI General Contractors
36 North Main Street
P.O. Box 113
Farmington, Utah 84025

December 27, 1991

MAPCO

**Equipment Modifications By HHI General Contractor**
**For**
**Naval Aviation Depot North Island**

CONVERSION OF BLDG. NO. 2 SCRUBBER
INTO A MIST ELIMINATOR FOR
CONTROL OF HEXAVALENT CHROME EMISSIONS
CONTRACT #N00244-92-M-6195

## 1.1 Background.

There are two chromic acid anodizing tanks in Building No. 2 for the surface treatment of helicopter rotors. The tanks are enclosed with covers. The anodizing solution is drained to a storage tank the when there is no rotor in a processing tank. The open area for each tank (front of tank plus cover openings) is approximately two (2) square feet. The electrical current used for anodizing is approximately 500 ampere-hours per day.

Mist is created in the anodizing operation when hydrogen and oxygen bubbles, generated during the application of electrical current, break at the surface of the liquid. The mist particles form from the collapse of the bubble dome, and from the ejection of particles formed by the liquid rushing in to fill the cavity left by the bubble. The composition of the mist is identical to the anodizing solution. The quantity of mist formed is a function of the anodizing current, and is approximately equal to 6 milligrams of hexavalent chromium per ampere-hour.

The anodizing tanks are locally ventilated and the exhaust is ducted through a packed bed scrubber prior to discharge to the atmosphere. The scrubber was tested recently by Pacific Environmental Services to determine compliance with San Diego County Air Pollution Control District (SDCAPCD) Rule 1201. The scrubber failed the compliance test, and NADEP contracted (N00244-92-M-6195) with HHI General Contractor of Farmington, Utah to design and implement improvements to the scrubber prior to scheduled replacement of the unit in 1992. MAPCO assisted HHI with the design and equipment modifications. A diagram of the scrubber prior to modification is attached as Drawing No. SCORG1.

## 1.2 Scrubber Control Of Hexavalent Chrome Emissions.

Packed bed scrubbers have a proven capability for removing gases, fumes and vapors from an airstream. They rely on the diffusion of gases into a liquid (normally water) counter-flowing over a mass transfer (packing) media. Scrubbers are not, however, recommended for control of mists or particulates. A major deterrent for their use in controlling mists is the fact that they are a new source of mist generation. The spray nozzles commonly used in packed bed scrubbers to distribute liquid over the packing media actually create mist. Additionally, liquid can be stripped off the packing media and entrained as a mist in the counter-flowing airstream.

Mists are generally collected by mechanical impingement and coalescence on an obstruction in the flow path. The *20th Edition of Industrial Ventilation* specifies wet absorbers (packed bed scrubbers) for control of gas and vapor contaminants (page 4-26). The *5th Edition of Perry's Chemical Engineers Handbook* (page 20-99) recommends packed bed scrubbers for gaseous contaminants and further states: "Packed towers are commonly used for distillation and absorption, but rarely for particle collection."

### 1.3 Mist Eliminator Control Of Hexavalent Chrome Emissions.

Mist particle collection by mechanical impingement and coalescence includes the following control mechanisms: (1) Inertial Impaction, (2) Flow-Line Interception, and (3) Brownian Motion Diffusion.

High efficiency Mist Eliminators employ all three control mechanisms. For example, if an obstruction is placed in an airstream to divert the flow of the air, mist particles will be carried forward by their inertia and will tend to impinge on the obstruction and be collected. This is known as Inertial Impaction. Inertial Impaction is efficient in collecting large mist particles, i.e., larger than 5 microns diameter.

If a 1 micron particle follows a streamline which passes within 0.5 microns of an obstruction, the particle will touch the obstruction and will be collected. This process is called Flow-line Interception. In entering a mesh pad, for example, a mist laden airstream will subdivide into thousands of small airstreams. These small airstreams subdivide and re-combine hundreds of times as they pass through the mesh pad. The finer the mesh size, the larger the number of airstreams, the larger the contacting surface area, and the higher the likelihood that a mist particle will contact a mesh filament. Flow line interception is efficient in collecting the mid-range mist particles, 0.5 - 10 microns diameter.

Fine mist particles, under 1 micron diameter, are normally collected by Brownian Motion Diffusion. This is defined as: The irregular motion of a particle arising from the thermal motion of the molecules of the material in which the particle is immersed. According to Perry's Handbook, Brownian movement is appreciable for particles under 3 microns in diameter and becomes entirely predominant for particles below 0.1 microns. Tests are reported to have shown that particles below 0.5 microns in diameter are collected as efficiently in mesh pad mist eliminators as larger particles.

### 1.4 Exhaust Requirements.

The open area for each tank was measured to be approximately 2 $ft^2$, or 4 $ft^2$ for the anodizing operation. The *20th Edition of Industrial Ventilation* (Page 10-22) recommends an exhaust rate of 60-150 $cfm/ft^2$ of open area for enclosing hoods. This equates to 600 cfm total when using a ventilation rate of 150 $cfm/ft^2$. This is also equivalent to stating that there will be an ingress of air through all the tank openings at a velocity of 150 fpm.

### 1.5 Source Test Failure.

The source test demonstrated that the scrubber was not capable of effective control of hexavalent chrome emissions. The reasons for the low efficiency probably include: (1) The velocity through the packing was too low at 150 fpm when it should have been 500 - 600 fpm. (2) The velocity through the chevron mist eliminator was too low at 150 fpm when it should have been 700 - 900 fpm. (3) The packing material, MasPac, had a relatively low coefficient of mass transfer. (4) The re-circulation spray nozzles were probably new sources for mist creation. (5) Chrome bearing rinse water in the scrubber sump was only replaced once per week.

### 1.6 Scrubber Conversion to Mist Eliminator.

To improve the collection efficiency, the scrubber body was converted to a mist eliminator. A drawing of the modified unit is included as Drawing No. SCMOD1. The major elements of the modification include:

**1.6.1 Velocity Control.** The cross-sectional area of the packing support grating was reduced from approximately 4 $ft^2$ to 1 $ft^2$. This results in an entry velocity of 600 fpm into the packing zone. At this velocity, a large portion of the large mist particles will be collected on the packing by Inertial Impaction.

**1.6.2 Packing Efficiency.** The MasPac was replaced by 2.3" diameter LanPac. The LanPac has a higher mass transfer coefficient, more surface area per cubic foot, and promotes a more tortuous air flow path. These characteristics will result in higher collection efficiencies.

**1.6.3 Packing Depth.** The packing depth was increased by 50% from 12" to 18".

**1.6.4 Mesh Pad Mist Eliminator.** The chevron section was replaced by a composite six inch thick mesh pad. The pad is a sandwich of three (3) 2" thick pads of differing filament size. The velocity through the mesh pads will be 200 - 250 fpm which is ideal for the collection of mid-size and fine mist particles through Flow-line Interception and Brownian Motion Diffusion.

**1.6.5 Spray System.** The re-circulation spray system was modified such that packing and mesh pad are washed only during non-anodizing hours -- when the exhaust fan is not operating. This practice eliminates the risk of entraining any of the wash-down water into the exhaust stream. A 24-hour timer was installed and set to operate the spray cycle and sump pump for a one (1) minute period during non-production hours.

**1.6.6 Rinse Water.** Only fresh water will be used to wash down the mesh pad and packing. Effluent from the wash down will be removed from the scrubber body for use as tank make-up water or disposal to the waste treatment facility. The two nozzles in the spray system are set to deliver 5.3 gpm per nozzle at a line pressure of 10 psi. During a one (1) minute wash down, the total water usage will be approximately 10.6 gallons.

## 1.7 Installation Features.

Referring to the included drawings, globe valve V1 and ball valve V3 were retained. Ball valve V2 was removed. The old packing (MasPac) was replaced with high performance packing (2.3" LanPac), the chevron mist eliminator was replaced with a composite mesh pad, and the four square foot (4 $ft^2$) grating was replaced with a one square foot (1 $ft^2$) grating.

The old spray header was replaced with a new header with one nozzle pointed upward to wash the mesh pad and one nozzle pointed downward to wash the packing. The header is connected to the fresh water supply line. The wash-down cycle is controlled by a normally closed solenoid valve (V4) which is energized by the timer switch. A pressure regulator valve (PRV) was set to reduce the spray header water pressure to 10 psi.

The existing pump was adapted from continuous operation, re-circulating rinse water, to intermittent operation where it transfers chrome bearing rinse water from the sump to a holding tank for disposition as make-up water or waste.

A timer switch, housed in a lockable box, was added to energize the solenoid valve and sump pump. The timer was set to open the valve and turn on the pump at 2:01 AM and to turn them off at 2:02 AM.

The damper in the exhaust duct was opened to set the air flow at 600 cfm. A Velometer was used to verify the velocity of the air into the front of the enclosed tanks at 150 fpm.

## 1.8 Operation Of The Control Equipment.

The control equipment operates as a dry mist eliminator that is washed down once per day. The wash down occurs during non-working hours while the exhaust fan is not operating. This procedure eliminates the risk of re-entraining any chrome bearing rinse water into the exhaust stream, and allows nearly complete drainage of the rinse water into the sump prior to operating the exhaust fan. The wash down water is fresh water. Chrome bearing wash water drains into the sump from which it is pumped into a transfer container. NOTE: The sump pump may run dry for 5 - 10 seconds towards the end of the wash-down cycle.

The wash down will require the disposal of approximately 10.6 gallons per day of chrome bearing water. It is important that the transfer container is replaced or emptied at a rate to accommodate the sump discharge. NOTE: It is important that ball valve V3 is open at all times, otherwise the sump will overflow into the air intake. The operator should monitor the sight port to ensure that the liquid level does not exceed the danger point noted on the port.

The timer switch can be set to the manual position to skip the wash-down sequence. This procedure could be implemented prior to long shut down periods, and/or during maintenance periods. NOTE: The timer switch housing box should be locked at all times to prevent tampering with the settings.

### 1.9 Maintenance.

The wash-down sequence should be run manually once per month to allow observation of the spray nozzles and sump pump. If the spray pattern does not provide full coverage of the mesh pad and packing, the nozzles should be cleaned or replaced. The mesh pad should be visibly inspected once per year for plugging and deterioration. The existing sump pump may require re-packing and/or lubrication according to the manufacturer's instructions.

### 1.10 Service.

Contact the following individual for additional information:

Don C. Hokanson, President
HHI GENERAL CONTRACTOR
36 North Main Street
P.O. Box 113
Farmington, Utah 84025
(801) 451-2846 phone
(801) 451-7727 fax

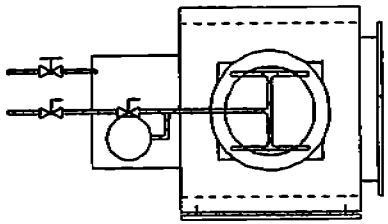
### 1.11 Attachments.

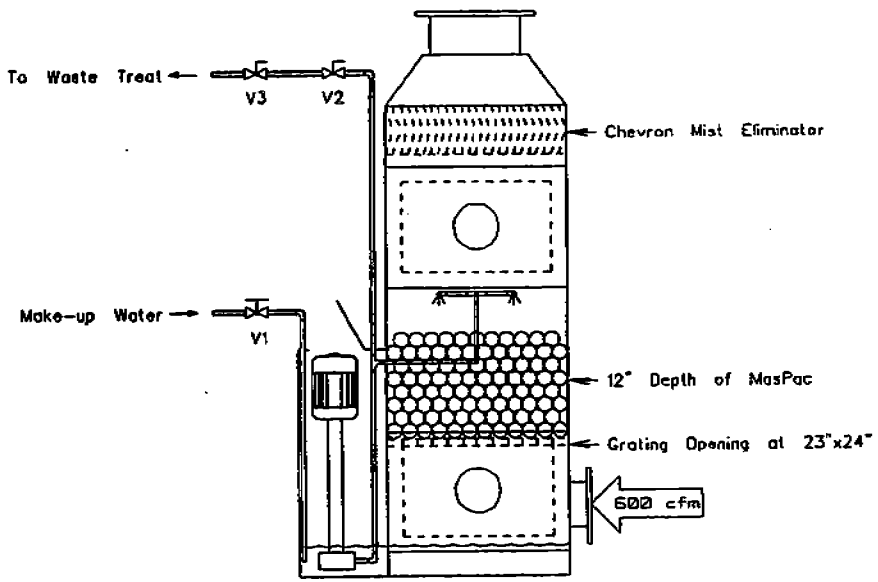
The following items are included as attachments:

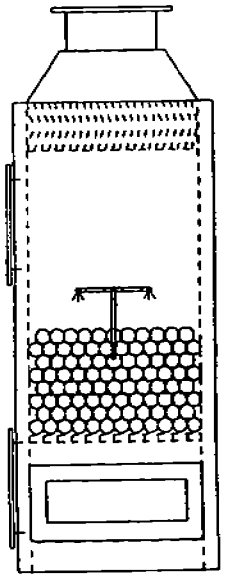
- Drawing No. SCORG1 ORIGINAL SCRUBBER CONFIGURATION
- Drawing No. SCMOD1 SCRUBBER CONVERSION TO MIST ELIMINATOR
- Timer Instruction Manual
- SpiralJet Nozzle Data Sheet
- Bete Nozzle Data Sheet (equivalent nozzle)

NOTE:

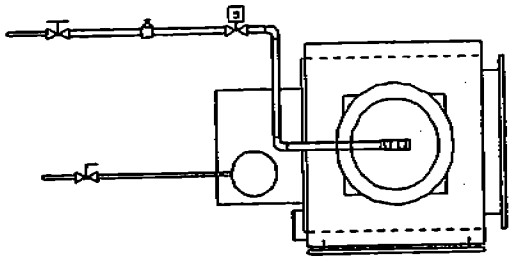
1. PUMP RECIRCULATES WATER WHEN EXHAUST FAN IS OPERATING.
2. VALVE V1 MANUALLY OPERATED TO ADD FRESH WATER AS NEEDED.
3. VALVES V2 & V3 MANUALLY OPENED ONCE PER WEEK FOR BLOWDOWN.





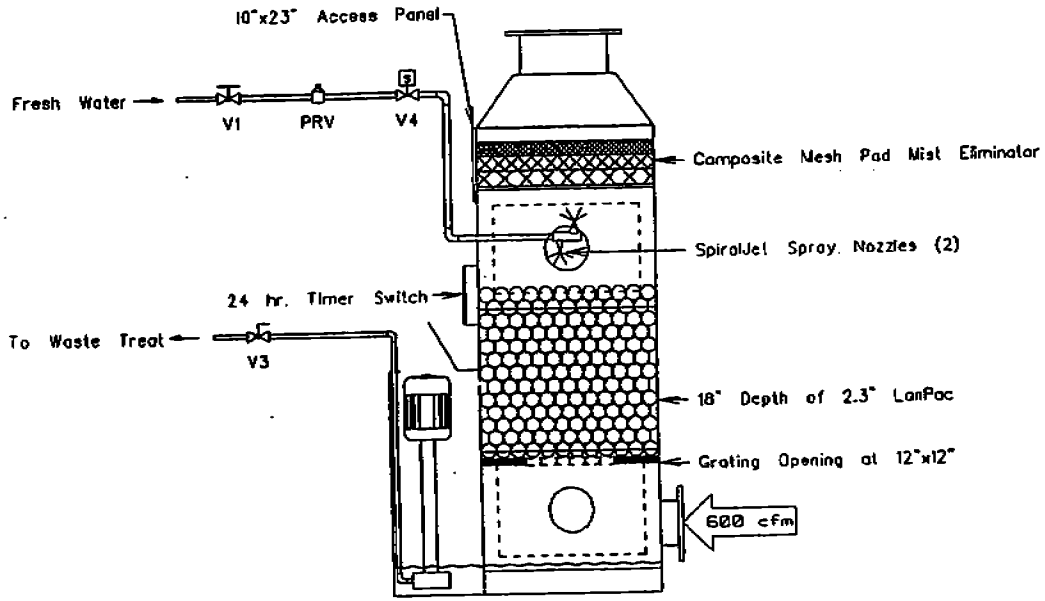



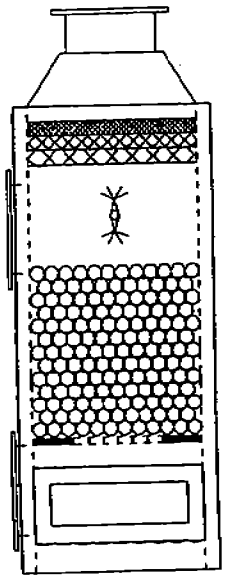
| | | | |
|---|---|---|---|
| DRAWING SCALE 0.5" = 1.0" | DATE 12/04/91 | DRAWN BY T.E.MILES | DRAWING SIZE A |
| MAPCO | TITLE ORIGINAL SCRUBBER CONFIGURATION CHROMIC ACID ANODIZE - Bldg 2 | | |
| DRAWING NUMBER SCORG1 | CUSTOMER NAME NADEP North Island | | |



## NOTE:

1. SET PRESSURE REGULATOR PRV TO 10 psi.
2. REMOVE VALVE V3 or LEAVE OPEN AT ALL TIME.
3. SOLINOID VALVE V4 and PUMP CONNECTED TO COMMON TIMER EVENT
4. TIMER ACTIVATES V4 & PUMP FOR 1 min. EACH DAY.
5. SET TIMER TO ACTIVATE V4 & PUMP WHILE EXHAUST FAN IS OFF.
6. WASH-DOWN USES 10.6 gpd OF FRESH WATER.
7. SPIRALJET NOZZLE NO: 3/8 HHSJ-PVC 150 53



| | | | |
|---|---|---|---|
| DRAWING SCALE 0.5" = 1.0' | DATE 12/26/91 | DRAWN BY T.E.MILES | NUMBER SIZE A |
| MAPCO | TITLE SCRUBBER CONVERSION TO M.E. CHROMIC ACID ANODIZE - Bldg 2 | | |
| DRAWING NUMBER SCM001 | CUSTOMER NAME NADEP North Island | | |

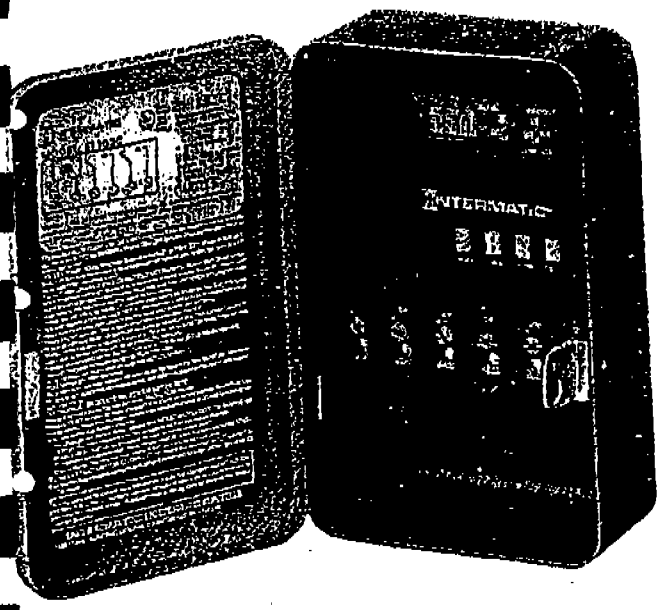
# ET100C SERIES

## ectronic 24 Hour Time Switch

ith Battery Carryover

# OWNER/INSTALLER INSTRUCTION MANUAL

**TTENTION: READ CAREFULLY BEFORE ATTEMPTING TO INSTALL YOUR INTERMATIC ME SWITCH. FAILURE TO COMPLY WITH INSTRUCTIONS COULD RESULT IN PERSONAL JURY AND/OR PROPERTY DAMAGE! RETAIN FOR FUTURE REFERENCE.**




### *Description*

The Intermatic Electronic 24 Hour Time Switch automatically switches loads according to a preset daily schedule. This time switch is designed to directly switch loads up to 30 amps and to switch resistive or inductive loads up to the time switch rating. For use as a control timer in applications requiring 24 hour load control such as lighting, heating, air conditioning systems, pumps, etcetera. Up to eight set points or events (4 ON/4 OFF) can be preset. This schedule will repeat on a daily basis. The program can be overridden by using the MANUAL position.

### *Specifications*

CLOCK VOLTAGE: 120 V.A.C., 60 Hz.
POWER CONSUMPTION: 3.0 Watts Max.
CONTACT CONFIGURATION: SPST
SWITCH RATING:
- 30 Amps Inductive/Resistive, 24/120 V.A.C., 60 Hz.
- 20 Amps Resistive - 28 V.D.C.,
- 1 H.P. 120 V. A.C., 60 Hz.
- 5 Amps. Tungsten, 120 V.A.C., 60 Hz.
- 5 Amps Ballast 120 V.A.C., 60 Hz.

SET POINTS (EVENTS): 8 total (4 ON/4 OFF)
BATTERY POWERED CARRYOVER: 3 Years minimum
MIN. "ON" or "OFF" TIME: 1 minute
MAX. "ON" or "OFF" TIME: 23 hours 59 minutes.
SHIPPING WEIGHT: 2.5 Lbs. (1.1 Kg)
CASE: Drawn steel; 7-3/4" (19.7 cm) high, 5" (12.7 cm) wide, 3" (7.6 cm) deep; gray finish w/lockable spring hasp.
KNOCKOUTS: Combination 1/2 - 3/4" (one on back and each side, two on bottom).

### *General Safety Information*

WARNING: Disconnect all power before installing or servicing this time switch or its connected loads.

1. Follow all local electrical and safety codes, National Electric Code (NEC), as well as Occupational Safety and Health Act (OSHA).
2. If the power disconnect point is out of sight, lock it in the "OFF" position and tag it to prevent unexpected application of power.
3. This time switch case must be grounded.
4. Do not exceed the maximum current carrying capacity of this time switch.
5. Always replace the plastic insulator covering the terminal before turning power "ON".

## *Installation*

WARNING: DISCONNECT THE POWER TO THE TIME SWITCH AND THE LOADS BEFORE INSTALLING THIS TIME SWITCH.

1. Remove the mechanism from the case by depressing the catch at the top of the case and pulling out. (See Fig. 1).

   CAUTION: DO NOT TOUCH CIRCUIT BOARD COMPONENTS.

2. Mount the time switch in the desired location (three holes for mounting are located on the back) eye level if possible. (See Fig. 2).

3. Replace the mechanism in the case.

4. Lift left side of insulator off of retaining post and pivot it up and away to expose the terminal strip.

5. Strip supply and load wires by removing 1/2" of insulation. DO NOT USE ALUMINUM WIRE. (See Fig. 3). Insert the wire ends under the proper terminal plates and tighten the screws firmly. Use AWG #10 through 18.

6. Replace the plastic insulator.

7. Be sure that the battery is functioning properly. This can be checked by making sure the display is lit properly. If the display has scrambled information, press RESET switch and hold for three to five seconds. Note that the battery is factory installed.

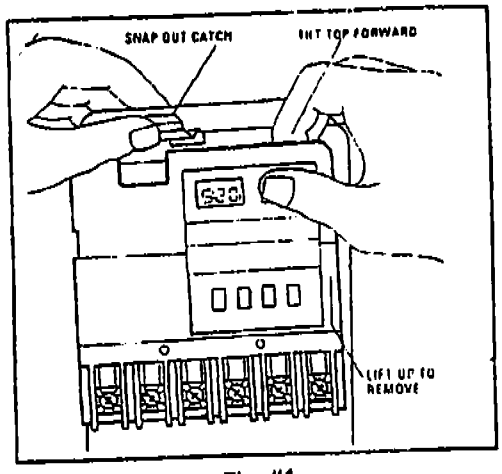



Fig. #1

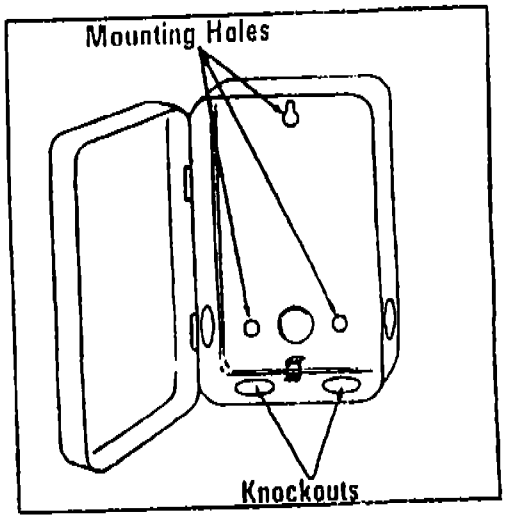



Fig. #2

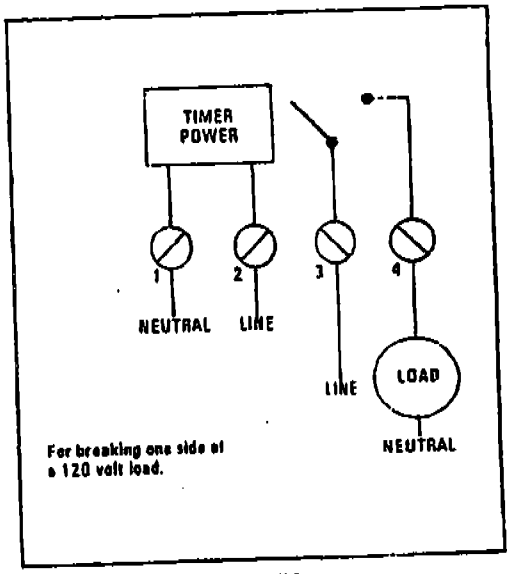



Fig. #3

8. Place the selector switches in the "MANUAL" and "RUN" positions.

9 Reapply power to the time switch.

10. Press the reset switch for three to five seconds. The display will now show 12:00 A.M. and Event #1. The timer is now ready for programming. Refer to the chart below and enter the scheduled events (set points) required.

| EVENT | TIME |
|---|---|
| On 1 | |
| Off 2 | |
| On 3 | |
| Off 4 | |
| On 5 | |
| Off 6 | |
| On 7 | |
| Off 8 | |

## *Programming Steps*

Refer to programming instructions on time switch door label and note the following:

- The MANUAL/AUTO selector can be used to temporarily override the program. Under normal operation the selector should be in the AUTO mode. The MANUAL mode maintains the program but prevents the loads from automatically switching.
- The other selector switch is used to set the time of day (TIME SET), the program information (PROGRAM) or to run the program (RUN). **FOR A PROGRAM TO FUNCTION PROPERLY, THE TWO SELECTOR SWITCHES MUST BE IN THE AUTO AND RUN POSITIONS.**
- The RESET switch is used only prior to initially programming the time switch or to erase all programmed set points.
- By holding the hour and/or minute buttons depressed you can achieve a fast roll of the displayed time. This is useful when setting the time of day or setting the programmed set points (events).
- Up to 4 ON and 4 OFF set points (8 events) can be programmed.
- The load can manually be switched ON or OFF at any time only if the selector switch is in the RUN mode by pressing the ON/OFF button.
- Pressing the ON/OFF button two times in the PROGRAM mode causes the event time displayed to be removed from the program. The display will show 0:00 and the Event (1 through 8).

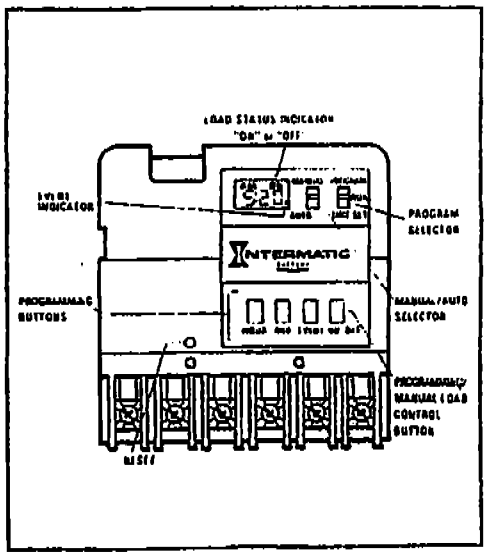



Fig. #4

## *Trouble Shooting*

| SYMPTOM | POSSIBLE CAUSE(S) | CORRECTIVE ACTION |
|---|---|---|
| Time switch has no display. | Battery not properly installed or defective. | Check battery and replace if necessary. To remove battery cover press in and slide down. |
| Display shows scrambled or erratic times. | Time switch has not been reset.<br><br>Electrical noise is interfering with the operation of the microprocessor. | Press the recessed reset switch and hold for approximately 5 seconds.<br>Electrical noise interference is highly unlikely since the electronic circuitry and the power supply are completely isolated. The installation of surge suppressors (metal oxide varistors-MOVS) across terminals 3/4 (model ET103C across terminals 3/4 & 5/6) will help to reduce electrical noise generated at the switching contacts. |
| Load does not switch at-programmed time. | MANUAL/AUTO selector not in AUTO position.<br>Time switch is programmed incorrectly<br><br>Power has not been supplied to the load through the line (line 1 and line 2 for ET103C) terminals. | Be sure MANUAL/AUTO is in the AUTO position.<br>Check program - place the Program Selector in the PROGRAM mode and press the Event button to review all eight possible Events.<br>Be sure power is applied to the line terminals #3 (#3 and #5 for ET103C) in order to power the load. Note that the output contacts are isolated from the timer power (terminals 1 and 2). This allows the timer to switch various loads from 24 volts through 277 volts. |

### FULL ONE YEAR WARRANTY

If within one (1) year from the date of purchase, this product fails due to a defect in material or workmanship, Intermatic Incorporated will repair or replace it free of charge.

The warranty does not apply to: (a) damage caused by accident, abuse, mishandling, dropping; (b) units which have been subject to unauthorized repair, opened, taken apart; (c) units not used in accordance with directions; (d) damages exceeding the cost of the product. Some states do not allow a limitation of damages, so the foregoing limitation may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

This warranty service is available by either (a) returning the product to the dealer from whom the unit was purchased, or (b) mailing postage prepaid to the nearest authorized service station listed. Please be sure to wrap the product securely when mailing to avoid damage. This warranty is made by: Intermatic Incorporated, Intermatic Plaza, Spring Grove, Illinois 60081-9698

### AUTHORIZED SERVICE STATION

INTERMATIC INCORPORATED, 4720 West Montrose Avenue, Chicago, Illinois 60041.

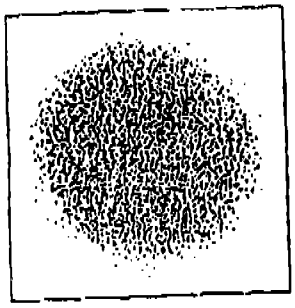
**INTERMATIC INCORPORATED**
SPRING GROVE, ILLINOIS 60081-9698

PRINTED IN U.S.A.

168ET7603

# SpiralJet® SPRAY NOZZLES

## COMPACT, ONE PIECE, LARGE FLOW RATE FULL CONE SPRAY NOZZLES



### HHSJ
threaded/hex nut
¼"-2" NPT (M)

### HHSJ
threaded/flats
¼"-4" NPT (M)

### HHSJ
threaded/round
¼"-4" NPT (M)

### DESIGN FEATURES

The Type HHSJ is a Full Cone spray nozzle available for spray angles ranging from 60° to 170°. These compact nozzles permit maximum liquid throughout for a given pipe size and the free passage design minimizes clogging. The compact size can be installed or retrofitted on most pipe systems. Available in NPT or BSPT (M) threads.

Flow capacity at 40 psi (3 bar) ranges from 1.4 to 1050 GPM (5.6 to 4140 l/min).

Sizes ¼" to 2" are available in Brass, Cast 316 Stainless Steel, and TEFLON or PVC materials. Brass version is available with hex design. Stainless steel with flats. TEFLON and PVC nozzles with rounded design. In the larger 3" and 4" sizes, both Brass and Stainless Steel are available in flats design only. They can also be produced from a wide variety of other materials for specific applications.

### COMMON APPLICATIONS

- Flue gas scrubbing
- Gas cooling
- Washing & Rinsing processes
- Fire supression & prevention

### ACCESSORIES

Adjustable Ball Fittings

Split Swivel Connector

Other Accessories

- Pressure Regulators
- Control Valves
- Solenoid Valves
- Swivel Connectors

SEE SECTION G FOR COMPLETE INFORMATION

### PERFORMANCE DATA

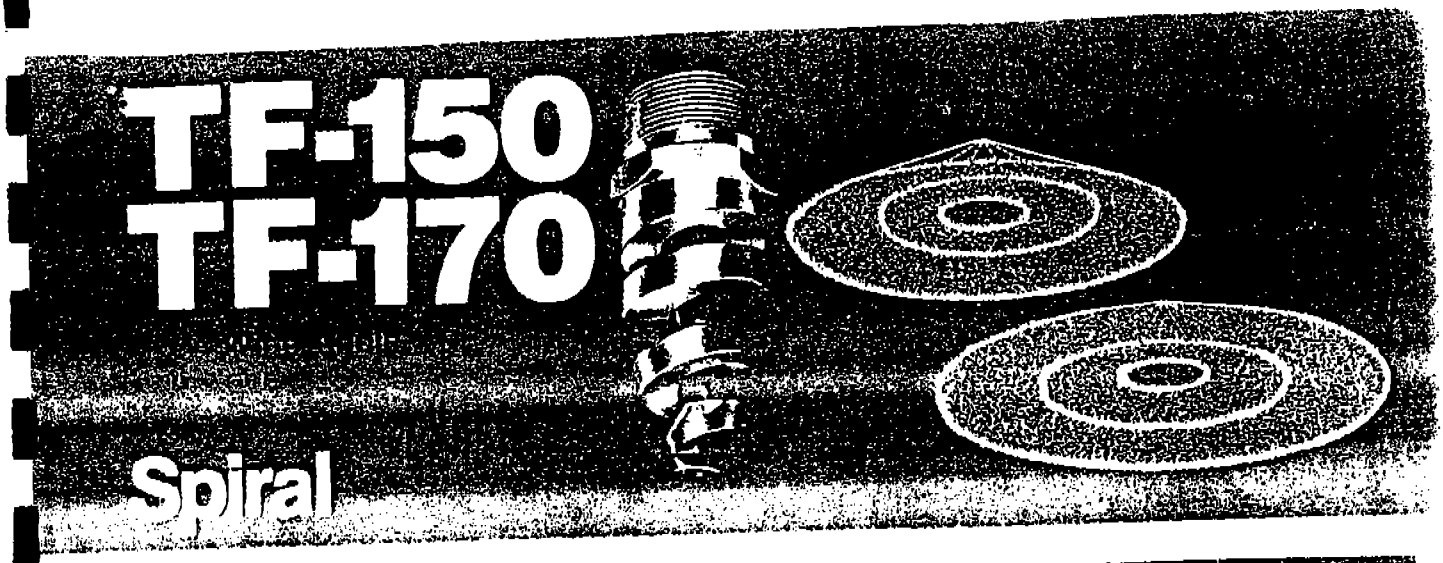
| Pipe Size NPT(M) | Pipe Size BSPT(M) | Spray Angle at 10 psi 60° | 90° | 120° | 150° | 170° | Capacity Size | Orifice Diam. | Free Passage Diam. | CAPACITY (gallons per minute) 10 psi | 20 psi | 40 psi | 100 psi | 400 psi | Nozzle Length 60°, 90° & 120° | 150° & 170° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/4 | B1/4 | ● | ● | ● | | | 07 | 1/32" | 1/16" | .7 | .99 | 1.4 | 2.2 | 4.4 | 1 7/8" | |
| | | ● | ● | ● | ● | ● | 13 | 1/8" | 1/4" | 1.3 | 1.8 | 2.6 | 4.1 | 8.2 | 1 7/8" | 2 1/8" |
| | | ● | ● | ● | ● | ● | 20 | 5/32" | 1/4" | 2.0 | 2.8 | 4.0 | 6.3 | 12.6 | 1 7/8" | 2 1/8" |
| 3/8 | B3/8 | ● | | | | | 07 | 1/32" | 1/16" | .7 | .99 | 1.4 | 2.2 | 4.4 | 1 7/8" | |
| | | ● | | | | | 13 | 1/8" | 1/8" | 1.3 | 1.8 | 2.6 | 4.1 | 8.2 | 1 7/8" | |
| | | ● | | | | | 20 | 5/32" | 1/8" | 2.0 | 2.8 | 4.0 | 6.3 | 12.6 | 1 7/8" | |
| | | ● | | | | | 30 | 3/16" | 1/8" | 3.0 | 4.2 | 6.0 | 9.5 | 19.0 | 1 7/8" | 2 1/8" |
| | | ● | ● | ● | ● | ● | 40 | 1/4" | 1/8" | 4.0 | 5.7 | 8.0 | 12.6 | 25 | 1 7/8" | 2 1/8" |
| | | ● | ● | ● | ● | ● | 53 | 1/4" | 1/8" | 5.3 | 7.5 | 10.6 | 16.8 | 34 | 1 7/8" | 2 1/8" |
| | | ● | ● | ● | ● | ● | 82 | 5/16" | 1/8" | 8.2 | 11.6 | 16.4 | 26 | 52 | 1 7/8" | 2 1/8" |
| 1/2 | B1/2 | ● | ● | ● | ● | ● | 120 | 3/8" | 3/16" | 12.0 | 17.0 | 24 | 38 | 76 | 2 1/8" | 3 1/16" |
| | | ● | ● | ● | ● | ● | 164 | 7/16" | 3/16" | 16.4 | 23 | 33 | 52 | 104 | 2 1/8" | 3 1/16" |
| 3/4 | B3/4 | ● | ● | ● | ● | ● | 210 | 1/2" | 3/16" | 21 | 30 | 42 | 66 | 133 | 3 1/8" | 3 1/8" |
| 1 | B1 | ● | ● | ● | ● | ● | 340 | 5/8" | 1/4" | 34 | 48 | 68 | 108 | 215 | 3 1/8" | 4 1/8" |
| | | ● | ● | ● | ● | ● | 470 | 3/4" | 1/4" | 47 | 66 | 94 | 148 | 297 | 3 1/8" | 4 1/8" |
| 1-1/2 | B1-1/2 | ● | ● | ● | ● | ● | 640 | 7/8" | 5/16" | 64 | 91 | 128 | 202 | 405 | 4 3/8" | 5 5/8" |
| | | ● | ● | ● | ● | ● | 820 | 1" | 5/16" | 82 | 116 | 164 | 259 | 519 | 4 3/8" | 5 5/8" |
| | | ● | ● | ● | ● | ● | 980 | 1 1/8" | 5/16" | 96 | 136 | 192 | 304 | 607 | 4 3/8" | 6 1/8" |
| 2 | B2 | ● | ● | ● | ● | ● | 1400 | 1 3/8" | 7/16" | 140 | 198 | 280 | 443 | 885 | 5 1/8" | 6 7/8" |
| | | ● | ● | ● | ● | ● | 1780 | 1 1/2" | 7/16" | 178 | 252 | 356 | 563 | 1126 | 5 1/8" | 6 7/8" |
| 3 | B3 | ● | ● | ● | | | 2560 | 1 3/4" | 9/16" | 256 | 362 | 512 | 810 | 1620 | 8" | |
| | | ● | ● | ● | | | 3360 | 2" | 9/16" | 336 | 475 | 672 | 1060 | 2120 | 8" | |
| 4 | B4 | ● | ● | ● | | | 5260 | 2 1/4" | 5/8" | 525 | 743 | 1050 | 1660 | 3320 | 9" | |

### ORDERING INFORMATION

COMPLETE NOZZLE NUMBER

**1/4 HHSJ - SS 120 07**

Pipe Size | Nozzle Type | Material Code | Spray Angle | Capacity Size




## DESIGN

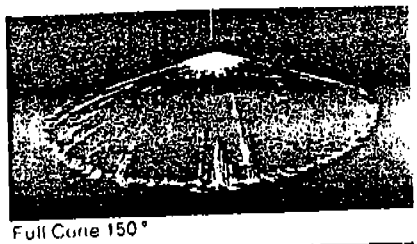
Widest full cone coverage available
HIGH ENERGY EFFICIENCY
Fine atomization
Non clogging
No internal parts allows free passage of foreign particles
Lowers water consumption by replacing two or more nozzles with extra wide pattern

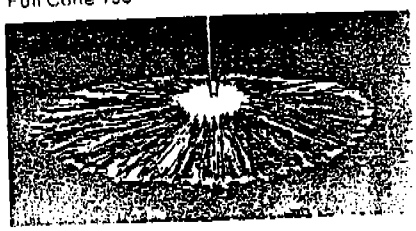
## SPRAY CHARACTERISTICS

Fine atomization
Spray pattern - full cone
Spray angles - 150° and 170° [illegible] angles
Flow rates - 3.0 to 1120 gpm

## MATERIALS

PVC
Polypropylene
Teflon
Brass
316 Stainless Steel
316 Stainless Steel
Other castable alloys


Full Cone 150°


[illegible]

## FULL CONE

| Spray Angle | Male Pipe Size | Nozzle Number | Orifice Dia | Free Passage Dia | Overall Length | Hex or Round Dia | Weight Plastic Oz | Weight Metal Oz |
|---|---|---|---|---|---|---|---|---|
| 150° | 3/8 | TF12-150 | 3/16 | 1/8 | 2 3/8 | 3/4 | 1 | [illegible] |
| | | TF14-150 | 7/32 | 1/8 | 2 3/8 | 3/4 | 1 | [illegible] |
| | | TF16-150 | 1/4 | 1/8 | 2 3/8 | 3/4 | 1 | [illegible] |
| | | TF20-150 | 5/16 | 1/8 | 2 3/8 | 3/4 | 1 | [illegible] |
| | 1/2 | TF24-150 | 3/8 | 5/16 | 3 1/16 | 7/8 | 1 1/4 | [illegible] |
| | | TF28-150 | 7/16 | 5/16 | 3 1/16 | 7/8 | 1 1/4 | [illegible] |
| | 3/4 | TF32-150 | 1/2 | 3/16 | 3 1/2 | 1 1/8 | 1 3/4 | [illegible] |
| | 1 | TF40-150 | 5/8 | 1/4 | 4 3/8 | 1 3/8 | 3 | 7 |
| | | TF48-150 | 3/4 | 1/4 | 4 3/8 | 1 3/8 | 3 | [illegible] |
| | 1 1/2 | TF56-150 | 7/8 | 5/16 | 5 3/8 | 2 | 6 1/2 | [illegible] |
| | | TF64-150 | 1 | 5/16 | 5 3/8 | 2 | 6 1/2 | [illegible] |
| | | TF72-150 | 1 1/8 | 5/16 | 5 3/8 | 2 | 6 1/2 | [illegible] |
| | 2 | TF88-150 | 1 3/8 | 7/16 | 6 7/8 | 2 1/2 | 9 | [illegible] |
| | | TF96-150 | 1 1/2 | 7/16 | 6 7/8 | 2 1/2 | 9 | [illegible] |
| 170° | 3/8 | TF12-170 | 3/16 | 1/8 | 2 3/8 | 3/4 | 1 | [illegible] |
| | | TF14-170 | 7/32 | 1/8 | 2 3/8 | 3/4 | 1 | [illegible] |
| | | TF16-170 | 1/4 | 1/8 | 2 3/8 | 3/4 | 1 | [illegible] |
| | | TF20-170 | 5/16 | 1/8 | 2 3/8 | 3/4 | 1 | [illegible] |
| | 1/2 | TF24-170 | 3/8 | 3/16 | 3 1/16 | 7/8 | 1 1/4 | [illegible] |
| | | TF28-170 | 7/16 | 3/16 | 3 1/16 | 7/8 | 1 1/4 | [illegible] |
| | 3/4 | TF32-170 | 1/2 | 3/16 | 3 1/2 | 1 1/8 | 1 3/4 | [illegible] |
| | 1 | TF40-170 | 5/8 | 1/4 | 4 3/8 | 1 3/8 | 3 | 7 |
| | | TF48-170 | 3/4 | 1/4 | 4 3/8 | 1 3/8 | 3 | [illegible] |
| | 1 1/2 | TF56-170 | [illegible] | [illegible] | 5 3/8 | [illegible] | [illegible] | [illegible] |
| | | TF64-170 | [illegible] | [illegible] | 5 3/8 | [illegible] | [illegible] | [illegible] |
| | | TF72-170 | [illegible] | [illegible] | 5 3/8 | [illegible] | [illegible] | [illegible] |
| | 2 | TF88-170 | [illegible] | [illegible] | 6 7/8 | [illegible] | [illegible] | [illegible] |
| | | TF96-170 | [illegible] | [illegible] | 6 7/8 | [illegible] | [illegible] | [illegible] |

| Nozzle Number | GALLONS PER MINUTE @ PSI 10 | 20 | 30 | 40 | 50 | 60 | 80 | 100 | 200* | 400* |
|---|---|---|---|---|---|---|---|---|---|---|
| TF12-150 | [illegible] | 4.2 | 5.2 | 6.0 | [illegible] | 7.4 | 8.5 | 9.5 | 13.4 | 19 |
| TF14-150 | 4.0 | 5.7 | 7.0 | 8.1 | 9.0 | 10.0 | 11.4 | 12.5 | 18 | 25 |
| TF16-150 | 5.3 | 7.5 | 9.2 | 10.7 | 12.0 | 13.0 | 15.0 | 16.7 | 24 | 33 |
| TF20-150 | 6.2 | 11.7 | 14.3 | 16.5 | 18.5 | 20.0 | 23.3 | 26.1 | 36 | 52 |
| TF24-150 | 15.0 | 17.0 | 20.8 | 24.1 | [illegible] | 29.4 | 33 | 36 | 54 | 75 |
| TF28-150 | 16.4 | 23 | 28 | [illegible] | [illegible] | 40 | 46 | 52 | 74 | 104 |
| TF32-150 | 23 | 30 | 37 | 42 | 2 | 52 | 60 | 67 | 94 | 134 |
| TF40-150 | 34 | 48 | 57 | 67 | [illegible] | 81 | 94 | 105 | 148 | 210 |
| TF48-150 | 47 | 67 | 83 | 95 | [illegible] | 117 | 135 | 151 | 214 | 302 |
| TF56-150 | 64 | 93 | 112 | 129 | 145 | 159 | 184 | 205 | 290 | 410 |
| TF64-150 | 84 | 120 | 147 | 169 | 190 | 208 | 240 | 268 | 380 | 536 |
| TF72-150 | 96 | 137 | 165 | 192 | 213 | 235 | 270 | 302 | 426 | 604 |
| TF88-150 | 146 | 198 | 240 | 280 | 310 | 340 | 395 | 438 | 620 | 876 |
| TF96-150 | 178 | 250 | 310 | 355 | 395 | 430 | 505 | 560 | 790 | 1120 |
| TF12-170 | 3.0 | 4.2 | 5.2 | 6.0 | [illegible] | 7.4 | 8.5 | 9.5 | 13.4 | 19 |
| TF14-170 | 4.0 | 5.7 | 7.0 | 8.1 | [illegible] | 10.0 | 11.4 | 12.5 | 18 | 25 |
| TF16-170 | 5.3 | 7.5 | 9.2 | 10.7 | 11.9 | 13.0 | 15.0 | 16.7 | 24 | 33 |
| TF20-170 | 6.2 | 11.7 | 14.3 | 16.5 | 18.5 | 20.0 | 23.3 | 26.1 | 36 | 52 |
| TF24-170 | 12.0 | 17.0 | 20.8 | 24.1 | 26.8 | 29.4 | 34 | 38 | 54 | 76 |
| TF28-170 | 16.4 | 23 | 28 | 33 | 37 | 40 | 46 | 52 | 74 | 104 |
| TF32-170 | 23 | 30 | 37 | 42 | 47 | 52 | 60 | 67 | 94 | 134 |
| TF40-170 | 34 | 48 | 57 | 67 | 74 | 81 | 94 | 105 | 148 | 210 |
| TF48-170 | 47 | 67 | 83 | 95 | [illegible] | 117 | 135 | 151 | 214 | 302 |
| TF56-170 | 64 | 93 | 112 | 129 | 145 | 159 | 184 | 205 | [illegible] | [illegible] |
| TF64-170 | [illegible] | [illegible] | [illegible] | [illegible] | 190 | 208 | 240 | 268 | [illegible] | [illegible] |
| TF72-170 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 235 | 270 | 302 | [illegible] | [illegible] |
| TF88-170 | [illegible] | 198 | 240 | 280 | 310 | 340 | 395 | 438 | [illegible] | [illegible] |
| TF96-170 | [illegible] | 250 | 310 | 355 | 395 | 430 | 505 | 560 | 790 | [illegible] |

*High pressure operation [illegible] recommended for most [illegible]

For adapters and bushings, refer to Accessories page

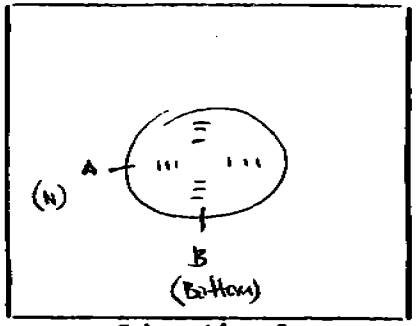
NOTE: Specify Spray Angle, Pipe Size, Nozzle Number and Material

# APPENDIX B

## Field Data, Calculations, and Process Data

Plant U.S. NAVY NADEP
Date 3-17-92
Sampling Location SCRUBBER EXHAUST
Sample Type METHOD 425
Run Number 1
Operator HERNANDEZ / BROWN
Ambient Temperature 71°F
Barometric Pressure 30.02
Static Pressure ($P_s$) -1.2"
Filter Number(s)
Pretest Leak Rate = .016 cfm @ 9 in. Hg
Pretest Pitot Leak Check
Pretest Orsat Leak Check N/A
Read and Record all Data Every 10 Minutes

FIELD DATA




Schematic of Traverse Point Layout

Probe Length and Type 18" SS. w/ GLASS LINER
Pitot Tube I.D. No. & 3B
Nozzle I.D. No. & Diameter 0.437 28PB
Assumed Moisture, % 2%

Meter Box Number 1A
Meter $\Delta H_@$ 1.964
C Factor 1.15
Meter Gamma 1.004
Heater Box Setting —
Reference $\Delta p$ 0.04
Post Test Leak Rate = 0.015 cfm @ 15 in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check —

Impinger Box No. 5B ; Blank Box No. 2B

| Traverse Point Number | Sampling Time, (min) | /Clock / Time / (24-hour clock) | Gas Meter Reading ($V_m$) Ft³ | Velocity Head ($\Delta P_s$) in. $H_2O$ | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Desired | Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A 1 | 0 | /15:13 | 442.315 | 0.08 | 3.6 | 2.2 | 67 | 75 | 74 | 15" | — | 68 | $\Delta H$ = 5048.3 |
| A 2 | 10 | / | 450.075 | 0.07 | 2.9 | 2.2 | 67 | 78 | 74 | 15 | — | 58 | |
| A 3 | 20 | / | 457.900 | 0.05 | 2.1 | 2.1 | 68 | 80 | 75 | 14 | — | 56 | |
| A 4 | 30 | / | 465.1[illegible] | | [illegible] | 1.8 | 67 | 79 | 74 | 11 | — | 53 | |
| A 5 | 40 | / | [illegible]472 | | | 2.2 | 68 | 79 | 75 | 15 | — | 54 | |
| A 6 | 50 | / | 480.6[illegible] | | | 2.2 | 68 | 75 | 73 | 15 | — | 54 | $\Delta H$ = 5091.8 |
| B 1 | 60 | /16:16/16:53 | 488.4[illegible] | | | 2.2 | 68 | 69 | 70 | 15 | — | 57 | Leaved A Started B |
| B 2 | 70 | / | 496.2[illegible] | | | 2.2 | 68 | 70 | 70 | 15 | | 50 | |
| B 3 | 80 | / | 504.04[illegible] | | | 2.2 | 68 | 74 | 70 | 15 | — | 52 | |
| B 4 | 90 | / | 511.87 | | | 2.1 | 68 | 75 | 71 | 13 | — | 53 | |
| B 5 | 100 | / | 519.48 | | | 2.2 | 66 | 76 | 71 | 15 | — | 53 | |
| B 6 | 110 | / | 527.3[illegible] | | | 2.2 | 67 | 76 | 72 | 15 | — | 54 | 5149.5 |
| | 120 | / 17:53 | 535.16 | | | | | | | | | | |
| | | / | | | | | | | | | | | |
| | | / | | | | | | | | | | | |
| | θ=120 | / | $V_m$=98.85 | | $\Delta H$ | =2.20 | | $T_m$ | =534 | | | | |
| | | / | | | | | | | | | | | |
| | | / | | $\sqrt{\Delta P}$=0.256 | | | $T_s$=528 | | | | | | |
| | | / | | | | | | | | | | | |
| | | / | | | | | | | | | | | |
| | | / | | | | | | | | | | | |
| | | / | | | | | | | | | | | |
| | | / | | | | | | | | | | | |
| | | / | | | | | | | | | | | |

5149.5
5048.3
101.2 amps

PACIFIC ENVIRONMENTAL SERVICES, INC.

PES

## SAMPLE RECOVERY DATA

Plant: NADEP

Date: 3-17-92

Sampling Location: HELO SCRUBBER EXHAUST

Sample Type: Cr +6 CARB 425

Run Number: 1

Sample Box Number: 5B

Clean-up Man: BROWN

Job Number:

Comments: A 657.4 - 117.8 = 539.6
B 171.2 - 44.1 = 127.1

**FRONT HALF**

Filter Number:

Description of Filter: CLEAN

**MOISTURE**

| | | | |
|---|---|---|---|
| Impingers | | | |
| Final Volume: | 598.4 ml | 581.1 ml | 488.3 ml |
| Initial Volume: | 588.3 ml | 579.7 ml | 487.0 ml |
| Net Volume: | 10.1 ml | 1.4 ml | 1.3 ml |
| Total $H_2O$: | | | |
| Silica Gel | | | |
| Final Volume: | 732.4 g | g | g |
| Initial Volume | 714.5 g | g | g |
| Net Volume | 17.9 g | g | g |
| Total Moisture: | | | |

Description of Impinger Catch: CLEAR 30.7

## EMISSION TEST CALCULATIONS

*Definiton of Symbols:*

| | |
|---|---|
| $A$ | : cross-sectional area of stack, $ft^2$ |
| $A_n$ | : cross-sectional area of nozzle, $ft^2$ |
| $B_{W_s}$ | : 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 |
| $V_{lc}$ | : 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 |
| $Y$ | : dry gas meter calibration factor |
| ^H | : average pressure differential across the orifice meter, in. of $H_2O$ |
| $\theta$ | : total sampling time, in minutes |
| 13.6 | : specific gravity of mercury |

Plant: U.S. NAVY

Date: 3-17-92

Source/Sample Number: 1

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

$Vm(std) = (17.64)(98.850)(1.004)\left[\frac{(30.02) + (2.20/13.6)}{(534)}\right]$

$Vm(std) =$ 98.9 dscf.

2. Volume water vapor collected (standard conditions).

$V(lo) =$ 30.7 condensate from impingers and selica gel.

$Vw(std) = (0.04707)\ V(lo) = (0.04707)(30.7)$

$Vw(std) =$ 1.45 scf.

3. Percent moisture, by volume.

$Bw_s = \frac{Vw(std)}{Vw(std) + Vm(std)} = \frac{(1.45)}{(1.45) + (98.9)} = 0.014$

$Bw_s =$ 1.4% .

4. Molecular weight, stack gas.

Dry molecular weight.

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

$Md = 0.440\ (\ \ ) + 0.320(\ \ ) + 0.280(\ \ )$

$Md =$ 29.0 lb/lb-mole.

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

$Ms =$ 28.85 lb/lb-mole.

Plant: U.S. NAVY

Date: 3-17-92

Source/Sample Number: 1

5. Stack gas velocity average.

$$Vs(avg) = (85.49)(Cp)(\sqrt{\Delta P})\left[avg\sqrt{\frac{(Ts)}{(Ps)(Ms)}}\right]$$

$$Vs(avg) = (85.49)(0.84)(0.256)\left[\sqrt{\frac{(528)}{(29.93)(28.85)}}\right]$$

Vs(avg) = 14.4 ft/sec.

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

$$Qs = (60)(Vs)(A) = (60)(14.4)(0.785)$$

Qs = 678 acfm.

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

$$Q(std) = (17.64)(Qs)(1-Bw_s)\left[\frac{(Ps)}{(Ts)}\right]$$

$$Q(std) = (17.64)(678)(1-0.014)\left[\frac{(29.93)}{(528)}\right]$$

Q(std) = 668 dscfm.

8. Isokinetic variation.

$$\%I = (K)\left[\frac{(Ts)(Vm(std))}{(Ps)(Vs)(An)(\theta)(1-Bw_s)}\right]$$

$$\%I = (0.0945)\left[\frac{(528)(98.9)}{(29.93)(14.4)(0.00104)(120)(1-0.014)}\right]$$

%I = 93.0 %

CLIENT: HHI / NADEP

Project No. 4572

Sampling Location: HELO SCRUBBER EXHAUST  Test Date: 3-17-92

Sample Volume: 98.9 DSCF  Stack Flow Rate: 668 DSCFM

Test No. 1

**Chromium**

**Blank:**  Sample No. HHI TEST 4A, 4B

A Total Cr: <0.0005 ug/ml x 438.0 mls = < 0.22 ug Cr
B acid wash: <0.0005 ug/ml x 138.8 mls = < 0.07 ug Cr
Total = < 0.29 ug Cr

$Cr^{+6}$: 0.00018 ug/ml x 438.0 mls = 0.08 ug $Cr^{+6}$

**Total Chromium**

**Source:**  Sample No. HHI TEST 1A, 1B

A Total Cr: 0.00689 ug/ml x 539.6 mls = 3.72 ug Cr
B acid wash: <0.0005 ug/ml x 127.1 mls = < 0.07 ug Cr
Total = 3.72 ug Cr

$$\frac{(3.72)\ \text{ug} \times 35.3\ \text{SCF/m}^3}{(98.9)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 0.00133\ \text{mg/m}^3\ \text{Cr}$$

$$\frac{(3.72)\ \text{ug} \times 60\ \text{min/hr} \times (668)\ \text{DSCFM}}{(98.9)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 1.51\ \text{mg/hr Cr}$$

$$\frac{(1.51)\ \text{mg/hr}}{(50.6)\ \text{amp-hr/hr}} = 0.0298\ \text{mg/amp-hr Cr}$$

**Hexavalent Chromium**

**Source:**  Sample No. HHI TEST 1A

A $Cr^{+6}$: 0.0069 ug/ml x 539.6 mls = 3.72 ug $Cr^{+6}$

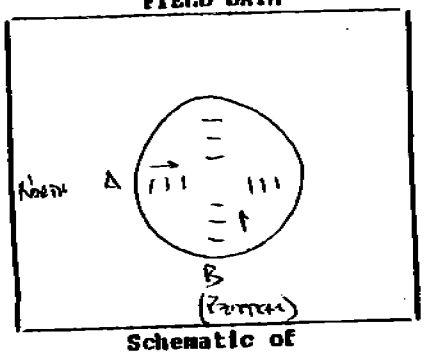
$$\frac{(3.72)\ \text{ug} \times 35.3\ \text{SCF/m}^3}{(98.9)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 0.00133\ \text{mg/m}^3\ Cr^{+6}$$

$$\frac{(3.72)\ \text{ug} \times 60\ \text{min/hr}}{(98.9)\ \text{DSCF} \times 1} \quad 1.51\ \text{mg/hr}\ Cr^{+6}$$

$$\frac{(1.51)\ \text{mg/hr}}{(50.6)\ \text{amp-h}}$$ g/amp-hr $Cr^{+6}$

## FIELD DATA

Plant NAVY NADEP
Date 3-18-92
Sampling Location CTG SCRUBBER EXHAUST
Sample Type CARB 425
Run Number Run 2
Operator HERNANDEZ/BROWN
Ambient Temperature 71
Barometric Pressure 29.77
Static Pressure ($P_g$) 1.2 -1.2
Filter Number(s) —
Pretest Leak Rate = 0.012 cfm @ 10 in. Hg
Pretest Pitot Leak Check OK
Pretest Orsat Leak Check —
Read and Record all Data Every 10 Minutes




Schematic of Traverse Point Layout

Probe Length and Type 18" SS w GLASS LINER
Pitot Tube I.D. No. S-3B
Nozzle I.D. No. & Diameter 0.383
Assumed Moisture, % 2%

Meter Box Number 1A
Meter $\Delta H_@$ 1.964
C Factor 1.15
Meter Gamma 1.004
Heater Box Setting —
Reference $\Delta p$
Post Test Leak Rate = 0.000 cfm @ ~~10~~ in. Hg
Post Test Pitot Leak Check ok
Post Test Orsat Leak Check ~~ok~~

Impinger Box No. 26 ; Blank Box No.

| Traverse Point Number | Sampling Time, (min) | Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) ft³ | Velocity Head ($\Delta P_s$) in. $H_2O$ | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Desired | Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B1 | 0 | 10:53 | 575.361 | 0.09 | 2.3 | 2.3 | 69 | 73 | 73 | 5.0 | — | 47 | 5183.7 |
| B2 | 10 | 11:03 | 583.5 | 0.09 | 2.3 | 2.3 | 69 | 78 | 74 | 5.0 | — | 47 | |
| B3 | 20 | 11:13 | 591.305 | 0.08 | 2.1 | 2.1 | 68 | 80 | 75 | 5.0 | — | 50 | |
| B4 | 30 | 11:23 | 598.970 | 0.08 | 2.1 | 2.1 | 68 | 81 | 76 | 5.0 | — | 50 | |
| B5 | 40 | 11:33 | 606.630 | 0.09 | 2.3 | 2.3 | 68 | 82 | 77 | 5.0 | — | 50 | |
| B6 | 50 | 11:43 | 614.2 | 0.08 | 2.3 | 2.3 | 68 | 82 | 77 | 5.0 | — | 89 | 5225.0 |
| A1 | 60 | 11:53/12:44 | 622.265 | 0.06 | 2.3 | 2.3 | 69 | ~~83~~ 78 | 78 | 5.0 | — | 47 | 5228.5 |
| A2 | 70 | 12:54 | 630.340 | 0.07 | 1.8 | 1.8 | 69 | 75 | 76 | 4.0 | — | 50 | |
| A3 | 80 | 13:04 | 637.490 | 0.05 | 1.25 | 1.25 | 69 | 80 | 77 | 3.0 | — | 49 | |
| A4 | 90 | 13:14 | 643.010 | 0.05 | 1.25 | 1.25 | 70 | 80 | 77 | 3.0 | — | 49 | |
| A5 | 100 | 13:24 | 649.430 | 0.06 | 1.50 | 1.50 | 69 | 80 | 77 | 3.5 | | 49 | AH: 5257.5 |
| A6 | 110 | 13:34 | 655.600 | 0.06 | 1.50 | 1.50 | 70 | 80 | 77 | 3.5 | | 49 | |
| — | 120 | 13:44 | 661.771 | | | | | | | | | | |
| | θ=120 | | $V_m$=86.410 | | | ΔH=1.92 | | | $T_m$=530 | | | | |
| | | | | $\sqrt{\Delta P}$=0.269 | | | $T_s$=529 | | | | | | |

Amps
5257.5
5183.7
73

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant: U.S. NAVY

Date: 3-18-92

Source/Sample Number: 2

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

$Vm(std) = (17.64)(86.410)(1.004)\left[\frac{(29.99) + (1.92/13.6)}{(538)}\right]$

$Vm(std) =$ 85.7 dscf.

2. Volume water vapor collected (standard conditions).

$V(lo) =$ 25.5 condensate from impingers and selica gel.

$Vw(std) = (0.04707)\ V(lo) = (0.04707)(25.5)$

$Vw(std) =$ 1.20 scf.

3. Percent moisture, by volume.

$Bw_s = \frac{Vw(std)}{Vw(std) + Vm(std)} = \frac{(1.20)}{(1.20) + (85.7)} =$ 0.0140

$Bw_s =$ 1.4 %.

4. Molecular weight, stack gas.

Dry molecular weight.

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

$Md = 0.440\ (\ __\ ) + 0.320(\ __\ ) + 0.280(\ __\ )$

$Md =$ 29.0 lb/lb-mole.

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

$Ms =$ 28.85 lb/lb-mole.

Plant: U.S. NAVY

Date: 3-18-92

Source/Sample Number: 2

5. Stack gas velocity average.

$$Vs(avg) = (85.49)(Cp)(\sqrt{\Delta P})\left[avg\sqrt{\frac{(Ts)}{(Ps)(Ms)}}\right]$$

$$Vs(avg) = (85.49)(0.84)(0.269)\left[\sqrt{\frac{(529)}{(29.90)(28.85)}}\right]$$

Vs(avg) = 15.1 ft/sec.

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

$$Qs = (60)(Vs)(A) = (60)(15.1)(0.785)$$

Qs = 711 acfm.

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

$$Q(std) = (17.64)(Qs)(1-Bw_s)\left[\frac{(Ps)}{(Ts)}\right]$$

$$Q(std) = (17.64)(711)(1-0.014)\left[\frac{(29.90)}{(529)}\right]$$

Q(std) = 699 dscfm.

8. Isokinetic variation.

$$\%I = (K)\left[\frac{(Ts)(Vm(std))}{(Ps)(Vs)(An)(\theta)(1-Bw_s)}\right]$$

$$\%I = (0.0945)\left[\frac{(529)(85.7)}{(29.90)(15.1)(0.000800)(120)(1-0.014)}\right]$$

%I = 100.2 %

CLIENT: HHI / NADEP

Project No. 4572

Sampling Location: HELO SCRUBBER EXHAUST  Test Date: 3-18-92

Sample Volume: 85.7 DSCF  Stack Flow Rate: 699 DSCFM

**Chromium**  Test No. 2

**Blank:**  Sample No. HHI TEST ~~4~~ 4A, 4B

A Total Cr: <0.0005 ug/ml x 438.0 mls = <0.22 ug Cr
B acid wash: <0.0005 ug/ml x 138.8 mls = <0.07 ug Cr
Total = <0.29 ug Cr

$Cr^{+6}$: 0.00018 ug/ml x 438.0 mls = 0.08 ug $Cr^{+6}$

**Total Chromium**

**Source:**  Sample No. HHI TEST 2A, 2B

A Total Cr: 0.00~~374~~ 476 ug/ml x 592.2 mls = 2.~~36~~ 82 ug Cr
B acid wash: <0.0005 ug/ml x 142.0 mls = <0.07 ug Cr
Total = 2.36 ug Cr

$$\frac{(2.\cancel{36}\ 82)\ \text{ug} \times 35.3\ \text{SCF/m}^3}{(85.7)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 0.00\cancel{097}\ 116\ \text{mg/m}^3\ \text{Cr}$$

$$\frac{(2.\cancel{36}\ 82)\ \text{ug} \times 60\ \text{min/hr} \times (699)\ \text{DSCFM}}{(85.7)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 1.\cancel{38}\ \text{mg/hr Cr}$$

$$\frac{(1.\cancel{38})\ \text{mg/hr}}{(\cancel{36.9}\ 35.2)\ \text{amp-hr/hr}} = 0.0\cancel{374}\ 392\ \text{mg/amp-hr Cr}$$

**Hexavalent Chromium**

**Source:**  Sample No. HHI TEST 2A

A $Cr^{+6}$: 0.0050 ug/ml x 592.2 mls = 2.96 ug $Cr^{+6}$

$$\frac{(2.96)\ \text{ug} \times 35.3\ \text{SCF/m}^3}{(85.7)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 0.00122\ \text{mg/m}^3\ Cr^{+6}$$

$$\frac{(2.96)\ \text{ug} \times 60\ \text{min/hr} \times (699)\ \text{DSCFM}}{(85.7)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 1.45\ \text{mg/hr}\ Cr^{+6}$$

$$\frac{(1.45)\ \text{mg/hr}}{(\cancel{36.9}\ 35.2)\ \text{amp-hr/hr}} = 0.0\cancel{393}\ 412\ \text{mg/amp-hr}\ Cr^{+6}$$

Plant NAVY NADEP
Date 3-18-92
Sampling Location GFG SCRUBBER EXHAUST
Sample Type CARB 425
Run Number 3
Operator BROWN
Ambient Temperature 71
Barometric Pressure 29.79
Static Pressure ($P_s$) -1.2
Filter Number(s)
Pretest Leak Rate = 0.012 cfm @ 8 in. Hg
Pretest Pitot Leak Check OK
Pretest Orsat Leak Check —
Read and Record all Data Every 10 Minutes

FIELD DATA

Schematic of Traverse Point Layout

Probe Length and Type 18" SS W/ GLASS LINER
Pitot Tube I.D. No. S-3B
Nozzle I.D. No. & Diameter 0.383
Assumed Moisture, % 2%

Meter Box Number 1A
Meter $\Delta H_@$ 1.964
C Factor 1.15
Meter Gamma 1.004
Heater Box Setting —
Reference $\Delta p$
Post Test Leak Rate = 0.007 cfm @ 5 in. Hg
Post Test Pitot Leak Check OK
Post Test Orsat Leak Check —

Impinger Box No. 3B ; Blank Box No.

| Traverse Point Number | Sampling Time, (min) | Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) ft³ | Velocity Head ($\Delta P_s$) in. $H_2O$ | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Desired | Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | 0 | 14:20 | 669.900 | 0.09 | 2.3 | 2.3 | 69 | 75 | 76 | 4.0 | — | 50 | 5257.8 |
| A2 | 10 | 14:30 | 670.000 | 0.06 | 1.4 | 1.4 | 69 | 80 | 76 | 3.0 | — | 53 | |
| A3 | 20 | 14:40 | 676.7 | 0.07 | 1.75 | 1.75 | 69 | 80 | 76 | 3.2 | — | 51 | |
| A4 | 30 | 14:50 | 683.7 | 0.08 | 2.00 | 2.00 | 69 | 81 | 77 | 3.5 | — | 51 | |
| A5 | 40 | 15:00 | 691.2 | 0.08 | 2.00 | 2.00 | 69 | 82 | 77 | 3.5 | — | 51 | |
| A6 | 50 | 15:10 | 698.7 | 0.07 | 1.75 | 1.75 | 69 | 82 | 77 | 3.2 | — | 51 | |
| B1 | 60 | 15:20/16:01 | 705.905 | 0.08 | 2.00 | 2.00 | 69 | 76 | 76 | 3.5 | — | 48 | 5282.0 |
| B2 | 70 | 16:11 | 713.4 | 0.08 | 2.00 | 2.00 | 69 | 79 | 76 | 3.5 | — | 53 | |
| B3 | 80 | 16:21 | 720.8 | 0.07 | 1.75 | 1.75 | 69 | 81 | 76 | 3.2 | — | 53 | |
| B4 | 90 | 16:31 | 727.9 | 0.07 | 1.75 | 1.75 | 69 | 81 | 77 | 3.2 | — | 53 | |
| B5 | 100 | 16:41 | 735.0 | 0.08 | 2.00 | 2.00 | 69 | 81 | 77 | 3.5 | — | 53 | |
| B6 | 110 | 16:51 | 742.0 | 0.08 | 2.00 | 2.00 | 69 | 83 | 77 | 3.5 | — | 53 | |
| END | 120 | 17:01 | 749.515 | — | — | — | — | — | — | — | — | — | 5343.5 |
| | θ=120 | | $V_m$=87.615 | | | $\Delta H$=1.89 | | | $T_m$=638 | | | | |
| | | | | $\sqrt{\Delta p}$=0.275 | | | $T_s$=529 | | | | | | |

5343.5
5257.8
85.7

PACIFIC ENVIRONMENTAL SERVICES, INC.

## SAMPLE RECOVERY DATA

Plant: NADEP

Date: 3-18-92

Sampling Location: HELO SCRUBBER EXHAUST

Sample Type: $Cr^{+6}$

Run Number: 3

Sample Box Number: 3B

Clean-up Man: BROWN

Job Number:

Comments: A = 668.8 - 116.8 = 552.0
B = 176.1 - 43.3 = 132.8

**FRONT HALF**

Filter Number:

Description of Filter: CLEAN

| MOISTURE | #1 | #2 | #3 |
|---|---|---|---|
| Impingers | | | |
| Final Volume: | 578.9 ml | 568.5 ml | 464.6 ml |
| Initial Volume: | 574.9 ml | 566.8 ml | 463.5 ml |
| Net Volume: | 4.0 ml | 1.7 ml | 1.1 ml |
| Total $H_2O$: | | | |
| Silica Gel | | | |
| Final Volume: | 692.2 g | g | g |
| Initial Volume | 678.5 g | g | g |
| Net Volume | 13.7 g | g | g |
| Total Moisture: | | | |

Description of Impinger Catch: CLEAR 20.5

Plant: U.S. NAVY

Date: 3-18-92

Source/Sample Number: 3

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

$Vm(std) = (17.64)(87.615)(1.004)\left[\frac{(29.99) + (1.89/13.6)}{(538)}\right]$

$Vm(std) =$ 86.9 dscf.

2. Volume water vapor collected (standard conditions).

$V(lo) =$ 20.5 condensate from impingers and selica gel.

$Vw(std) = (0.04707)\ V(lo) = (0.04707)(20.5)$

$Vw(std) =$ 0.96 scf.

3. Percent moisture, by volume.

$Bw_s = \frac{Vw(std)}{Vw(std) + Vm(std)} = \frac{(0.96)}{(0.96) + (86.9)} = 0.011$

$Bw_s =$ 1.1 %.

4. Molecular weight, stack gas.

Dry molecular weight.

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

$Md = 0.440\ (\ \ ) + 0.320(\ \ ) + 0.280(\ \ )$

$Md =$ 29.0 lb/lb-mole.

$Ms = Md + Bw_s\ (18 - Md) = (29) + (0.011)(18 - 29)$

$Ms =$ 28.88 lb/lb-mole.

Plant: U.S. NAVY

Date: 3-18-92

Source/Sample Number: 3

5. Stack gas velocity average.

$$Vs(avg) = (85.49)(Cp)(\sqrt{\Delta P})\left[avg\sqrt{\frac{(Ts)}{(Ps)(Ms)}}\right]$$

$$Vs(avg) = (85.49)(0.84)(0.275)\left[\sqrt{\frac{(529)}{(29.90)(28.88)}}\right]$$

Vs(avg) = 15.5 ft/sec.

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

$$Qs = (60)(Vs)(A) = (60)(15.5)(0.785)$$

Qs = 730 acfm.

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

$$Q(std) = (17.64)(Qs)(1-Bw_s)\left[\frac{(Ps)}{(Ts)}\right]$$

$$Q(std) = (17.64)(730)(1-0.011)\left[\frac{(29.90)}{(529)}\right]$$

Q(std) = 720 dscfm.

8. Isokinetic variation.

$$\%I = (K)\left[\frac{(Ts)(Vm(std))}{(Ps)(Vs)(An)(\theta)(1-Bw_s)}\right]$$

$$\%I = (0.0945)\left[\frac{(529)(86.9)}{(29.90)(15.5)(0.000800)(120)(1-0.011)}\right]$$

%I = 98.7 %

CLIENT: HHI / NADEP

Project No. 4572

Sampling Location: HELO SCRUBBER EXHAUST  Test Date: 3-18-92

Sample Volume: 86.9 DSCF  Stack Flow Rate: 720 DSCFM

Test No. 3

**Chromium**

Blank:  Sample No. HHI TEST 4A, 4B

Total Cr: <0.0005 ug/ml x 438.0 mls = <0.22 ug Cr
acid wash: <0.0005 ug/ml x 138.8 mls = <0.07 ug Cr
Total = <0.29 ug Cr

$Cr^{+6}$: 0.00018 ug/ml x 438.0 mls = 0.08 ug $Cr^{+6}$

**Total Chromium**

Source:  Sample No. HHI TEST 3A, 3B

Total Cr: 0.000865 ug/ml x 552.0 mls = 0.48 ug Cr
acid wash: <0.0005 ug/ml x 132.8 mls = <0.07 ug Cr
Total = 0.48 ug Cr

$$\frac{(0.48)\ \text{ug} \times 35.3\ \text{SCF/m}^3}{(86.9)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 0.00019\ \text{mg/m}^3\ \text{Cr}$$

$$\frac{(0.48)\ \text{ug} \times 60\ \text{min/hr} \times (720)\ \text{DSCFM}}{(86.9)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 0.239\ \text{mg/hr Cr}$$

$$\frac{(0.239)\ \text{mg/hr}}{(42.9)\ \text{amp-hr/hr}} = 0.0056\ \text{mg/amp-hr Cr}$$

**Hexavalent Chromium**

Source:  Sample No. HHI TEST 3A

$Cr^{+6}$: 0.0016 ug/ml x 552.0 mls = 0.88 ug $Cr^{+6}$

$$\frac{(0.88)\ \text{ug} \times 35.3\ \text{SCF/m}^3}{(86.9)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 0.00036\ \text{mg/m}^3\ Cr^{+6}$$

$$\frac{(0.88)\ \text{ug} \times 60\ \text{min/hr} \times (720)\ \text{DSCFM}}{(86.9)\ \text{DSCF} \times 1000\ \text{ug/mg}} = 0.44\ \text{mg/hr}\ Cr^{+6}$$

$$\frac{(0.44)\ \text{mg/hr}}{(42.9)\ \text{amp-hr/hr}} = 0.010\ \text{mg/amp-hr}\ Cr^{+6}$$

## SAMPLE RECOVERY DATA

Plant: NADEP

Date: 3-17-92

Sampling Location: HELO SCRUBBER EXHAUST

Sample Type: BLANK TRAIN Cr+6 CARB 425

Run Number: 4

Sample Box Number: 2B

Clean-up Man: BROWN

Job Number:

Comments: A 555.5 - 117.5 = 438.0
B 174.2 - 43.4 = 138.8

**FRONT HALF**

Filter Number:

Description of Filter:

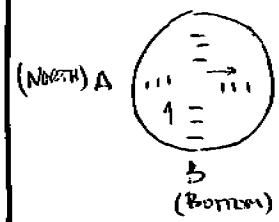
**MOISTURE**

| | | | |
|---|---|---|---|
| Impingers | | | |
| Final Volume: | 611.6 ml | 521.5 ml | 432.8 ml |
| Initial Volume: | 573.7 ml | 561.0 ml | 432.5 ml |
| Net Volume: | 37.9 ml | -39.5 ml | 0.3 ml |
| Total $H_2O$: | | | |
| Silica Gel | | | |
| Final Volume: | 750.9 g | g | g |
| Initial Volume | 750.5 g | g | g |
| Net Volume | 0.4 g | g | g |
| Total Moisture: | | | |

Description of Impinger Catch:

Plant NAVY NADEP
Date 3-18-92
Sampling Location SCRUBBER EXHAUST
Sample Type CARB 425
Run Number 2
Operator HERNANDEZ / BROWN
Ambient Temperature 68
Barometric Pressure 29.99
Static Pressure ($P_s$)
Filter Number(s)
Pretest Leak Rate = 0.005 cfm @ 10 in. Hg
Pretest Pitot Leak Check ✓
Pretest Orsat Leak Check —
Read and Record all Data Every 10 Minutes

**FIELD DATA**




Schematic of Traverse Point Layout

Probe Length and Type 18" SS w/ GLASS LINER
Pitot Tube I.D. No. S-38
Nozzle I.D. No. & Diameter 0.383
Assumed Moisture, % 2%

Meter Box Number 1A
Meter $\Delta H_@$ 1.964
C Factor 1.15
Meter Gamma 1.004
Heater Box Setting —
Reference $\Delta p$
Post Test Leak Rate = ___ cfm @ ___ in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check —

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

| Traverse Point Number | Sampling Time, (min) | Clock Time (24-hour clock) | Gas Meter Reading ($V_m$) $ft^3$ | Velocity Head ($\Delta P_s$) in. $H_2O$ | Orifice Pres. Differential ($\Delta H$) in. $H_2O$ Desired | Actual | Stack Temp. ($T_s$) °F | Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F | Outlet ($T_{m_{out}}$) °F | Pump Vacuum in. Hg | Sample Box Temp. Filter Temp. °F | Impinger Temp. °F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B 1 | 0 | 0908 | 512.275 | 0.09 | 2.3 | 2.3 | 62 | 69 | 68 | 11.0 | — | 55 |
| B 2 | 10 | 0918 | 550.560 | 0.08 | ~~1.0~~ 2.1 | 2.1 | 64 | 74 | 70 | 9.0 | — | 52 |
| B 3 | 20 | 0928 | 557.860 | 0.09 | 2.3 | 2.3 | 61 | 77 | 71 | 11.0 | — | 55 |
| B 4 | 30 | 0938 | 565.805 | 0.07 | 1.8 | 1.8 | 61 | 78 | 72 | 8.0 | — | 56 |
| B 5 | 40 | 0948 | 573.020 | 0.07 | 1.8 | 1.8 | 61 | 79 | 73 | 8.0 | — | 56 |
| B 6 | 50 | / | | | | | | | | | | |
| A 1 | 60 | / | | | | | | | | | | |
| A 2 | | / | | | | | | | | | | |
| A 3 | | / | | | | | | | | | | |
| A 4 | | / | | | | | | | | | | |
| A 5 | | / | | | | | | | | | | |
| A 6 | | / | | | | | | | | | | |
| ~~A 7~~ | | / | | | | | | | | | | |
| ~~A 8~~ | | / | | | | | | | | | | |

$P_b$: 5161.8

VOIDED TEST
Probe Line Broke @ 0949

PACIFIC ENVIRONMENTAL SERVICES, INC.

## SAMPLE RECOVERY DATA

Plant: NADEP

Date: 3-18-92

Sampling Location: HELO SCRUBBER EXHAUST

Sample Type: $Cr^{+6}$

Run Number: 2

Sample Box Number: 5B

Clean-up Man: BROWN

Job Number:

Comments: XBORT

**FRONT HALF**

Filter Number: _____ _____ _____

Description of Filter: _____

**MOISTURE**

| | #1 | #2 | #3 |
|---|---|---|---|
| Impingers | | | |
| Final Volume: | ml | ml | ml |
| Initial Volume: | 602.9 ml | 571.6 ml | 488.1 ml |
| Net Volume: | ml | ml | ml |
| Total $H_2O$: | | | |
| Silica Gel | | | |
| Final Volume: | g | g | g |
| Initial Volume | 699.9 g | g | g |
| Net Volume | g | g | g |
| Total Moisture: | | | |

Description of Impinger Catch: _____

PACIFIC ENVIRONMENTAL SERVICES, INC.

RESEARCH TRIANGLE PARK, NC
WASHINGTON, D.C.
PHILADELPHIA, PA
LOS ANGELES, CA
CINCINNATI, OH

#20892

# OUTSIDE LABORATORY ANALYSIS REQUEST

TO: WEST COAST ANALYTICAL

( )

SUBMITTAL DATE: 3-19-92

VERBAL RESULTS DATE: 4-10-92

CONTACT: S. HUGH BROWN

TELEPHONE: (818) 856-1400

**SEND ANALYSIS INVOICE TO:**

*PACIFIC ENVIRONMENTAL SERVICES, INC.*

**SEND ANALYSIS REPORT TO:**

PES SUITE 100
13100 BROOKS DR
BALDWIN PARK, CA
91706

*RE: PROJECT NO.*

| SAMPLE NUMBER | VOLUME | ANALYSIS REQUEST |
|---|---|---|
| PES/HH1 | | TOTAL Cr BY ICP/MS, $Cr^{+6}$ BY IC |
| TEST 1A | | " " |
| 2A | | " " |
| 3A | | " " |
| 4A | | " " |
| AUDIT | SAN DIEGO APCD | " " |
| PES/HH1, B | | TOTAL Cr BY ICP/MS |
| 2B | | " |
| 3B | | " |
| 4B | | " |
| | | |
| | | |
| | | |
| | | |

COMMENT: ANALYZE $Cr^{+6}$ ON 3-19-92
REPORT WITH FULL QA/QC PLEASE. #20892

CHAIN OF CUSTODY

From: S. Hugh Brown 3/19/92 To: Mary Mulcahey 3-19-92 7:4 A.

From: To:

NOTE: Write signature and date on appropriate line. Include this form within analysis report.

~~11/18/91 65M-2786 0941 0810~~
~~10 0810 Alendrite~~

11-15-91 APR 60mm NNA Fumes-60
Dwayne Rose

11-20-91 REMOVE 15 GAL chrome water
Replace with 15 GAL clean water
Dwayne Rose

2-24-91 (leak) 659-03
1ST Shift disconnected elect.
Do not operate

| | | | |
|---|---|---|---|
| 65M-2772 | 1210 - 1310 | 1-31-92 | Repholz |
| 65M-6062 | 0935 - 1035 | 2-3-92 | Repholz |
| 65M-3696 | 0915 - 1015 | 2-7-92 | Repholz |
| 65M-3696 | C. DOUCETTE LIFT TAPE ON | | |
| 65M-6396 | 1150 - 1250 | 2-10-92 | Repholz |
| 65M-3936 | 0935 - 1035 | 2-11-92 | Repholz |
| 61M-5748 | 0930 - 2130 | 2-12-92 | Delton |
| 61M-7241 | 1630 - 1730 | 2-19-92 | Delton |
| 65M-3660 | 1800 - 1900 | 2-23-92 | Delton |
| 61M-7239 | 1145 - 1245 | 2-24-92 | Repholz |
| 65M-1940 | 1310 - 1410 | 2-24-92 | Repholz |

| | | | |
|---|---|---|---|
| 61M 4255 | 1700-1800 | 2-24-92 | Delford |
| 65M 237 | 1900-2000 | 2-24-92 | Delford |
| 61M-4255 | 0710-0810 | 2-27-92 | Replogle |
| 65M-3518 | 1120-1220 | 2-27-92 | Replogle |
| 65M 3352 | 1800-1900 | 2-27-92 | Delford |
| 65M-3135 | 1345-1445 | 3-2-92 | Replogle |
| 65M 1202 | 1600-1700 | 3-2-92 | Delford |
| 61M-855 | 1220-1320 | 3-3-92 | Replogle |
| 65M-3454 | 1335-1435 | 3-3-92 | Replogle |
| 65M 1222 | 1900-2000 | 3-3-92 | Delford |
| 65M 6404 | 1800-1900 | 3-5-92 | Delford |
| 61M 5748 | 2100-2200 | 3-5-92 | Delford |
| 65M-3708 | 0650-0750 | 3-7-92 | Replogle |
| 61M-4719 | 1230-1330 | 3-7-92 | Richardson |
| 65M-1971 | 0940-1040 | 3-9-92 | Replogle |
| 61M 4107 | 1700-1800 | 3-9-92 | Delford |
| 65M 1875 | 2100-2200 | 3-9-92 | Delford |
| 65M 3882 | 1030-1130 | 3-10-92 | Richardson |
| 65M 6177 | 1600-1700 | 3-10-92 | Delford |
| 65M 788 | 07:30-08:30 | 3-12-92 | Clarke |
| 65M-6599 | 07:45-0845 | 3-13-92 | Replogle |
| 65M 611 | 2000-2100 | 3-13-92 | Delford |
| 65M 3456 | 1600-1700 | 3-14-92 | Delford |
| 65M 4424 | 1700-1800 | 3-14-92 | Delford |
| 65M-3552 | 0910-1010 | 3-18-92 | Replogle |
| 65M-6334 | 1100-1200 | 3-18-92 | Replogle |
| 65M-693 | 1240-1340 | 3-18-92 | Replogle |
| 65M-2940 | 1425-1525 | 3-8-92 | Replogle |

"SNA - K2-1

# Acid Anodize

Limits: Chromic Acid ($CrO_3$) ---- 7.0 - 13.0 oz/gal

Operating Temp ---- 50° - 95°F

*Make-up*

1) Add ½ tank of water.
2) Add 100 lbs. $CrO_3$.
3) Add water to level.

*Tank Capacity:* 150 Gallons

| Analysis: $CrO_3$ Date | | Action | Chit # | Out | In |
|---|---|---|---|---|---|
| [illegible] | | None | --- | --- | --- |
| [illegible] | | 1) Empty and clean tank. 2) Tank leaks - [illegible] welding. | 3823 | 2/27 | 2/28 |
| [illegible] | | Replace tank. | 3835 | 3/6 | 3/6 |
| [illegible] | xxxx | 1) Add ½ tank of water. 2) Add 100 lbs. of chromic acid. 3) Top-off with $H_2O$. | 3908 | 4/10 | 4/11 |
| 4/12/91 | 6.3 | Add 10 lbs. of chromic acid. | 3942 | 4/22 | 4/29 |
| 5/3/91 | 7.1 | None | --- | --- | --- |
| 6/4/91 | xxxx | 1) Empty and clean tank. 2) Add 100 lbs. of chromic acid. 3) Top-off with $H_2O$. | 4050 | 6/4 | 6/6 |
| 6/7/91 | 5.6 | 1) Add 75 lbs. of chromic acid. 2) Dump remaining 25 lbs $CrO_3$ in C3-12. | 4099 | 6/19 | 6/27 |
| 7/2/91 | 9.2 | None | --- | --- | --- |
| 8/6/91 | 9.2 | None | --- | --- | --- |
| 9/3/91 | 10.0 | None | --- | --- | --- |
| 10/1/91 | 8.4 | None | --- | --- | --- |
| 10/17/91 | 7.3 | Surface Tension - 63.64 | --- | --- | --- |

TANK # M2-1

# Chromic Acid Anodize

ts: Chromic Acid ($CrO_3$) ---- 7.0 - 13.0 oz/gal

rating Temp ------ 90° - 95°F

Make-up
1) Add ½ tank of water.
2) Add 100 lbs. $CrO_3$.
3) Add water to level.

Tank Capacity: 150 Gallons

| alysis Date | $CrO_3$ oz/gal | Surface Tension | Action | Chit # | Chit Out | Chit In |
|---|---|---|---|---|---|---|
| /23/91 | xxxx | xxxxx | Add 50 ml. of AND-FUME-GO fume suppressant. | 4325 | 10/23 | 10/23 |
| /24/91 #1 | xxxx | 48.98 | Special EPA Testing | --- | --- | --- |
| /24/91 #2 | xxxx | 53.54 | Special EPA Testing | --- | --- | --- |
| /25/91 #3 | xxxx | 48.18 | Special EPA Testing | --- | --- | --- |
| /25/91 #4 | xxxx | 49.26 | Special EPA Testing | --- | --- | --- |
| /5/91 | 7.1 | 48.56 | None | --- | --- | --- |
| /12/91 | xxxx | 55.89 | Add 100 ml. of AND-FUME-GO fume suppressant. | 4364 | 11/15 | |
| /18/91 | xxxx | 47.43 | None | --- | --- | --- |
| /26/91 | xxxx | xxxxx | Tank not in use. | xxx | xxx | xxx |
| /2/91 | xxxx | xxxxx | Tank not in use. | xxx | xxx | xxx |
| 1992 | | | | | | |
| /9/92 | xxxx | xxxxx | Tank not in use. | xxx | xxx | xxx |
| /14/92 | xxxx | xxxxx | Tank not in use. | xxx | xxx | xxx |
| /30/92 | xxxx | xxxxx | Tank not in use. | xxx | xxx | xxx |

TANK # M2-1

# Chromic Acid Anodize

Limits: Chromic Acid ($CrO_3$) ---- 7.0 - 13.0 oz/gal

Operating Temp ------ 90° - 95°F

Make-up
1) Add ½ tank of water.
2) Add 100 lbs. $CrO_3$.
3) Add water to level.

Tank Capacity: 150 Gallons

| Analysis Date | $CrO_3$ oz/gal | Surface Tension | Action | Chit # | Chit Out | Chit In |
|---|---|---|---|---|---|---|
| 2/5/92 | 9.7 | 74.9 | Added 50 ml of ANO-FUME GO. | --- | --- | --- |
| 2/19/92 | xxxx | 71.8 | Told by Code 670 not to add fume suppressant for now. | --- | --- | --- |
| 2/26/92 | xxxx | 71.5 | Added 100 ml of ANO-FUME GO. | --- | --- | --- |
| 3/3/92 | 10.9 | 73.6 | None | --- | --- | --- |
| 3/11/92 | xxxx | 71.2 | None | --- | --- | --- |

# APPENDIX C

## Laboratory Analyses
## QA/QC Package

WCAS
WEST COAST ANALYTICAL SERVICE, INC.
ANALYTICAL CHEMISTS

March 26, 1992

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

Attn: S. Hugh Brown

JOB NO. 20892 S

# LABORATORY REPORT

Samples Received: Nine (9) Liquid Samples
Date Received: 3-19-92
Purchase Order No: Proj#: 4572.000

The samples were analyzed as follows:

| Samples Analyzed | Analysis | Results |
|---|---|---|
| Nine (9) liquids | Cr(VI) by SCAQMD 205.1 | Table 1 |
| Nine (9) liquids | Total Chrome by ICPMS | Table 2 |

Enclosure: Data Package



Michael Shelton
Technical Director

D. J. Northington, Ph.D.
President

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

WEST COAST ANALYTICAL SERVICE, INC.

PACIFIC ENVIRONMENTAL SERVICES
Mr. S. Hugh Brown

Job #20892
March 26, 1992

LABORATORY REPORT

Table 1

Hexavalent Chromium by AQMD 205.1

| Sample ID | Parts Per Billion (ug/L) |
|---|---|
| PES/HHI Audit | 42 |
| PES/HHI Test 1A | 6.9 |
| PES/HHI Test 2A | 5.0 |
| PES/HHI Test 3A | 1.6 |
| PES/HHI Test 4A | 0.18 |
| Detection Limit: | 0.01 |

Date(s) Analyzed: 3-19-92

Matrix Spike/Matrix Spike Duplicate Recovery Summary

Client: Pacfic Environmental Service
Job No.: 20892
Date(s) Analyzed: 3-19-92

Sample: Test 4A
Matrix: Impinger
Units : ppb (ug/L)
Method: AQMD 205.1

| Analyte | Sample Result | Amount Spiked | MS Result | % Rec MS | MSD Result | % Rec MSD | RPD |
|---|---|---|---|---|---|---|---|
| Hexavalent Chromium | 0.183 | 2.5 | 2.62 | 97 | 2.67 | 99 | 2 |

QC Limits

| Analyte | RPD Warning | RPD Control | % Recovery Warning | | % Recovery Control | |
|---|---|---|---|---|---|---|
| Hexavalent Chromium | 8 | 12 | 87 | 114 | 80 | 120 |

WEST COAST ANALYTICAL SERVICE, INC.

PACIFIC ENVIRONMENTAL SERVICES
Mr. S. Hugh Brown

Job #20892
March 26, 1992

LABORATORY REPORT

Table 2

Total Chromium by ICPMS

Parts Per Million (mg/L)

Calc'd Summ

| File | Sample ID | Run 1 | Run 2 | Average |
|---|---|---|---|---|
| 12 | Audit | 0.0355 | 0.036 | 0.03575 |
| 13 | PES/HHI Test1B | ND | ND | ND |
| 14 | PES/HHI Test2A | 0.00392 | 0.00405 | 0.003985 |
| 15 | PES/HHI Test2B | ND | ND | ND |
| 16 | PES/HHI Test3A | 0.00083 | 0.0009 | 0.000865 |
| 17 | PES/HHI Test1A | 0.00676 | 0.00702 | 0.00689 |
| 18 | PES/HHI Test1A DUP | 0.0095 | 0.0095 | 0.0095 |
| 19 | PES/HHI Test1A MS | 0.104 | 0.106 | 0.105 |
| 20 | PES/HHI Test1A MSD | 0.104 | 0.104 | 0.104 |
| 23 | PES/HHI Test3B | ND | ND | ND |
| 24 | PES/HHI Test4A | ND | ND | ND |
| 25 | PES/HHI Test4B | ND | ND | ND |
| 30 | PES/HHI Test2A | 0.00479 | 0.00472 | 0.004755 |
| 31 | PES/HHI Test2A+.10 | 0.0985 | 0.0965 | 0.0975 |
| 32 | PES/HHI Test2A+.25 | 0.219 | 0.217 | 0.218 |
| 33 | PES/HHI Test2A+.50 | 0.488 | 0.493 | 0.4905 |
| 34 | PES/HHI Test2A+.75 | 0.737 | 0.727 | 0.732 |

Job Number: 20892
Date Recieved: 03-19-92
Date Prepared: 03-23-92
Date Analyzed: 03-23-92
Instrument ID: ICPMS
Matrix: liquid

Detection Limit: 0.0005



WCAS

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Total Chromium by ICPMS
Date Analyzed: 3-23-92


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PACIFIC ENVIRONMENTAL SERVICES, INC.

#20892

RESEARCH TRIANGLE PARK, NC
WASHINGTON, D.C.
PHILADELPHIA, PA
LOS ANGELES, CA
CINCINNATI, OH

01

# OUTSIDE LABORATORY ANALYSIS REQUEST

TO: WEST COAST ANALYTICAL

SUBMITTAL DATE: 3-19-92

VERBAL RESULTS DATE: 4-10-92

CONTACT: S. HUGH BROWN

TELEPHONE: (818) 856-1400

SEND ANALYSIS INVOICE TO:

PACIFIC ENVIRONMENTAL SERVICES, INC.

SEND ANALYSIS REPORT TO:

PES SUITE 100
13100 BROOKS DR
BALDWIN PARK, CA
91706

RE: PROJECT NO.

| SAMPLE NUMBER | VOLUME | ANALYSIS REQUEST |
|---|---|---|
| PES/HH1 | | TOTAL Cr BY ICP/MS, $Cr^{+6}$ BY IC |
| TEST 1A | | " " |
| 2A | | " " |
| 3A | | " " |
| 4A | | " " |
| AUDIT | SAN DIEGO APCD | " " |
| PES/HH1/B | | TOTAL Cr BY ICP/MS |
| 2B | | " |
| 3B | | " |
| 4B | | " |
| | | |
| | | |
| | | |
| | | |

COMMENT: ANALYZE $Cr^{+6}$ ON 3-19-92
REPORT WITH FULL QA/QC PLEASE. #20892

CHAIN OF CUSTODY

From: S. Hugh Brown 3/19/92 To: Mary Mulcahey 3-19-92 7:40 A.M.

From: To:

NOTE: Write signature and date on appropriate line. Include this form within analysis report.

## METHOD SUMMARY

50ml of impinger sample are digested with 3ml of nitric acid at 120°C for two hours. To the digests are added 0.5ml of internal standards, and the digests are made up to a final volume of 50ml. The digests are analyzed by ICPMS by scanning mass 52 for Chromium and mass 45 for Scandium (internal standard).

## NON-CONFORMANCE SUMMARY

The sample/duplicate RPD was 31.87. However, since the results were less than twenty times detection limit, RPD's larger than the control limit (25%) are expected. One of the two intergrations for the last LCS (run #26) was out of control.

The concentration in Test 2A predicted from standard additions did not agree well with that calculated from the calibration curve. However, the concentration from the calibration curve is expected to be more accurate because the standard addition amounts were large compared to the original concentration. All other QC parameters were in control.

# TOTAL CHROMIUM METHOD BLANK SUMMARY

Laboratory: West Coast Analytical Service

Matrix_____ liquid
Date Prepared_____ 03-23-92
Date Analyzed_____ 03-23-92
Instrument ID_____ ICPMS
Units_____ mg/L

| File: 111 | Result | Detection limit |
|---|---|---|
| Total chromium | ND | 0.0005 |

This blank applies to the following samples:

Audit
PES/HHI Test1B
PES/HHI Test2A
PES/HHI Test2B
PES/HHI Test3A
PES/HHI Test1A
PES/HHI Test1Adup
PES/HHI Test1Ams
PES/HHI Test1Amsd
PES/HHI Test3B
PES/HHI Test4A
PES/HHI Test4B
PES/HHI Test2A
PES/HHI Test2A+.1
PES/HHI Test2A+.25
PES/HHI Test2A+.5
PES/HHI Test2A+.75

Sample: PES/HHI Test1A

TOTAL CHROMIUM DUPLICATE/MS/MSD RESULTS

Laboratory Name: West Coast Analytical Service

| | |
|---|---|
| Matrix | liquid |
| Date Received | 03-19-92 |
| Date Prepared | 03-23-92 |
| Date Analyzed | 03-23-92 |
| Instrument | ICPMS |
| Units | mg/L |

| | |
|---|---|
| Sample Result: | 0.00689 |
| Duplicate: | 0.0095 |
| Matrix Spike: | 0.105 |
| Matrix Spike Dup: | 0.104 |
| Spike Level: | 0.100 |
| Detection Limit: | 0.0005 |
| Sample/Duplicate RPD: | 31.8% ** |
| Matrix Spike Recovery: | 96.8% |
| Matrix Spike Dup Recovery: | 95.8% |
| Matrix Spike/Matrix Spike Dup RPD | 1.0% |

** The sample duplicate results were less than 20 times the detection limit. RPDs larger than the control limit (25%) are expected at low concentrations.

# TOTAL CHROMIUM CALIBRATION SUMMARY

Laboratory: West Coast Analytical Service

Date Analyzed_____03-23-92

Instrument ID_____ICPMS

## INITIAL CALIBRATION SUMMARY

| File: | Total Cr ug/mL | Area Cnts m/z 52 |
|---|---|---|
| 21 | 0 | 0 |
| 51 | 1 | 580833 |
| 61 | 0.1 | 60017 |
| 71 | 0.01 | 5897 |

Correlation coefficient, r^2: 0.999989
Total Cr (ppm)= 1.72E-06 * Area +( -0.0011 )

The Area in this equation is that calculated after correction for IS recovery, then subtracting the Cali Blk. The raw peak integrals are proportional to the areas saved in the ASCII files from which this data is taken.

## CONTINUING CALIBRATION SUMMARY

| File no. | Concentration | % Error |
|---|---|---|
| 211 | 0.0945 | -5.5% |
| 212 | 0.0971 | -2.9% |
| 281 | 0.0985 | -1.5% |
| 282 | 0.099 | -1.0% |
| 361 | 0.0927 | -7.3% |
| 362 | 0.0955 | -4.5% |

TOTAL CHROMIUM LABORATORY CONTROL STANDARD SUMMARY

Laboratory: West Coast Analytical Service

Date Analyzed_____ 03-23-92
Instrument ID_____ ICPMS
LCS Sample ID_____ USGS T111
True Value_____ 0.0258 +/- 0.003
Units_____ Parts per million (mg/L)

| File no. | Result | % Error | |
|---|---|---|---|
| 81 | 0.024 | -7.0% | |
| 82 | 0.024 | -7.0% | |
| 261 | 0.0231 | -10.5% | |
| 262 | 0.0223 | -13.6% | ** |

# CHROMIUM

## STANDARD ADDITIONS

Job Number: 20892
Date Recieved: 03-19-92
Date Prepared: 03-23-92
Date Analyzed: 03-23-92
Instrument ID: ICPMS
Matrix: liquid

| File | Sample | (X) mg/L added | IS Corr Response Run 1 | Run 2 | (Y) Respor |
|---|---|---|---|---|---|
| 30 | PES/HHI Test2A | 0.00 | 4145 | 4103 | 4124 |
| 31 | PES/HHI Test2A+.1 | 0.10 | 58664 | 57350 | 58007 |
| 32 | PES/HHI Test2A+.25 | 0.25 | 128164 | 126725 | 127444 |
| 33 | PES/HHI Test2A+.5 | 0.50 | 284493 | 287252 | 285872 |
| 34 | PES/HHI Test2A+.75 | 0.75 | 428664 | 423173 | 425919 |

Regression Output:

| | |
|---|---|
| Constant | -1260.17 |
| Std Err of Y Est | 8614.009 |
| R Squared | 0.998149 |
| No. of Observations | 5 |
| Degrees of Freedom | 3 |
| X Coefficient(s) | 567291.9 |
| Std Err of Coef. | 14104.28 |

| Amt Added | Predicted Response |
|---|---|
| 0.10 | 55469 |
| 0.25 | 140563 |
| 0.50 | 282386 |
| 0.75 | 424209 |
| 0 | -1260 |
| 0.002221 | 0 |

Response=567291.9 * Amt Added + -1260.17

When Response = 0

Amt Added = 0.002221

2A
0.0095 predicted MSA

Concentration:

Predicted from MSA X= -0.00222 mg/L

From Calib Curve X= 0.004755 mg/L

Ratio (MSA/Calib) -0.47

Note: Since the amounts added were much larger than the original sample concentration, the amount from the calib curve is thought to be more accurate.

Job Number: 20892
Date Recieved: 03-19-92
Date Prepared: 03-23-92
Date Analyzed: 03-23-92
Instrument ID: ICPMS
Matrix: liquid

Detection Limit: 0.0005

TOTAL CHROMIUM, mg/L

| File | Sample ID | Run 1 | Run 2 | Average |
|---|---|---|---|---|
| 12 | Audit | 0.0355 | 0.036 | 0.03575 |
| 13 | PES/HHI Test1B | ND | ND | ND |
| 14 | PES/HHI Test2A | 0.00392 | 0.00405 | 0.003985 |
| 15 | PES/HHI Test2B | ND | ND | ND |
| 16 | PES/HHI Test3A | 0.00083 | 0.0009 | 0.000865 |
| 17 | PES/HHI Test1A | 0.00676 | 0.00702 | 0.00689 |
| 18 | PES/HHI Test1Adup | 0.0095 | 0.0095 | 0.0095 |
| 19 | PES/HHI Test1Ams | 0.104 | 0.106 | [illegible] |
| 20 | PES/HHI Test1Amsd | 0.104 | 0.104 | |
| 23 | PES/HHI Test3B | ND | ND | |
| 24 | PES/HHI Test4A | ND | ND | ND |
| 25 | PES/HHI Test4B | ND | ND | ND |
| 30 | PES/HHI Test2A | 0.00479 | 0.00472 | 0.004755 |
| 31 | PES/HHI Test2A+.1 | 0.0985 | 0.0965 | 0.0975 |
| 32 | PES/HHI Test2A+.25 | 0.219 | 0.217 | 0.218 |
| 33 | PES/HHI Test2A+.5 | 0.488 | 0.493 | 0.4905 |
| 34 | PES/HHI Test2A+.75 | 0.737 | 0.727 | 0.732 |

$Cr_2(f)$
Summ.

3/23/92
032392

tuning
mnt 620,100
run 620,100

deadtime=20
2 runs/sample

EM=CR2
WASH=160
UP=70

0892a

1) Cali blank 0317-295-1
2) Cali
3) Std 1b 0131-283-1
4) Std 2b 0311-293-2
5) Std 3b 0311-253-3 1ppm
*6) Std 4b 0312-294-2 .1
7) Std 5b 1227-273-3 .01
8) T111 USGS 0312-294-3
9) Cali
10) Cali
11) 20892 PES Blank 50/50 $HNO_3$ Cr
12) Audit
13) PES/HHI Test 1B
14) PES/HHI Test 2A
15) PES/HHI Test 2B
16) PES/HHI Test 3A
17) PES/HHI Test 1A
18) PES/HHI Test 1A dup
19) PES/HHI Test 1A ms
20) PES/HHI Test 1A msd
*21) Std 4b CCV
22) Cali
23) 20892 PES PES/HHI Test 3B 50/50 $HNO_3$ Cr
24) PES/HHI Test 4A
25) PES/HHI Test 4B
26) T111 SRM
27) Cali
*28) Std 4b CCV
29) Cali
30) 20892 PES PES/HHI Test 2A 50/50 $HNO_3$ Cr
31) PES/HHI Test 2A+100ppb Cr spike
32) PES/HHI Test 2A+250ppb Cr spike
33) PES/HHI Test 2A+500ppb Cr spike

continued on pg 256

Continued from pg 255

34) 20892 PES PES/HI Test 2A +75 ppb Cr spike 50/50 $HNO_3$ Cr
35) Cu Li
* 36) Std 4/6 CCV

CRMSA
10-30-91

Run Name: 0892a
1st Samp: 1
Last Samp: 36
IS Corr File: 61

Repeats: 2
Diln Fact 1
Det Lim: 0.0005
FWT File:817H
MB File: 111
MB Res: 0.0005
PQ(Tor2):T

| File: | Raw Areas Sc 45 | Raw Areas Cr 52 | IS Corr 367336 Cr 52 | CB SUB 424 Cr 52 |
|---|---|---|---|---|
| 11 | 332805 | 211 | 233 | 0 |
| 12 | 338113 | 233 | 253 | 0 |
| 21 | 338167 | 390 | 424 | 0 |
| 22 | 342378 | 310 | 333 | 0 |
| 31 | 313331 | 2546821 | 2985785 | 2985361 |
| 32 | 303270 | 2511526 | 3042088 | 3041664 |
| 41 | 336818 | 415 | 453 | 29 |
| 42 | 354422 | 413 | 428 | 4 |
| 51 | 342336 | 541698 | 581257 | 580833 |
| 52 | 342944 | 543987 | 582678 | 582255 |
| 61 | 367336 | 60441 | 60441 | 60017 |
| 62 | 373263 | 61715 | 60735 | 60311 |
| 71 | 399410 | 6872 | 6320 | 5897 |
| 72 | 403985 | 6655 | 6051 | 5628 |
| 81 | 365917 | 14971 | 15029 | 14605 |
| 82 | 362564 | 14778 | 14973 | 14549 |
| 91 | 373104 | 280 | 276 | 0 |
| 92 | 370640 | 313 | 310 | 0 |
| 101 | 365084 | 256 | 258 | 0 |
| 102 | 367459 | 283 | 283 | 0 |
| 111 | 415479 | 303 | 268 | 0 |
| 112 | 420186 | 294 | 257 | 0 |
| 121 | 410134 | 24552 | 21990 | 21566 |
| 122 | 403711 | 24443 | 22241 | 21817 |
| 131 | 391773 | 1635 | 1533 | 1109 |
| 132 | 393683 | 1647 | 1537 | 1113 |
| 141 | 435540 | 4315 | 3639 | 3216 |
| 142 | 447521 | 4522 | 3712 | 3288 |
| 151 | 455980 | 1713 | 1380 | 956 |
| 152 | 464421 | 1718 | 1359 | 935 |
| 161 | 464798 | 2330 | 1841 | 1418 |
| 162 | 468710 | 2407 | 1886 | 1463 |
| 171 | 460114 | 6619 | 5284 | 4861 |
| 172 | 464166 | 6868 | 5435 | 5012 |
| 181 | 452438 | 8460 | 6869 | 6445 |
| 182 | 456325 | 8529 | 6866 | 6442 |
| 191 | 433283 | 72724 | 61655 | 61232 |
| 192 | 426458 | 72948 | 62835 | 62411 |
| 201 | 411326 | 68897 | 61529 | 61105 |
| 202 | 412064 | 68935 | 61452 | 61029 |
| 211 | 426988 | 65015 | 55932 | 55508 |
| 212 | 421391 | 65876 | 57426 | 57002 |
| 221 | 420972 | 251 | 219 | 0 |

| | | | | |
|---|---|---|---|---|
| 222 | 417805 | 239 | 210 | 0 |
| 231 | 408010 | 912 | 821 | 397 |
| 232 | 408728 | 950 | 854 | 430 |
| 241 | 362067 | 685 | 695 | 271 |
| 242 | 365005 | 755 | 760 | 336 |
| 251 | 395657 | 464 | 431 | 7 |
| 252 | 393674 | 528 | 493 | 69 |
| 261 | 400507 | 15794 | 14486 | 14062 |
| 262 | 399255 | 15219 | 14002 | 13579 |
| 271 | 382263 | 278 | 267 | 0 |
| 272 | 384834 | 259 | 247 | 0 |
| 281 | 377142 | 59790 | 58235 | 57812 |
| 282 | 377654 | 60356 | 58707 | 58283 |
| 291 | 388583 | 278 | 263 | 0 |
| 292 | 391972 | 275 | 258 | 0 |
| 301 | 337233 | 3805 | 4145 | 3721 |
| 302 | 335487 | 3747 | 4103 | 3679 |
| 311 | 340487 | 54376 | 58664 | 58240 |
| 312 | 341560 | 53326 | 57350 | 56927 |
| 321 | 328747 | 114700 | 128164 | 127740 |
| 322 | 332813 | 114815 | 126725 | 126301 |
| 331 | 325895 | 252398 | 284493 | 284069 |
| 332 | 326328 | 255184 | 287252 | 286828 |
| 341 | 318332 | 371479 | 428664 | 428241 |
| 342 | 323843 | 373069 | 423173 | 422750 |
| 351 | 378096 | 255 | 248 | 0 |
| 352 | 382903 | 288 | 276 | 0 |
| 361 | 377112 | 56343 | 54882 | 54459 |
| 362 | 376056 | 57824 | 56483 | 56060 |

Calibration Summary:

| File | Cr(ppm) | Area |
|---|---|---|
| 21 | 0 | 0 |
| 51 | 1 | 580833 |
| 61 | 0.1 | 60017 |
| 71 | 0.01 | 5897 |

Regression Output:

| | |
|---|---|
| Constant | -0.00111 |
| Std Err of Y Est | 0.001939 |
| R Squared | 0.999989 |
| No. of Observations | 4 |
| Degrees of Freedom | 2 |
| X Coefficient(s) | 1.72E-06 |
| Std Err of Coef. | 0.000000 |

Cr(ppm)= 1.72E-06 *CrArea+( -0.0011 )

Meth Blk= 0.0005

[For Prep Samples/Not STDS or LCS]

| File: | Cr ppm (eq above) | Cr ppm MB Sub | Dil Fact | Total Cr (Tot ug) |
|---|---|---|---|---|
| 11 | 0 | ND | 1 | ND |
| 12 | 0 | ND | 1 | ND |
| 21 | 0 | ND | 1 | ND |
| 22 | 0 | ND | 1 | ND |
| 31 | 5.14 | 5.14 | 1 | 5.14 |
| 32 | 5.24 | 5.24 | 1 | 5.24 |
| 41 | -0.00106 | ND | 1 | ND |
| 42 | -0.00111 | ND | 1 | ND |
| 51 | 1 | 1 | 1 | 1 |
| 52 | 1 | 1 | 1 | 1 |
| 61 | 0.102 | 0.102 | 1 | 0.102 |
| 62 | 0.103 | 0.103 | 1 | 0.103 |
| 71 | 0.009 | 0.0085 | 1 | 0.0085 |
| 72 | 0.00958 | 0.00808 | 1 | 0.00808 |
| 81 | 0.024 | 0.0235 | 1 | 0.0235 |
| 82 | 0.024 | 0.0235 | 1 | 0.0235 |
| 91 | 0 | ND | 1 | ND |
| 92 | 0 | ND | 1 | ND |
| 101 | 0 | ND | 1 | ND |
| 102 | 0 | ND | 1 | ND |
| 111 | 0 | ND | 1 | ND |
| 112 | 0 | ND | 1 | ND |
| 121 | 0.036 | 0.0355 | 1 | 0.0355 |
| 122 | 0.0365 | 0.036 | 1 | 0.036 |
| 131 | 0.00079 | ND | 1 | ND |
| 132 | 0.0008 | ND | 1 | ND |
| 141 | 0.00442 | 0.00392 | 1 | 0.00392 |
| 142 | 0.00455 | 0.00405 | 1 | 0.00405 |
| 151 | 0.00053 | ND | 1 | ND |
| 152 | 0.00049 | ND | 1 | ND |
| 161 | 0.00133 | 0.00083 | 1 | 0.00083 |
| 162 | 0.0014 | 0.0009 | 1 | 0.0009 |
| 171 | 0.00726 | 0.00676 | 1 | 0.00676 |
| 172 | 0.00752 | 0.00702 | 1 | 0.00702 |
| 181 | 0.01 | 0.0095 | 1 | 0.0095 |
| 182 | 0.01 | 0.0095 | 1 | 0.0095 |
| 191 | 0.104 | 0.104 | 1 | 0.104 |
| 192 | 0.106 | 0.106 | 1 | 0.106 |
| 201 | 0.104 | 0.104 | 1 | 0.104 |
| 202 | 0.104 | 0.104 | 1 | 0.104 |
| 211 | 0.0945 | 0.094 | 1 | 0.094 |
| 212 | 0.0971 | 0.0966 | 1 | 0.0966 |
| 221 | 0 | ND | 1 | ND |

| | | | | |
|---|---|---|---|---|
| 222 | 0 | ND | 1 | ND |
| 231 | -0.00043 | ND | 1 | ND |
| 232 | -0.00037 | ND | 1 | ND |
| 241 | -0.00065 | ND | 1 | ND |
| 242 | -0.00053 | ND | 1 | ND |
| 251 | -0.00110 | ND | 1 | ND |
| 252 | -0.00099 | ND | 1 | ND |
| 261 | 0.0231 | 0.0226 | 1 | 0.0226 |
| 262 | 0.0223 | 0.0218 | 1 | 0.0218 |
| 271 | 0 | ND | 1 | ND |
| 272 | 0 | ND | 1 | ND |
| 281 | 0.0985 | 0.098 | 1 | 0.098 |
| 282 | 0.099 | 0.0985 | 1 | 0.0985 |
| 291 | 0 | ND | 1 | ND |
| 292 | 0 | ND | 1 | ND |
| 301 | 0.00529 | 0.00479 | 1 | 0.00479 |
| 302 | 0.00522 | 0.00472 | 1 | 0.00472 |
| 311 | 0.099 | 0.0985 | 1 | 0.0985 |
| 312 | 0.097 | 0.0965 | 1 | 0.0965 |
| 321 | 0.219 | 0.219 | 1 | 0.219 |
| 322 | 0.217 | 0.217 | 1 | 0.217 |
| 331 | 0.488 | 0.488 | 1 | 0.488 |
| 332 | 0.493 | 0.493 | 1 | 0.493 |
| 341 | 0.737 | 0.737 | 1 | 0.737 |
| 342 | 0.727 | 0.727 | 1 | 0.727 |
| 351 | 0 | ND | 100 | ND |
| 352 | 0 | ND | 100 | ND |
| 361 | 0.0927 | 0.0922 | 100 | 9.22 |
| 362 | 0.0955 | 0.095 | 100 | 9.5 |

ICPMS
RECORD OF SAMPLE PREPARATION

PAGE : 1 OF 1

DATE : 20-Mar-92 JOB # : 20892 CLIENT :PES

ANALYSIS : Cr PREPED BY AR

SAMPLE MATRIX : WATER NITRIC ACID - DIGEST

| SAMPLE ID NUMBER | SAMPLE DESCRIPTION | QC |
|---|---|---|
| PES/HHI Test 1A | Impinger soln | |
| PES/HHI Test 1A DUP | Impinger soln | |
| * PES/HHI Test 1A MS | Impinger soln | |
| * PES/HHI Test 1A MSD | Impinger soln | |
| PES/HHI Test 2A | Impinger soln | |
| PES/HHI Test 2A MSA → | Impinger soln → MSA | 100ml → 100ml (1.0g IS) |
| PES/HHI Test 3A | Impinger soln | |
| PES/HHI Test 4A | Impinger soln | use 100ppm Cr spike 01H-276 |
| AUDIT | Impinger soln | |
| PES/HHI Test 1B | Impinger soln | 20ml 20µl (100ppb) |
| PES/HHI Test 2B | Impinger soln | 20ml 50µl (250ppb) |
| PES/HHI Test 3B | Impinger soln | 20ml 100µl (500ppb) |
| PES/HHI Test 4B | Impinger soln | 20ml 150µl (750ppb) |

SAMPLE PREP PROCEDURE :

SAMPLE QUANTITY : 50 ml

To 50 grams of the sample is added 3 ml HNO3 in a beaker. The sample is heated on a hotplate for 2 hours at 120C. 0.5 ml internal standard is added and the sample is brought to 50 grams with 18 megohm water.

NOTES - *MS/MSD spiked with 50µl of 100ppm CAMA 0117-278-3
CAMB 0131-282-2

Hexavalent Chromium
Analyzed: 3/19/1992
Job Number(s): 20,892

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OL(6)
THC 6.Tab

6+ 4 + 2 (2)

01

PACIFIC ENVIRONMENTAL SERVICES, INC.

#20892

RESEARCH TRIANGLE PARK NC
WASHINGTON D.C.
PHILADELPHIA PA
LOS ANGELES CA
CINCINNATI OH

# OUTSIDE LABORATORY ANALYSIS REQUEST

TO: WEST COAST ANALYTICAL

( )

SUBMITTAL DATE: 3-19-92

VERBAL RESULTS DATE: 4-10-92

CONTACT: S. HUGH BROWN

TELEPHONE: (818) 856-1400

**SEND ANALYSIS INVOICE TO:**

PACIFIC ENVIRONMENTAL SERVICES, INC.

**SEND ANALYSIS REPORT TO:**

PES SUITE 100
13100 BROOKS DR
BALDWIN PARK, CA
91706

RE: PROJECT NO.

| SAMPLE NUMBER | VOLUME | ANALYSIS REQUEST | |
|---|---|---|---|
| PES/HH1 | | TOTAL Cr BY ICP/MS, | $Cr^{+6}$ BY IC |
| TEST 1A | | " | " |
| 2A | | " | " |
| 3A | | " | " |
| 4A | | " | " |
| AUDIT | SAN DIEGO APCD | " | " |
| PES/HH1 1B | | TOTAL Cr BY ICP/MS | |
| 2B | | " | |
| 3B | | " | |
| 4B | | " | |
| | | | |
| | | | |
| | | | |
| | | | |

COMMENT: ANALYZE $Cr^{+6}$ ON 3-19-92
REPORT WITH FULL QA/QC PLEASE. #20892

CHAIN OF CUSTODY

From: S. Hugh Brown 3/19/92 To: Mary Montenegro 3-19-92 7:40 A.M.

From: To:

C-2

## METHODOLOGY REVIEW

Analyses of air samples collected for hexavalent chromium analyses are performed using ion chromatography. Impinger samples are filtered prior to analysis; cassette filters are prepared by leaching with 20 millimolar sodium bicarbonate buffer overnight, followed by filtration. The hexavalent chromium in the samples is separated chromatographically and derivatized using an acidified 1,5-diphenylcarbohydrazide solution, which forms a red complex with Cr(VI). This complex is then detected spectrophotometrically at 520 nm. Quantitation is performed using external standards with a five-point calibration from 0.02 to 5.0 ppb

Total chromium analyses are performed using Inductively Coupled Plasma/Mass Spectrometry (ICPMS). Cassette filters or accurately weighed portions of high volume filters are digested in concentrated nitric acid for two hours. The digestates are filtered, internal standard is added, the digestates brought to a final volume of 50 ml. These are then analyzed using ICPMS, monitoring mass 52 for Cr and mass 45 for Sc (internal standard). Quantitation is preformed using internal standards with a multi-point calibration.

## NON-CONFORMANCE SUMMARY

Sample injection #8 was analyzed in error and is not included in this package.

# HEXAVALENT CHROMIUM METHOD BLANK SUMMARY

Laboratory: West Coast Analytical Service

Matrix_____Impinger Solution
Date Prepared_____3-19-92
Date Analyzed_____3-19-92
Instrument ID_____IC
Units_____Parts per billion (ug/L)

| File No. | 6 | Result | Detection limit |
|---|---|---|---|
| Hexavalent chromium | | ND | 0.01 |

This blank applies to the following samples:

Audit
Test 1A
Test 2A
Test 3A
Test 4A

HEXAVALENT CHROMIUM LABORATORY CONTROL STANDARD SUMMARY

Laboratory: West Coast Analytical Service

Date Analyzed_____ 3-19-92
Instrument ID_____ IC
True Value_____ 1.0
Units_____ Parts per billion (ug/L)

| File no. | Result | % Error |
|---|---|---|
| 7 | 1.05 | 5.0% |

Sample: Test 4A

HEXAVALENT CHROMIUM DUPLICATE/MS/MSD RESULTS

Laboratory Name: West Coast Analytical Service

Matrix Impinger Solution
Date Received 3-19-92
Date Prepared 3-19-92
Date Analyzed 3-19-92
Instrument IC
Units Parts per billion (ug/L)

| | |
|---|---|
| Sample Result: | 0.18 |
| Matrix Spike: | 2.6 |
| Matrix Spike Dup: | 2.7 |
| Spike Level: | 2.5 |

| | |
|---|---|
| Matrix Spike Recovery: | 96.8% |
| Matrix Spike Dup Recovery: | 100.8% |
| Matrix Spike/Matrix Spike Dup RPD | 3.8% |

Client: Pacific Environmental Services
Job no.: 20892

Date(s) Prepared: 3-19-92 Matrix: Impinger

Date(s) Analyzed: 3-19-92 Inst ID: IC

| Sample ID | Hexavalent Chromium Parts per billion |
|---|---|
| Audit | 42 |
| Test 1A | 6.9 |
| Test 2A | 5 |
| Test 3A | 1.6 |
| Test 4A | 0.18 |

Audit Cr(6) lab sum

Detection Limit 0.01

3-19-92 JM

Hex Chrom Syst 2

07

Column: AS7, NG-1 Inj: 75 µl
Flow: 1.7 ml/min Pressure: 760 psi

| File # | Job # | Client | Sample ID | Dilution |
|---|---|---|---|---|
| 3190E001.D01 | | | Method SR (5 ppb) | 1107-295 |
| D02 | | | Method SR (1 ppb) | 1107-296 |
| D03 | | | Method SR (0.5 ppb) | 1107-297 |
| D04 | | | Method SR (0.05 ppb) | 1107-298 |
| D05 | | | Method IR (0.02 ppb) | 1107-299 |
| D06 | | | Method Blank | ~~1107-294~~ |
| D07 | | | 1.0 ppb FCV | 1107-29 |
| D08 | 20892 | PES | HH1-1B | 1 |
| D09 | | | TEST 1A | 1 |
| D10 | | | TEST 2A | 1 |
| D11 | | | TEST 3A | 1 |
| D12 | | | TEST 4A | 1 |
| D13 | | | TEST 1A | 10 |
| D14 | | | TEST 4A 2.5 ppb MS | 1 |
| D15 | | | TEST 4A 2.5 ppb MSD | 1 |
| D16 | | | Audit | 100 |
| D17 | | | Audit | 10 |
| D18 | | | 0.5 ppb Std | 1107-298 |
| D19 | 20892 | PES | TEST 4A + 0.5 ppb | 1 |
| D20 | | | TEST 4A + 1.0 ppb | 1 |
| D21 | | | TEST 4A + 1.5 ppb | 1 |
| D22 | | | TEST 4A + 2.0 ppb | 1 |
| D23 | | | 0.5 ppb Std | |

D-Lab
3-24-92
6-303-3
6-303-2
6-304-1
100
100
1000
0000
000
000
00

DIONEX SCHEDULE - C:\DX\SCHEDULE\MCLAREN.SCH

| Inj# | Sample Name | Method | Data File | Vol. | Dil. | Int.St |
|---|---|---|---|---|---|---|
| 1 | AUTOCAL5R | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 2 | AUTOCAL4R | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 3 | AUTOCAL3R | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 4 | AUTOCAL2R | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 5 | AUTOCAL1R | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 6 | METHOD_BLANK | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 7 | 1_PPB_ICV | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 8 | 20892/PES/HH1 1B | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 9 | 20892/TEST 1A | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 10 | 20892/TEST 2A | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 11 | 20892/TEST 3A | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 12 | 20892/TEST 4A | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 13 | 20892/TEST 1A | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 14 | 20892/PES/TEST 4A 2.5 P | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 15 | 20892/PES/TEST 4A 2.5 P | .\MCLAREN | .\319CR | 1 | 10 | 1 |
| 16 | 20892/AUDIT | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 17 | 20892/AUDIT | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 18 | 0.5_PPB_STD | .\MCLAREN | .\319CR | 1 | 100 | 1 |
| 19 | 20892/PES/TEST 4A + 0.5 | .\MCLAREN | .\319CR | 1 | 10 | 1 |
| 20 | 20892/PES/TEST 4A + 1.0 | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 21 | 20892/PES/TEST 4A + 1.5 | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 22 | 20892/PES/TEST 4A + 2.0 | .\MCLAREN | .\319CR | 1 | 1 | 1 |
| 23 | 0.5_PPB_STD | .\MCLAREN | .\319CR | 1 | 1 | 1 |

Custom Report Title of your choice

09

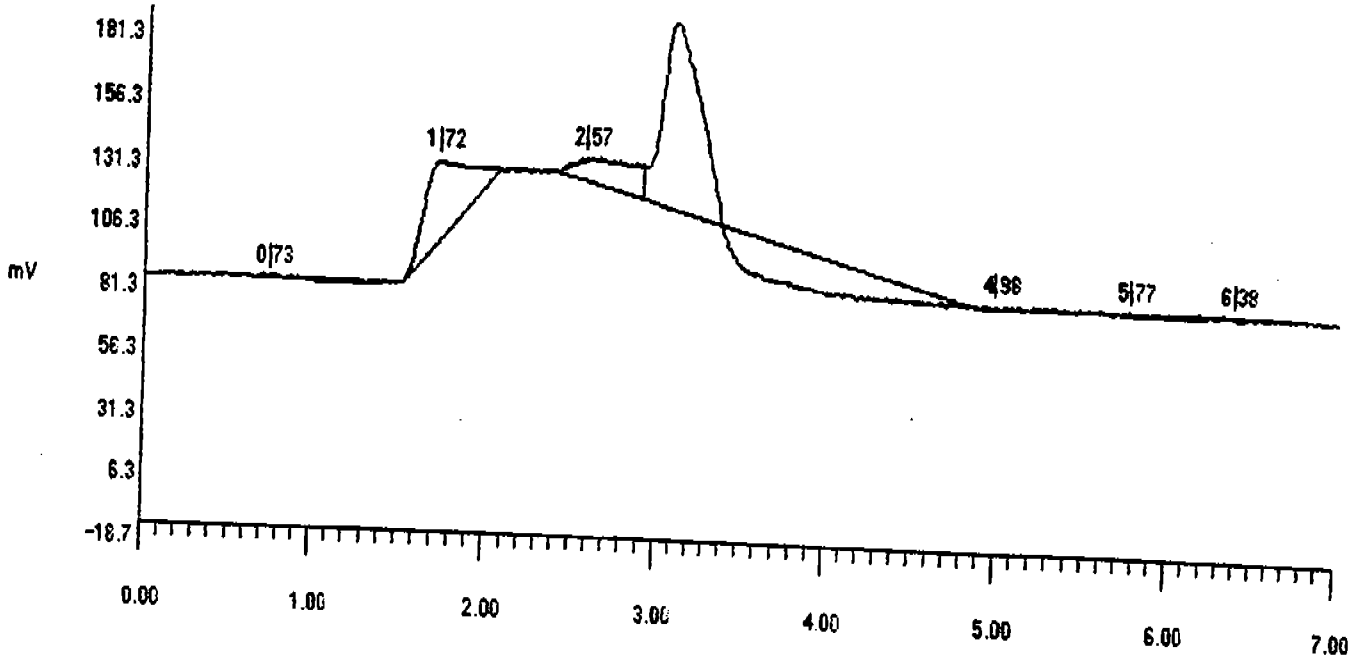
```
==================================================================================
| Sample Name: 20892/PES/HH1                                                     |
| Data File  : C:\DX\DATA\METALS\319CR001.D08          Date: Thu Mar 19 13:40:46 1992|
| Method     : C:\DX\METHOD\MCLAREN.MET                                          |
| ACI Address: 1        System : 2        Inject#:   8  Detector: VDM-1         |
==================================================================================
*********************** PEAKS NOT FOUND IN THIS RUN ***************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |
| HEX. CHROME | 3.93 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 0.73 | | 0.000 | 555 | 25443 | 1 | |
| 2 | 1.72 | | 0.000 | 31931 | 522378 | 1 | |
| 3 | 2.57 | | 0.000 | 8455 | 271131 | 2 | |
| 4 | 3.07 | | 0.000 | 72248 | 308790 | 2 | |
| 5 | 4.98 | | 0.000 | 477 | 12798 | 1 | |
| 6 | 5.77 | | 0.000 | 982 | 16041 | 2 | |

File: C:\DX\DATA\METALS\319CR001.D08 Sample: 20892/PES/HH1



Custom Report Title of your choice



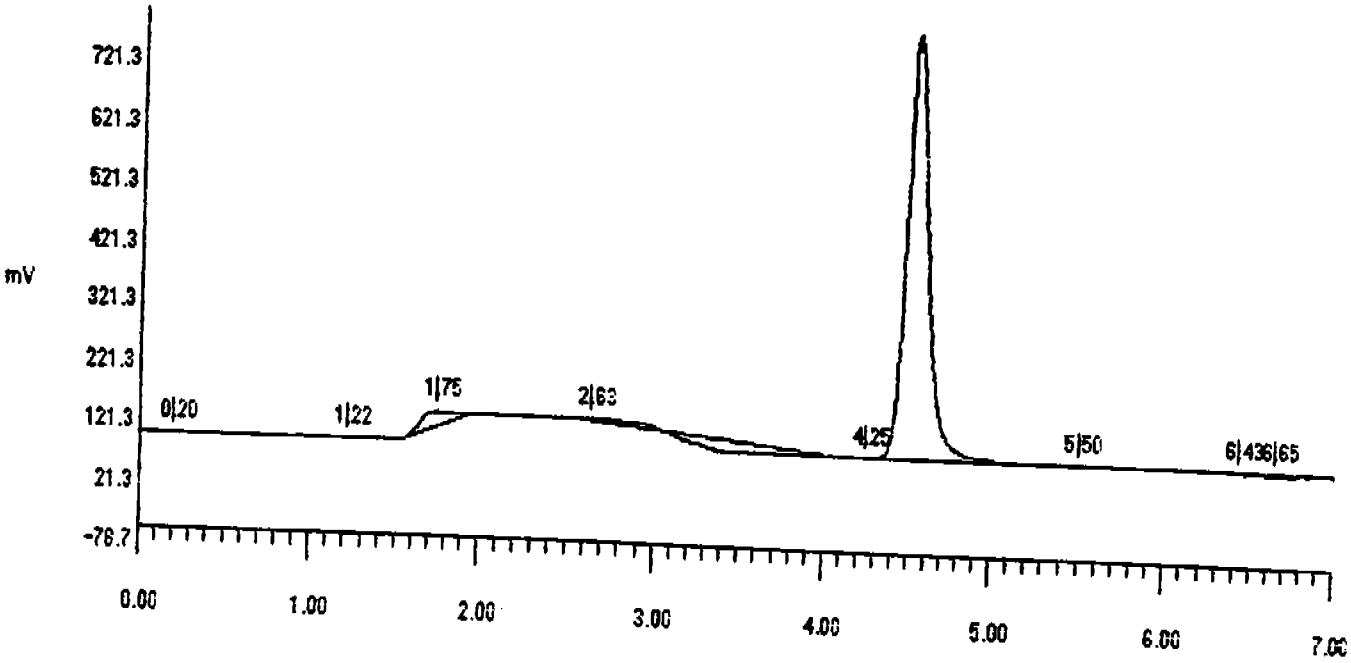
```
==================================================================================
| Sample Name: 20892/TEST 1A                                                     |
| Data File  : C:\DX\DATA\METALS\319CR001.D09          Date: Thu Mar 19 13:51:05 1992|
| Method     : C:\DX\METHOD\MCLAREN.MET                                          |
| ACI Address: 1        System : 2        Inject#:   9  Detector: VDM-1         |
==================================================================================
************************ PEAKS NOT FOUND IN THIS RUN ***************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 2 | 1.22 | | 0.000 | 1140 | 12616 | 1 | |
| 3 | 1.75 | | 0.000 | 25576 | 339588 | 1 | |
| 4 | 2.63 | | 0.000 | 2874 | -431751 | 1 | |
| 6 | 4.52 | HEX. CHROME | 6.970 | 707725 | 6750188 | 2 | 14.83 |

File: C:\DX\DATA\METALS\319CR001.D09 Sample: 20892/TEST 1A



Custom Report Title of your choice



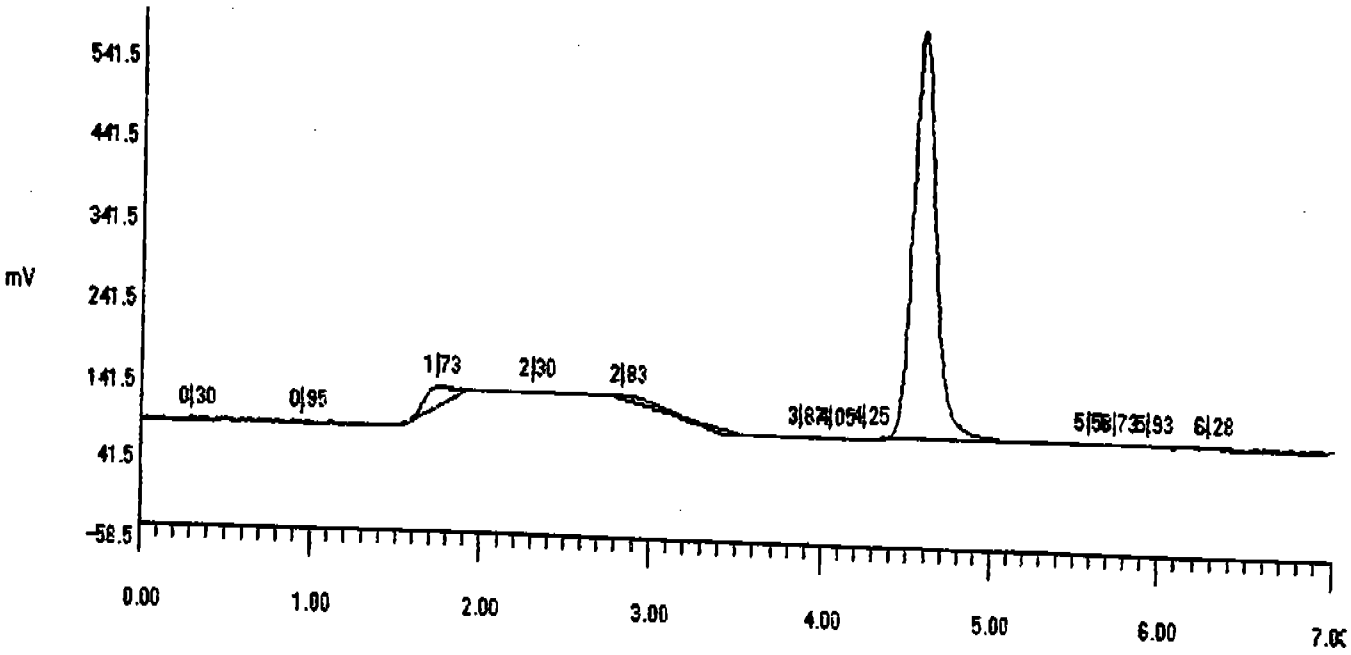
```
==================================================================================
| Sample Name: 20892/TEST 2A                                                     |
| Data File  : C:\DX\DATA\METALS\319CR001.D10          Date: Thu Mar 19 14:01:23 1992|
| Method     : C:\DX\METHOD\MCLAREN.MET                                          |
| ACI Address: 1        System : 2        Inject#:  10  Detector: VDM-1         |
==================================================================================
*********************** PEAKS NOT FOUND IN THIS RUN ***************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 0.30 | | 0.000 | 1568 | 13549 | 1 | |
| 3 | 1.73 | | 0.000 | 25315 | 287328 | 1 | |
| 5 | 2.83 | | 0.000 | 3393 | 39408 | 1 | |
| 9 | 4.57 | HEX. CHROME | 4.987 | 505541 | 4847606 | 2 | 12.76 |
| 13 | 6.28 | | 0.000 | 1035 | 11163 | 2 | |

File: C:\DX\DATA\METALS\319CR001.D10 Sample: 20892/TEST 2A



Custom Report Title of your choice

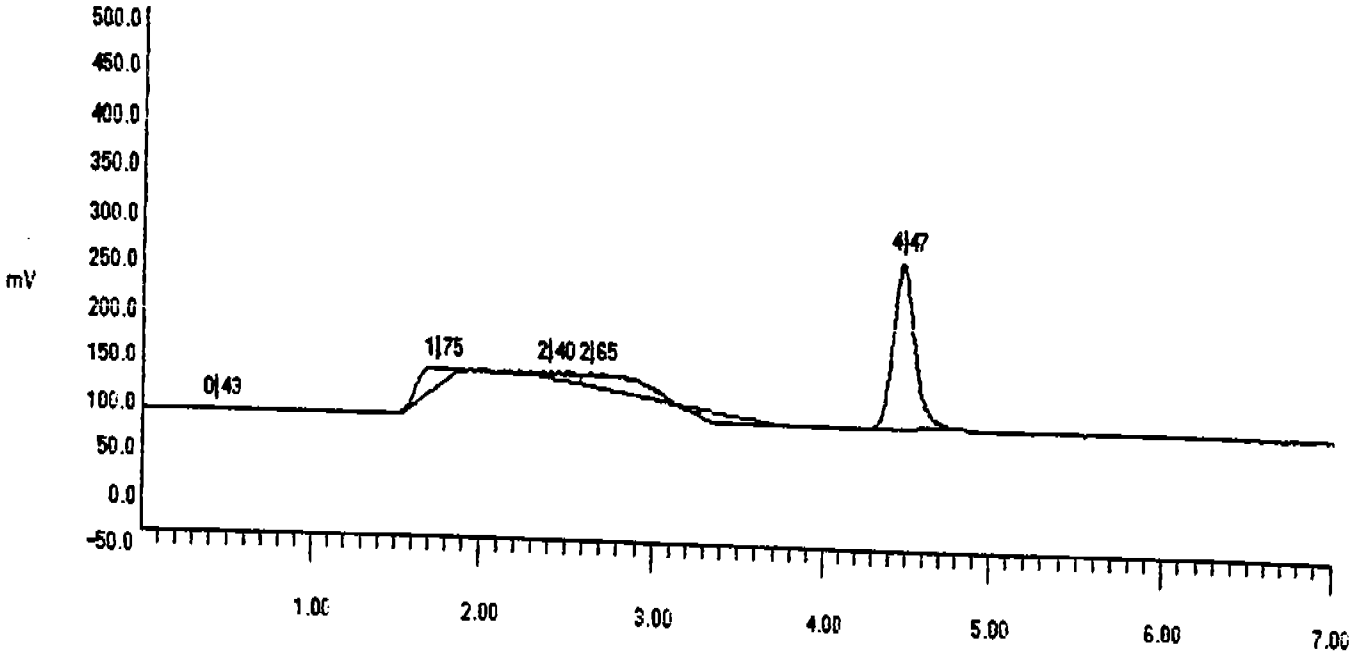


Sample Name: 20892/TEST 3A
Data File : C:\DX\DATA\METALS\319CR001.D11 Date: Thu Mar 19 14:11:38 1992
Method : C:\DX\METHOD\MCLAREN.MET
ACI Address: 1 System : 2 Inject#: 11 Detector: VDM-1

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 0.43 | MATRIX | 0.000 | 932 | 12876 | 1 | 160.00 |
| 2 | 1.75 | | 0.000 | 19652 | 289295 | 1 | |
| 3 | 2.40 | | 0.000 | 4692 | 98031 | 2 | |
| 4 | 2.65 | | 0.000 | 13065 | 244760 | 2 | |
| 5 | 4.47 | HEX. CHROME | 1.630 | 174104 | 1626677 | 1 | 13.56 |

File: C:\DX\DATA\METALS\319CR001.D11 Sample: 20892/TEST 3A



Custom Report Title of your choice



Sample Name: 20892/TEST 4A
Data File : C:\DX\DATA\METALS\319CR001.D12 Date: Thu Mar 19 14:23:51 1992
Method : C:\DX\METHOD\MCLAREN.MET
ACI Address: 1 System : 2 Inject#: 12 Detector: VDM-1

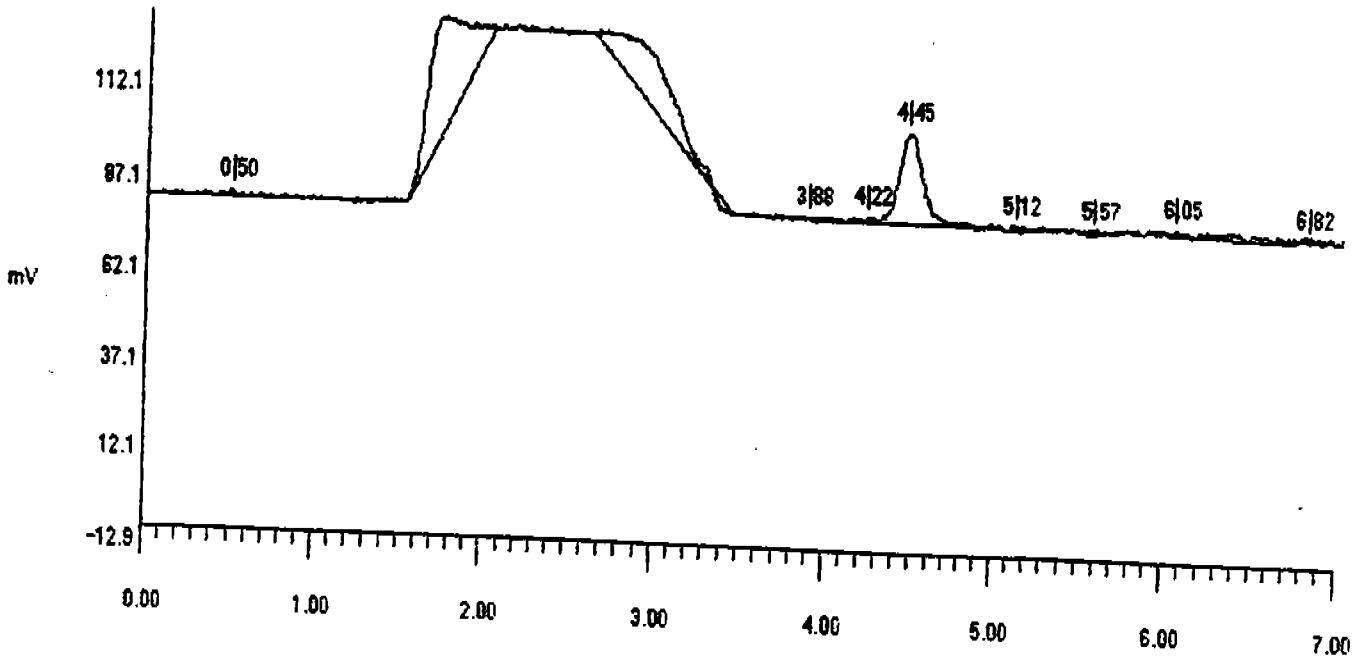
********** PEAKS NOT FOUND IN THIS RUN **********

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.16 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 0.50 | | 0.000 | 1494 | 21778 | 1 | |
| 2 | 1.73 | | 0.000 | 30913 | 495102 | 1 | |
| 3 | 2.68 | | 0.000 | 4324 | 312254 | 1 | |
| 6 | 4.45 | HEX. CHROME | 0.183 | 24544 | 238920 | 2 | 14.59 |
| 9 | 6.05 | | 0.000 | 1042 | 23912 | 1 | |

File: C:\DX\DATA\METALS\319CR001.D12 Sample: 20892/TEST 4A



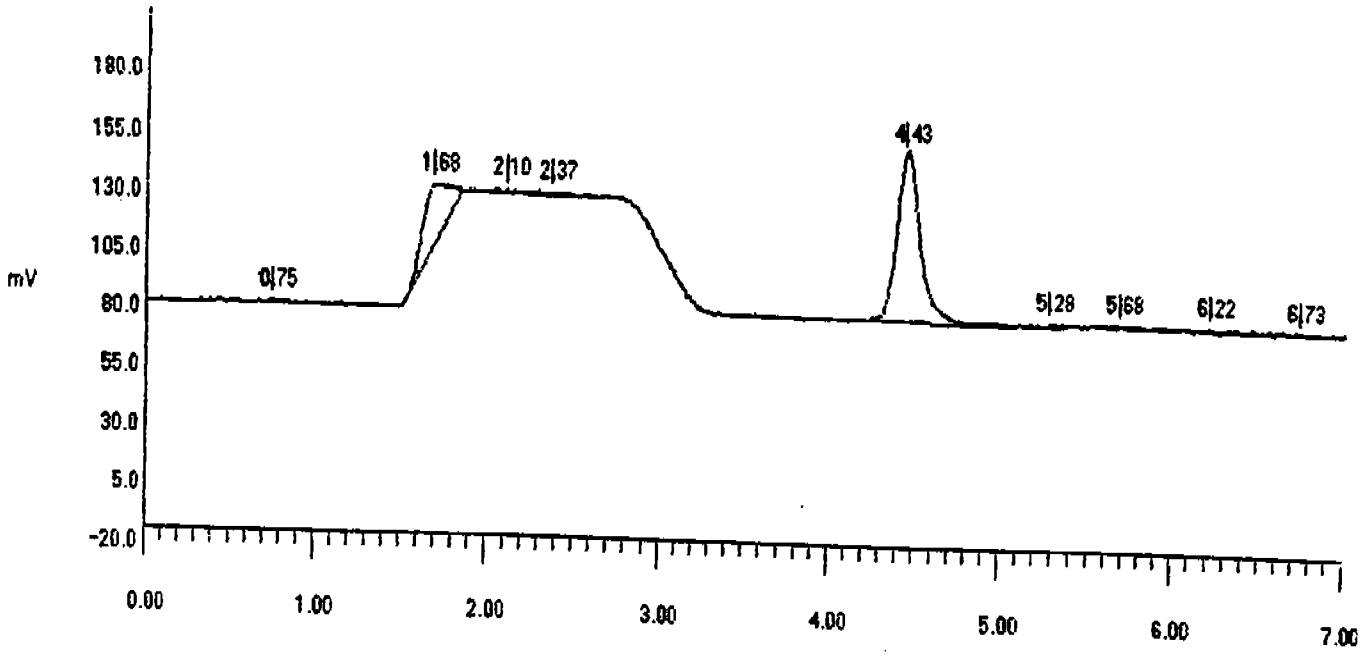
Custom Report Title of your choice

```
==================================================================================
| Sample Name: 20892/TEST 1A                          Date: Thu Mar 19 14:34:09 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D13                                       |
| Method     : C:\DX\METHOD\MCLAREN.MET                                             |
| ACI Address: 1        System : 2        Inject#:  13  Detector: VDM-1            |
==================================================================================
************************ PEAKS NOT FOUND IN THIS RUN ****************************
Name                Adjusted Ret Time   Reference Peak
----------------------------------------------------------
MATRIX                   0.17                2
```

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 10 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 2 | 1.68 | | 0.000 | 26100 | 254971 | 1 | |
| 5 | 4.43 | HEX. CHROME | 6.877 | 70837 | 722821 | 1 | 12.71 |
| 8 | 6.22 | | 0.000 | 1007 | 12141 | 1 | |

File: C:\DX\DATA\METALS\319CR001.D13 Sample: 20892/TEST 1A



Custom Report Title of your choice

DATA REPROCESSED ON Thu Mar 19 15:24:01 1992



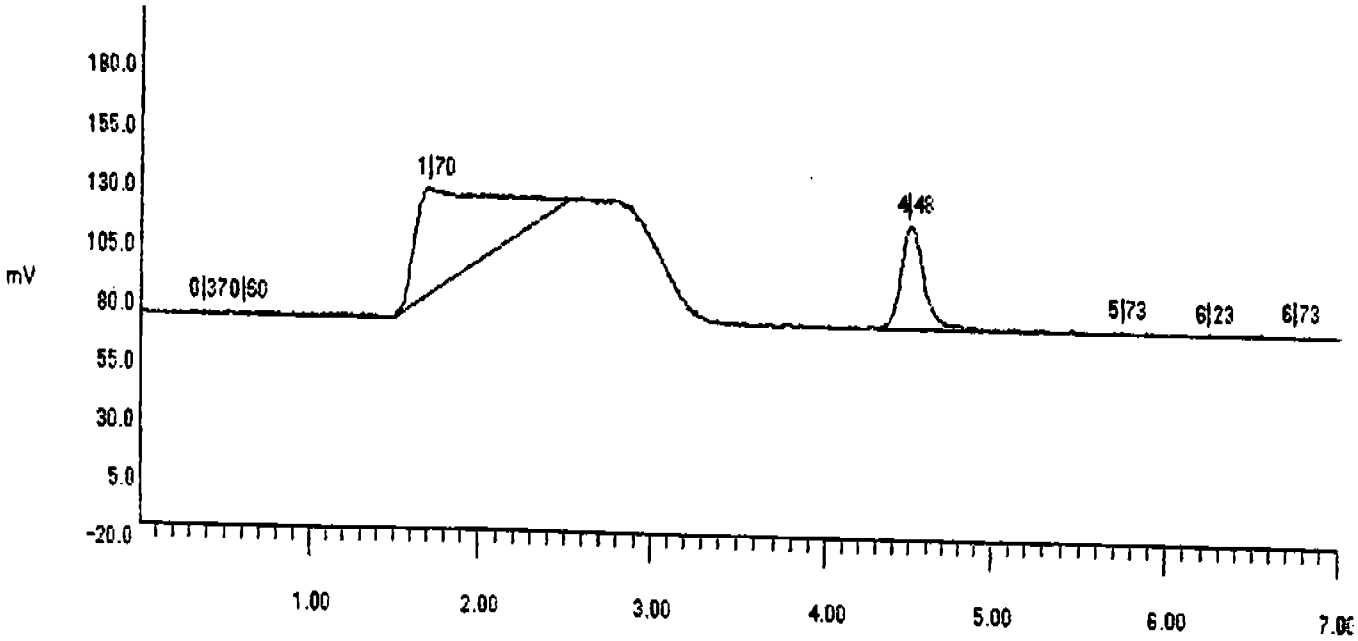
```
==================================================================================
| Sample Name: 20892/AUDIT                                                       |
| Data File  : C:\DX\DATA\METALS\319CR001.D16          Date: Thu Mar 19 15:11:54 1992|
| Method     : C:\DX\METHOD\MCLAREN.MET                                          |
| ACI Address: 1        System : 2        Inject#:  16  Detector: VDM-1         |
==================================================================================
**********************  PEAKS NOT FOUND IN THIS RUN  **************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 100 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 2 | 0.60 | | 0.000 | 973 | 27446 | 1 | |
| 3 | 1.70 | | 0.000 | 43855 | 1280101 | 1 | |
| 4 | 4.48 | HEX. CHROME | 37.768 | 42356 | 425367 | 1 | 13.98 |
| 6 | 6.23 | | 0.000 | 498 | 18018 | 1 | |

File: C:\DX\DATA\METALS\319CR001.D16 Sample: 20892/AUDIT



Custom Report Title of your choice

```
==================================================================================
| Sample Name: 20892/AUDIT                          Date: Thu Mar 19 15:25:17 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D17                                     |
| Method     : MCLAREN.MET                                                        |
| ACI Address: 1        System : 2        Inject#:  17  Detector: VDM-1          |
==================================================================================
```

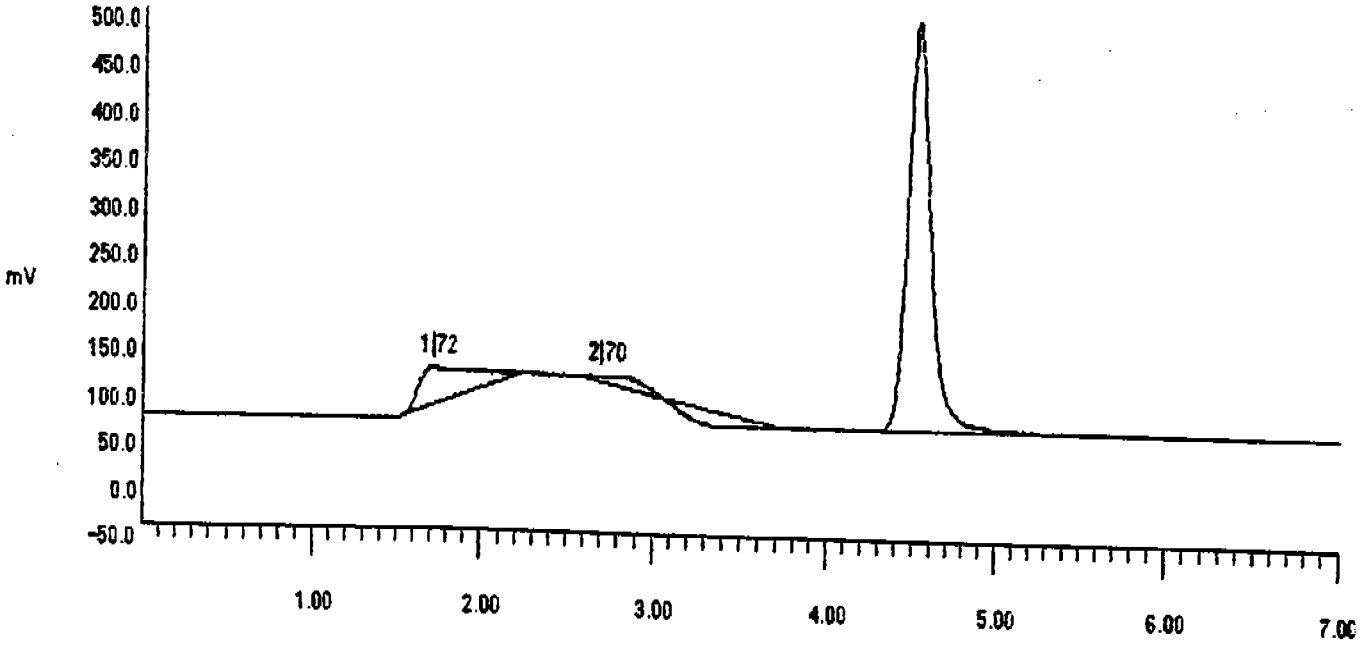
********** PEAKS NOT FOUND IN THIS RUN **********

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 10 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 1.72 | | 0.000 | 38754 | 789691 | 1 | |
| 2 | 2.70 | | 0.000 | 5789 | -159676 | 1 | |
| 3 | 4.52 | HEX. CHROME | 4.235 | 429520 | 4126600 | 1 | 0.00 |

File: C:\DX\DATA\METALS\319CR001.D17 Sample: 20892/AUDIT



# HEXAVALENT CHROMIUM CALIBRATION SUMMARY

Laboratory: West Coast Analytical Service

Date Analyzed_____3-19-92

Instrument ID_____IC

## INITIAL CALIBRATION SUMMARY

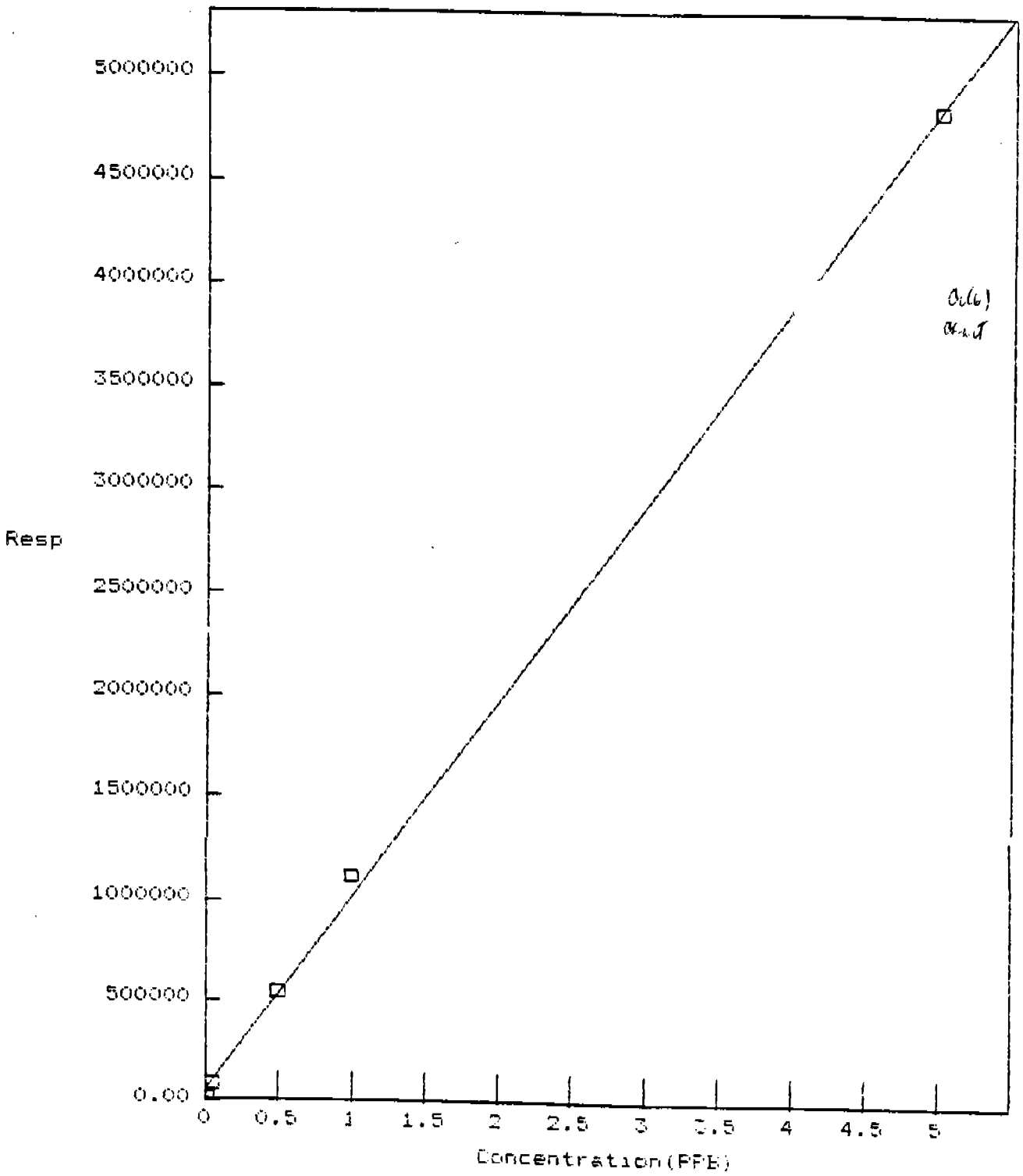
| Cr(VI) concentration, ug/L | Area counts |
|---|---|
| 5 | 4839202 |
| 1 | 1117647 |
| 0.5 | 542231 |
| 0.05 | 85427 |
| 0.02 | 21843 |

Correlation coefficient, r^2: 0.999152

## CONTINUING CALIBRATION SUMMARY

| File no. | Concentration | % Error |
|---|---|---|
| 18 | 0.504 | 0.8% |
| 23 | 0.518 | 3.6% |

Method: MCLAREN.MET
Component: HEX. CHROME
Fit Type: Linear
r^2: 0.999152
Conc = Resp * 1.041e-006 + -0.06168
Resp = Conc * 9.605e+005 + 59240
Standardization: External
Calibration: Area



********** AUTOMATIC CALIBRATION UPDATE **********

```
==================================================================================
| Sample Name: AUTOCAL5R                          Date: Thu Mar 19 12:12:42 1992|
| Result File: C:\DX\DATA\METALS\319CR001.R01                                   |
| Method     : C:\DX\METHOD\MCLAREN.MET                   Calibration Level: 5 |
| ACI Address: 1        System : 2        Inject#:  1        Detector: VDM-1   |
==================================================================================
```

********** PEAKS NOT FOUND IN THIS RUN **********

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.16 | 2 |

********** COMPONENTS FOUND IN THIS RUN **********

| COMP NUM | COMPONENT NAME | OLD RET.TIME | MEASURED RET.TIME | NEW RET.TIME | OLD AREA | MEASURED AREA | NEW AREA |
|---|---|---|---|---|---|---|---|
| 2 | HEX. CHROME | 4.65 | 4.57 | 4.57 | 5.645e+006 | 4.839e+006 | 4.839e+006 |

Custom Report Title of your choice



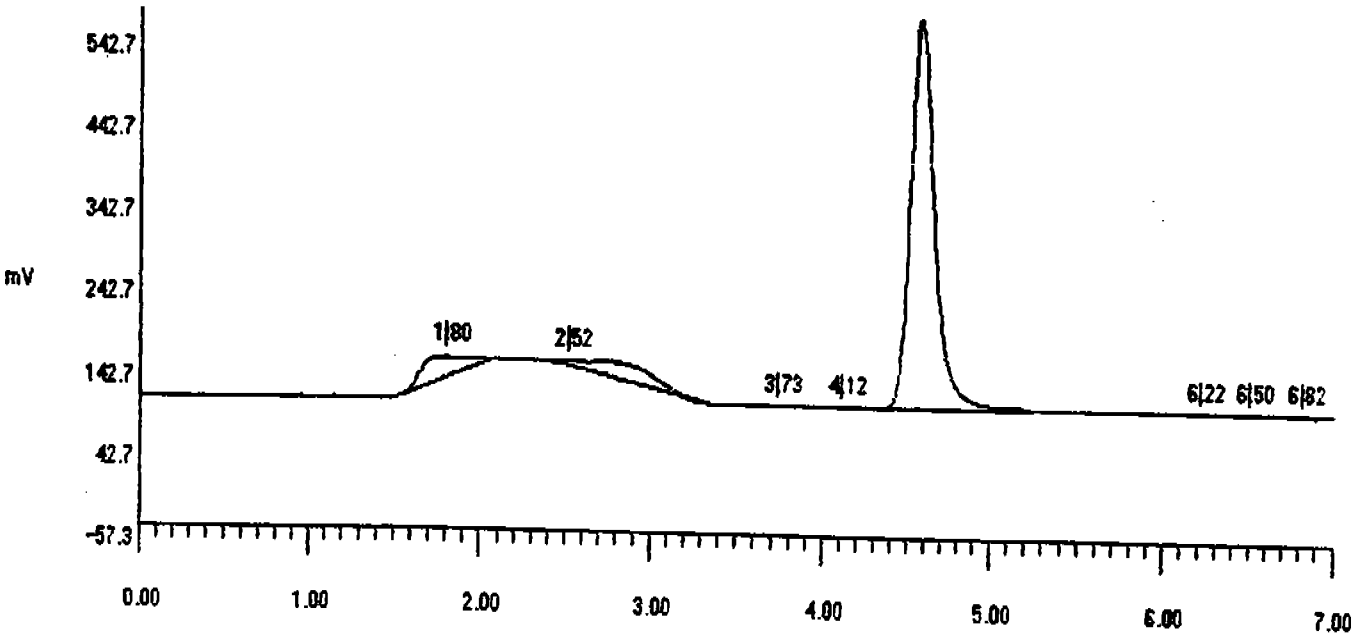
```
==================================================================================
| Sample Name: AUTOCAL5R                                Date: Thu Mar 19 12:12:42 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D01                                      |
| Method     : C:\DX\METHOD\MCLAREN.MET                                            |
| ACI Address: 1        System : 2        Inject#:   1  Detector: VDM-1           |
==================================================================================
************************ PEAKS NOT FOUND IN THIS RUN ************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.16 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA | REJ |
|---|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 | |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 1.80 | | 0.000 | 26824 | 506524 | 1 | |
| 2 | 2.52 | | 0.000 | 6483 | 537608 | 1 | |
| 3 | 3.73 | | 0.000 | 1006 | 13447 | 1 | |
| 5 | 4.57 | HEX. CHROME | 5.000 | 471502 | 4839202 | 2 | 0.00 |

File: C:\DX\DATA\METALS\319CR001.D01 Sample: AUTOCAL5R



********** AUTOMATIC CALIBRATION UPDATE **********

```
==================================================================================
: Sample Name: AUTOCAL4R                          Date: Thu Mar 19 12:24:51 1992:
: Result File: C:\DX\DATA\METALS\319CR001.R02                                    :
: Method     : C:\DX\METHOD\MCLAREN.MET                   Calibration Level: 4 :
: ACI Address: 1        System : 2        Inject#:  2        Detector: VDM-1    :
==================================================================================
```

********** PEAKS NOT FOUND IN THIS RUN **********

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

********** COMPONENTS FOUND IN THIS RUN **********

| COMP NUM | COMPONENT NAME | OLD RET.TIME | MEASURED RET.TIME | NEW RET.TIME | OLD AREA | MEASURED AREA | NEW AREA |
|---|---|---|---|---|---|---|---|
| 2 | HEX. CHROME | 4.57 | 4.58 | 4.58 | 1.157e+006 | 1.118e+006 | 1.118e+006 |

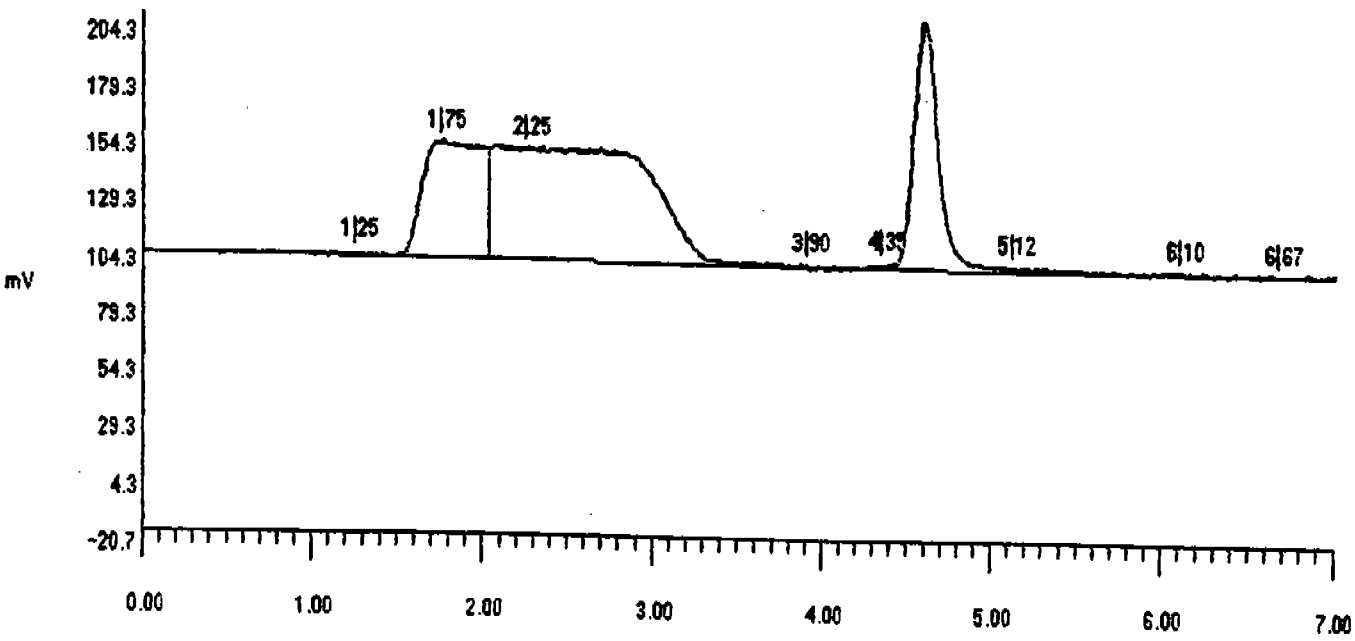
Custom Report Title of your choice

```
==================================================================================
| Sample Name: AUTOCAL4R                                Date: Thu Mar 19 12:24:51 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D02                                     |
| Method     : C:\DX\METHOD\MCLAREN.MET                                           |
| ACI Address: 1        System : 2        Inject#:   2  Detector: VDM-1          |
==================================================================================
************************  PEAKS NOT FOUND IN THIS RUN  ****************************
Name                Adjusted Ret Time   Reference Peak
----------------------------------------------------------
MATRIX                  0.17                 2
```

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA | REJ |
|---|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 | |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 2 | 1.75 | | 0.000 | 50287 | 1210717 | 2 | |
| 3 | 2.25 | | 0.000 | 48101 | 2898221 | 2 | |
| 6 | 4.58 | HEX. CHROME | 1.000 | 106718 | 1117647 | 3 | 0.00 |
| 7 | 5.12 | | 0.000 | 1317 | 29702 | 4 | |

File: C:\DX\DATA\METALS\319CR001.D02 Sample: AUTOCAL4R



********** AUTOMATIC CALIBRATION UPDATE **********

```
==================================================================================
| Sample Name: AUTOCAL3R                          Date: Thu Mar 19 12:35:10 1992|
| Result File: C:\DX\DATA\METALS\319CR001.R03                                   |
| Method     : C:\DX\METHOD\MCLAREN.MET                   Calibration Level: 3 |
| ACI Address: 1       System : 2       Inject#:  3        Detector: VDM-1     |
==================================================================================
```

********** PEAKS NOT FOUND IN THIS RUN **********

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

********** COMPONENTS FOUND IN THIS RUN **********

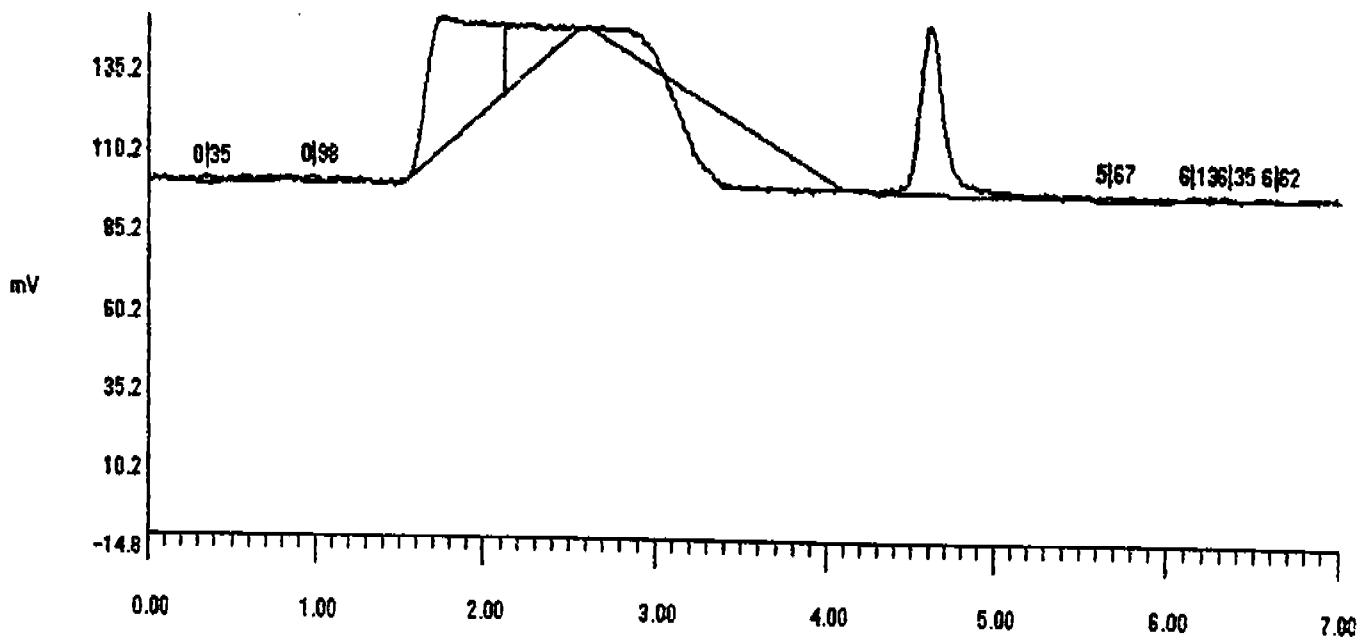
| COMP NUM | COMPONENT NAME | OLD RET.TIME | MEASURED RET.TIME | NEW RET.TIME | OLD AREA | MEASURED AREA | NEW AREA |
|---|---|---|---|---|---|---|---|
| 2 | HEX. CHROME | 4.58 | 4.60 | 4.60 | 5.773e+005 | 5.422e+005 | 5.422e+005 |

```
==================================================================================
| Sample Name: AUTOCAL3R                          Date: Thu Mar 19 12:35:10 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D03                                   |
| Method     : C:\DX\METHOD\MCLAREN.MET                                         |
| ACI Address: 1        System : 2        Inject#:   3  Detector: VDM-1        |
==================================================================================
************************ PEAKS NOT FOUND IN THIS RUN ***************************
Name                Adjusted Ret Time   Reference Peak
-------------------------------------------------------
MATRIX                 0.17                 2
```

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 0.35 | | 0.000 | 1187 | 24437 | 1 | |
| 3 | 1.75 | | 0.000 | 40388 | 952372 | 2 | |
| 4 | 2.30 | | 0.000 | 13182 | 171308 | 2 | |
| 5 | 2.75 | | 0.000 | 4296 | -685286 | 1 | |
| 6 | 4.60 | HEX. CHROME | 0.500 | 51830 | 542231 | 2 | 0.00 |
| 7 | 5.67 | | 0.000 | 1176 | 22898 | 2 | |

File: C:\DX\DATA\METALS\319CR001.D03 Sample: AUTOCAL3R



********** AUTOMATIC CALIBRATION UPDATE **********

```
==================================================================================
| Sample Name: AUTOCAL2R                          Date: Thu Mar 19 12:45:29 1992 |
| Result File: C:\DX\DATA\METALS\319CR001.R04                                    |
| Method     : C:\DX\METHOD\MCLAREN.MET                   Calibration Level: 2   |
| ACI Address: 1        System : 2        Inject#:  4        Detector: VDM-1    |
==================================================================================
```

********** PEAKS NOT FOUND IN THIS RUN **********

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

********** COMPONENTS FOUND IN THIS RUN **********

| COMP NUM | COMPONENT NAME | OLD RET.TIME | MEASURED RET.TIME | NEW RET.TIME | OLD AREA | MEASURED AREA | NEW AREA |
|---|---|---|---|---|---|---|---|
| 2 | HEX. CHROME | 4.60 | 4.60 | 4.60 | 4.696e+004 | 8.543e+004 | 8.543e+004 |

Custom Report Title of your choice

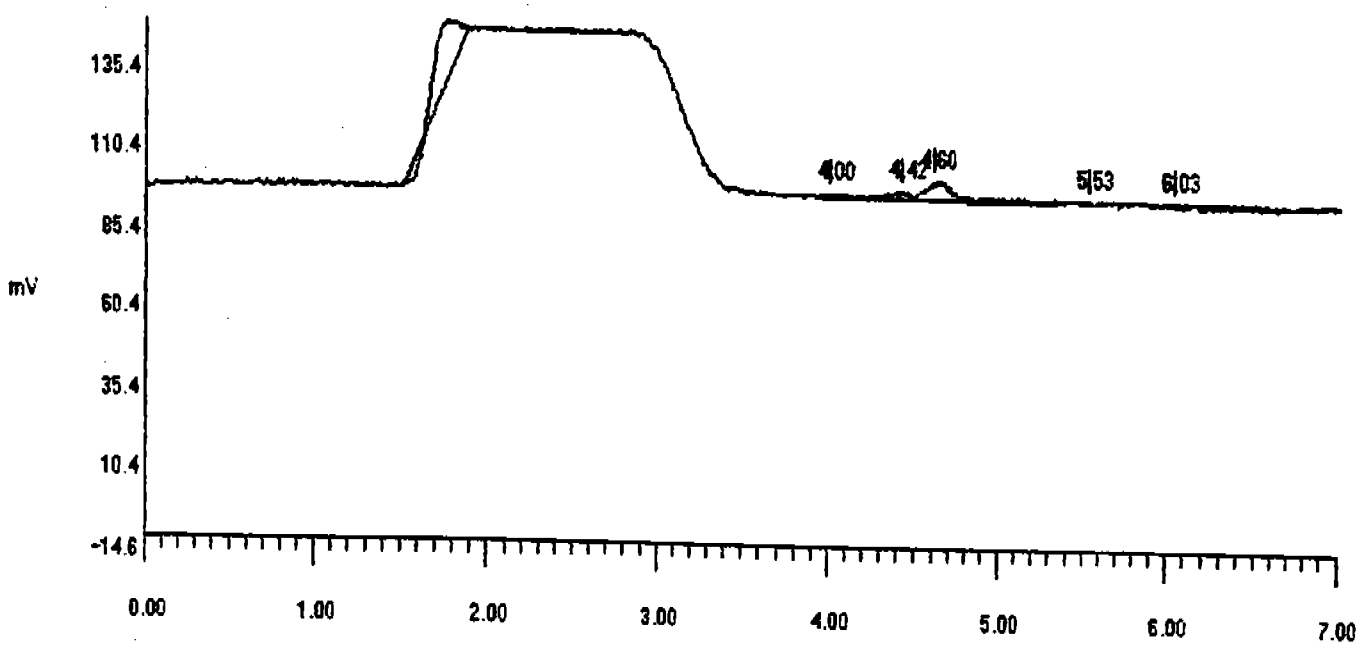
```
==================================================================================
| Sample Name: AUTOCAL2R                                                         |
| Data File  : C:\DX\DATA\METALS\319CR001.D04          Date: Thu Mar 19 12:45:29 1992|
| Method     : C:\DX\METHOD\MCLAREN.MET                                          |
| ACI Address: 1        System : 2        Inject#:   4  Detector: VDM-1        |
==================================================================================
************************  PEAKS NOT FOUND IN THIS RUN  ****************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 1.75 | | 0.000 | 18884 | 151789 | 1 | |
| 2 | 2.33 | | 0.000 | 863 | 16534 | 1 | |
| 4 | 4.42 | | 0.000 | 2135 | 15734 | 2 | |
| 5 | 4.60 | HEX. CHROME | 0.050 | 5316 | 85427 | 2 | 0.00 |

File: C:\DX\DATA\METALS\319CR001.D04 Sample: AUTOCAL2R



********** AUTOMATIC CALIBRATION UPDATE **********

```
Sample Name: AUTOCAL1R
Result File: C:\DX\DATA\METALS\319CR011.R05          Date: Thu Mar 19 13:09:42 1992
Method     : C:\DX\METHOD\MCLAREN.MET
ACI Address: 1        System : 2        Inject#:  5        Calibration Level: 1
                                                            Detector: VDM-1
```

********** PEAKS NOT FOUND IN THIS RUN **********

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.16 | 2 |

********** COMPONENTS FOUND IN THIS RUN **********

| COMP NUM | COMPONENT NAME | OLD RET.TIME | MEASURED RET.TIME | NEW RET.TIME | OLD AREA | MEASURED AREA | NEW AREA |
|---|---|---|---|---|---|---|---|
| 2 | HEX. CHROME | 4.02 | 3.93 | 3.93 | 6.830e+004 | 3.417e+004 | 3.417e+004 |

Custom Report Title of your choice



DATA REPROCESSED ON Mon Mar 23 11:57:41 1992

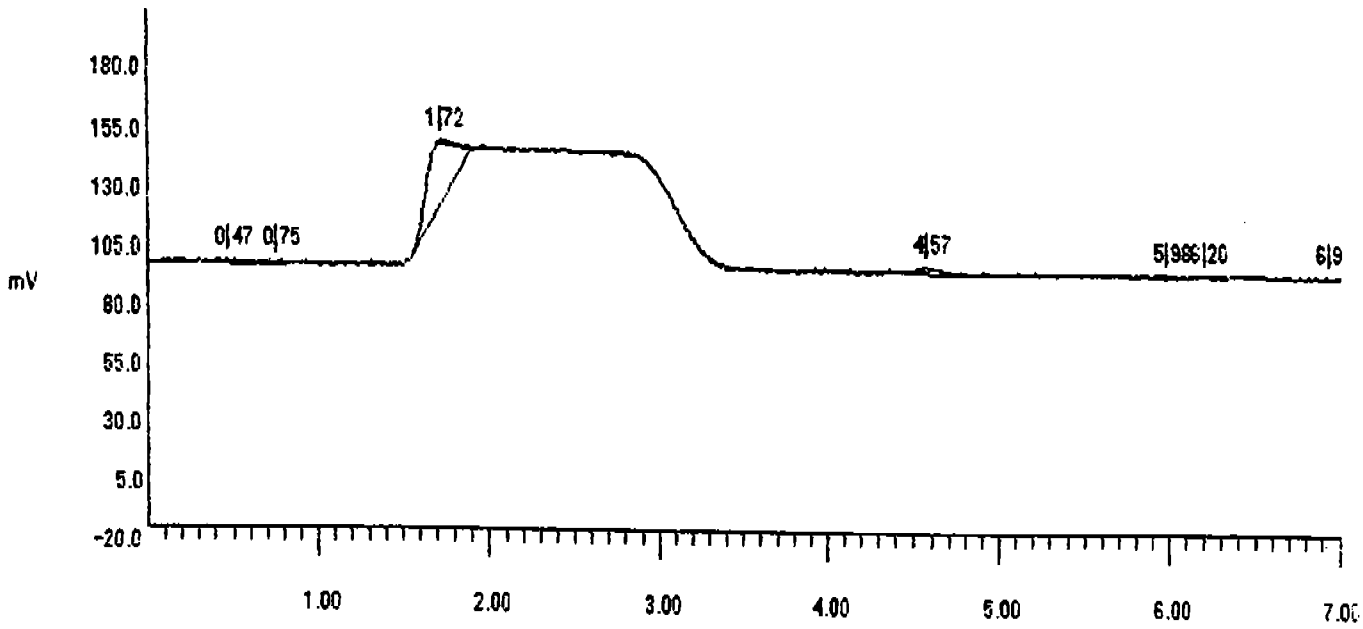
```
==================================================================================
| Sample Name: AUTOCAL1R                          Date: Thu Mar 19 13:09:42 1992|
| Data File  : C:\DX\DATA\METALS\319CR011.D05                                   |
| Method     : C:\DX\METHOD\MCLAREN.MET                                         |
| ACI Address: 1       System : 2       Inject#:   5  Detector: VDM-1          |
==================================================================================
************************  PEAKS NOT FOUND IN THIS RUN  **************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 0.47 | | 0.000 | 1848 | 15444 | 1 | |
| 3 | 1.72 | | 0.000 | 27681 | 300234 | 1 | |
| 4 | 4.57 | HEX. CHROME | 0.020 | 2485 | 21843 | 1 | 16.10 |

File: C:\DX\DATA\METALS\319CR011.D05 Sample: AUTOCAL1R

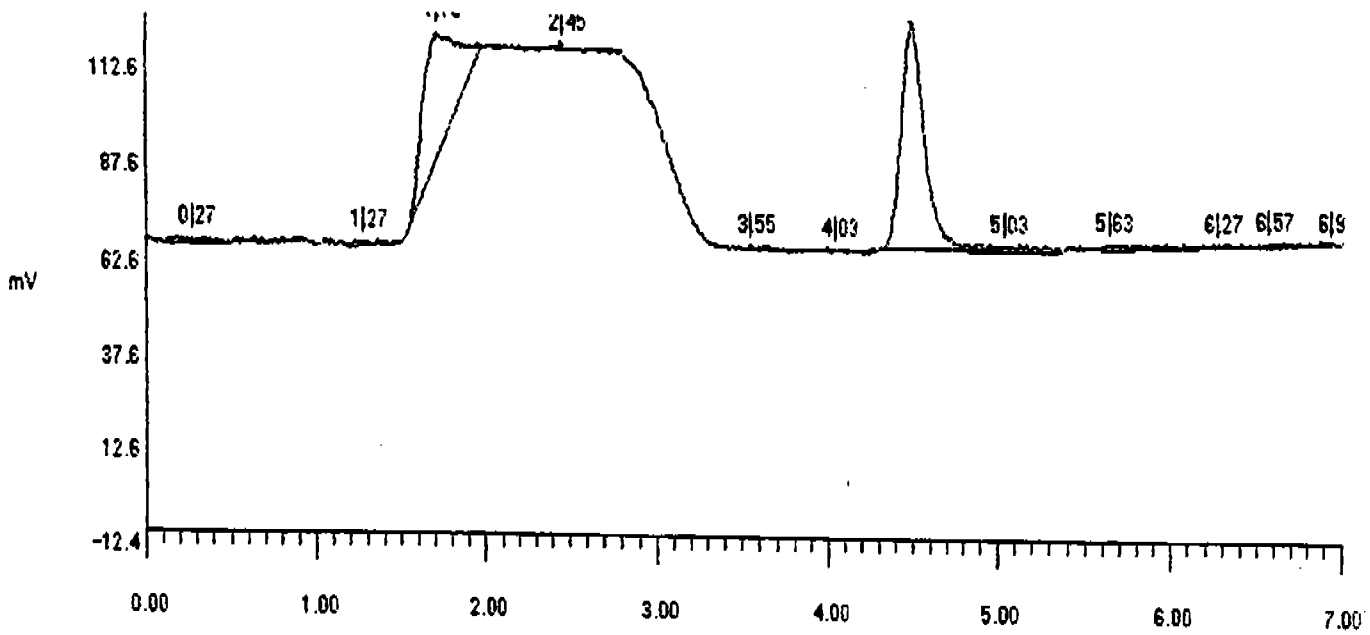


```
==================================================================================
| Sample Name: 0.5_PPB_STD                          Date: Thu Mar 19 16:56:07 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D23                                     |
| Method     : C:\DX\METHOD\MCLAREN.MET                                           |
| ACI Address: 1        System : 2        Inject#:  23  Detector: VDM-1          |
==================================================================================
************************  PEAKS NOT FOUND IN THIS RUN  **************************
Name                Adjusted Ret Time   Reference Peak
-------------------------------------------------------
MATRIX                  0.17                2


REPORT        VOLUME   DILUTION POINTS RATE  START   STOP AREA REJ
-------------------------------------------------------------------
External          1          1   2105  5Hz   0.00   7.02    10000

 Pk.    Ret Component          Concentration     Height        Area BL %Delta
 Num   Time Name
-------------------------------------------------------------------------------
   1   0.27                          0.000        928       14042  1
   3   1.70                          0.000      33484      440401  1
   7   4.47 HEX. CHROME              0.518      56845      559682  3    0.00
   8   5.03                          0.000        978       22229  4
   9   5.63                          0.000        968       20373  2
```

File: C:\DX\DATA\METALS\319CR001.D23 Sample: 0.5_PPB_STD



Custom Report Title of your choice



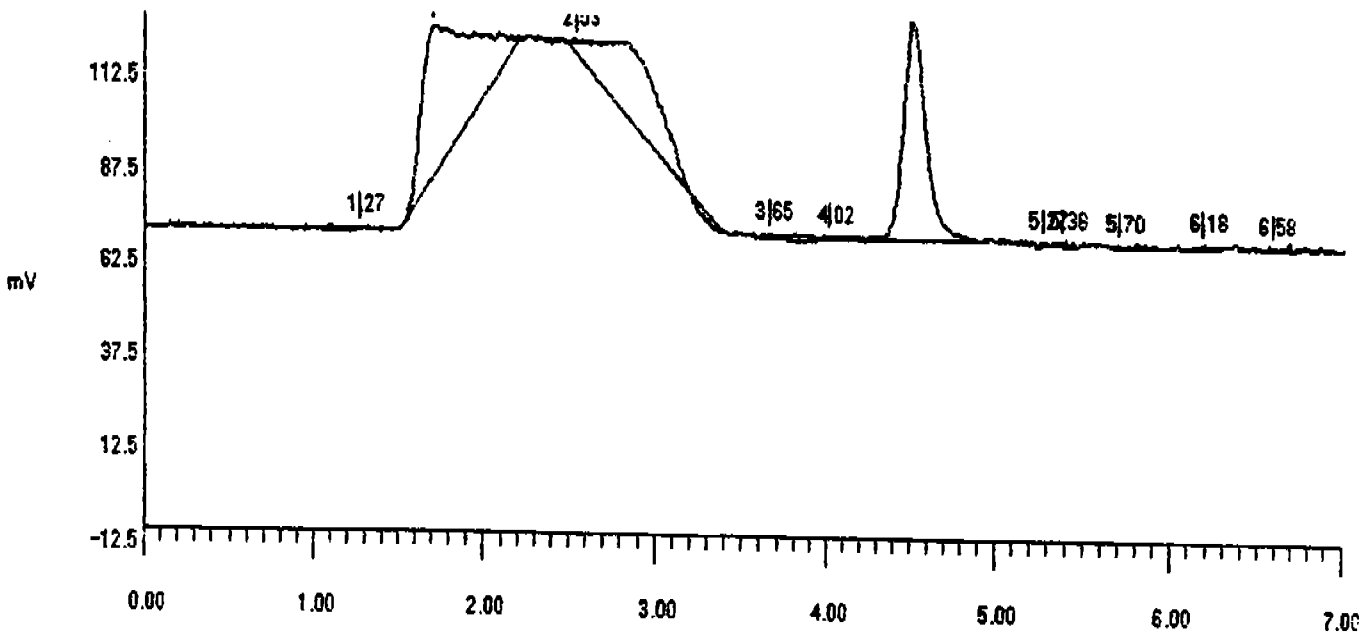
```
==============================================================================
: Sample Name: 0.5_PPB_STD                          Date: Thu Mar 19 15:35:30 1992:
: Data File  : C:\DX\DATA\METALS\319CR001.D18                                  :
: Method     : C:\DX\METHOD\MCLAREN.MET                                        :
: ACI Address: 1        System : 2        Inject#:  18  Detector: VDM-1       :
==============================================================================
*********************** PEAKS NOT FOUND IN THIS RUN ***************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA | REJ |
|---|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 | |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 2 | 1.70 | | 0.000 | 39519 | 766519 | 1 | |
| 3 | 2.53 | | 0.000 | 3202 | 437253 | 1 | |
| 4 | 3.65 | | 0.000 | 1093 | 16561 | 1 | |
| 5 | 4.02 | | 0.000 | 498 | 12864 | 2 | |
| 6 | 4.50 | HEX. CHROME | 0.504 | 57771 | 546819 | 2 | 0.00 |
| 9 | 5.70 | | 0.000 | 1007 | 12917 | 1 | |

File: C:\DX\DATA\METALS\319CR001.D18 Sample: 0.5_PPB_STD



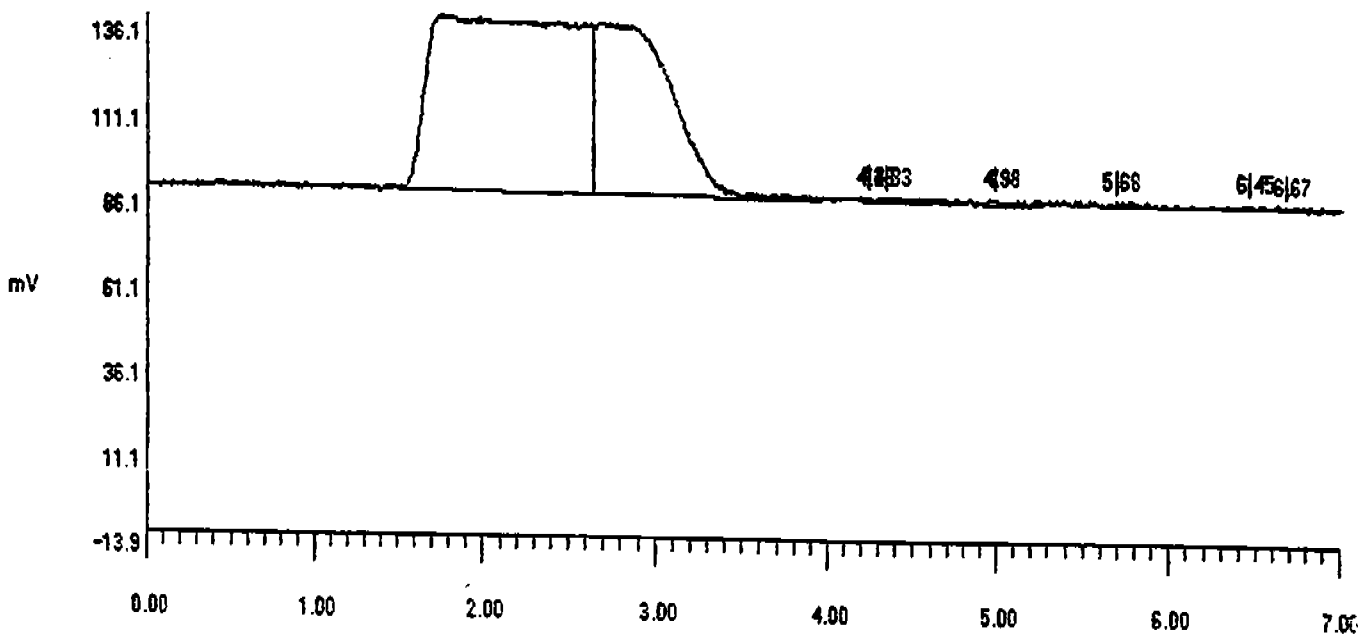
Custom Report Title of your choice

```
==================================================================================
| Sample Name: METHOD_BLANK                          Date: Thu Mar 19 13:20:01 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D06                                      |
| Method     : C:\DX\METHOD\MCLAREN.MET                                            |
| ACI Address: 1        System : 2        Inject#:   6  Detector: VDM-1           |
==================================================================================
************************  PEAKS NOT FOUND IN THIS RUN  **************************
Name                Adjusted Ret Time   Reference Peak
-------------------------------------------------------
MATRIX                 0.17                2
```

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 1.75 | | 0.000 | 51326 | 2966032 | 2 | |
| 2 | 2.72 | | 0.000 | 48911 | 1462108 | 2 | |
| 4 | 4.33 | HEX. CHROME | -0.050 | 1006 | 15328 | 1 | 10.17 |
| 5 | 4.98 | | 0.000 | 1502 | 10480 | 1 | |
| 6 | 5.68 | | 0.000 | 1001 | 28123 | 2 | |

File: C:\DX\DATA\METALS\319CR001.D06 Sample: METHOD_BLANK



Custom Report Title of your choice



DATA REPROCESSED ON Thu Mar 19 13:46:05 1992

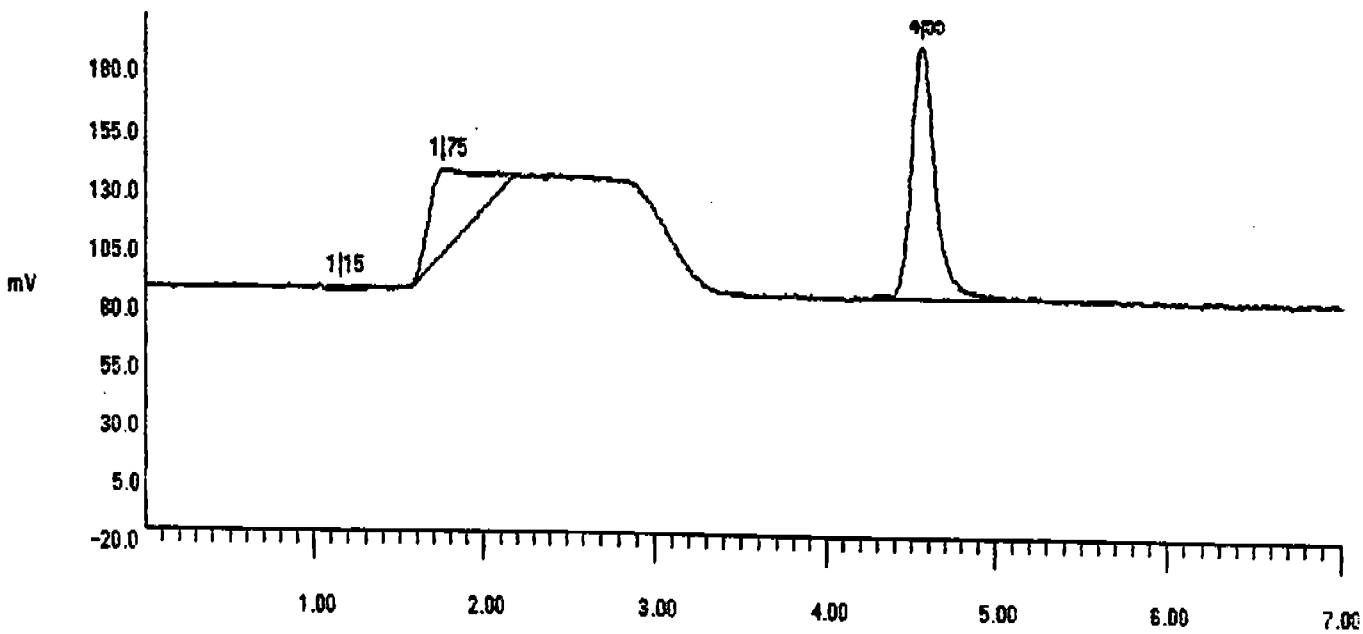
```
==================================================================================
| Sample Name: 1_PPB_ICV                          Date: Thu Mar 19 13:30:22 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D07                                   |
| Method     : C:\DX\METHOD\MCLAREN.MET                                         |
| ACI Address: 1       System : 2       Inject#:   7  Detector: VDM-1          |
==================================================================================
************************ PEAKS NOT FOUND IN THIS RUN ************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 2 | 1.75 | | 0.000 | 35088 | 632766 | 1 | |
| 3 | 4.55 | HEX. CHROME | 1.046 | 106216 | 1066386 | 1 | 15.68 |

File: C:\DX\DATA\METALS\319CR001.D07 Sample: 1_PPB_ICV



Custom Report Title of your choice



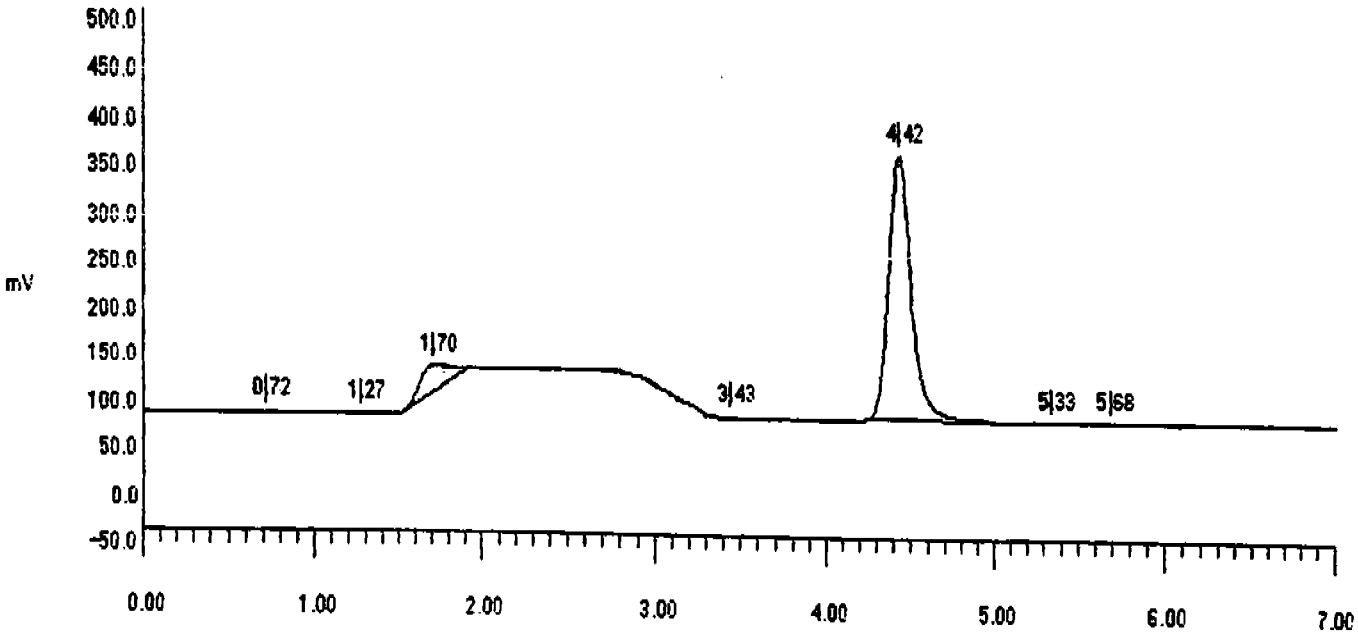
DATA REPROCESSED ON Thu Mar 19 14:58:05 1992

```
==================================================================================
| Sample Name: 20892/PES/TEST 4A 2.5 PPB MS   Date: Thu Mar 19 14:47:57 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D14                                |
| Method     : C:\DX\METHOD\MCLAREN.MET                                      |
| ACI Address: 1        System : 2        Inject#:  14  Detector: VDM-1      |
==================================================================================
```

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 0.72 | MATRIX | 0.000 | 1015 | 15945 | 1 | 0.00 |
| 3 | 1.70 | | 0.000 | 28652 | 339263 | 1 | |
| 4 | 3.43 | | 0.000 | 1176 | 17019 | 1 | |
| 5 | 4.42 | | 2.621 | 279333 | 2578096 | 1 | |
| 7 | 5.68 | | 0.000 | 1008 | 51802 | 1 | |

File: C:\DX\DATA\METALS\319CR001.D14 Sample: 20892/PES/TEST 4A 2.5 PPB MS



Custom Report Title of your choice

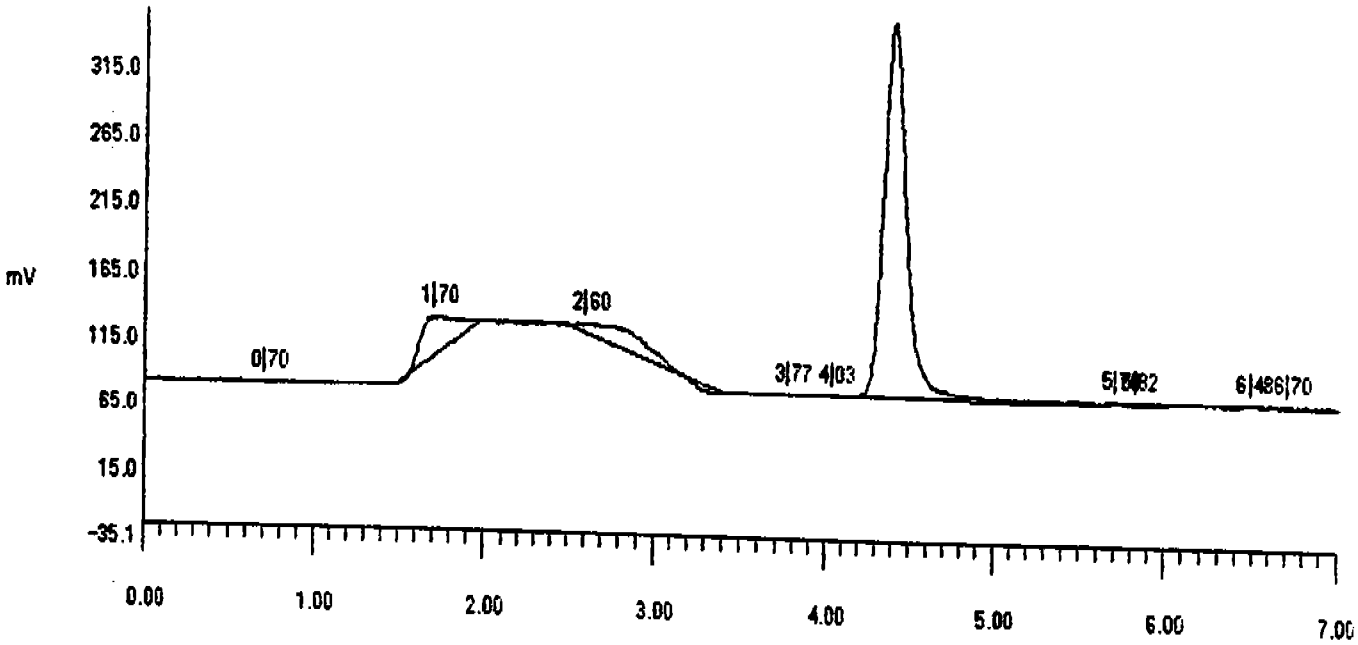
```
==================================================================================
| Sample Name: 20892/PES/TEST 4A 2.5 PPB MSD  Date: Thu Mar 19 15:01:36 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D15                                |
| Method     : C:\DX\METHOD\MCLAREN.MET                                      |
| ACI Address: 1        System : 2        Inject#:  15  Detector: VDM-1      |
==================================================================================
*********************** PEAKS NOT FOUND IN THIS RUN ***************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.17 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 0.70 | | 0.000 | 797 | 19754 | 1 | |
| 2 | 1.70 | | 0.000 | 30028 | 402014 | 1 | |
| 3 | 2.60 | | 0.000 | 5923 | 265898 | 1 | |
| 6 | 4.38 | HEX. CHROME | 2.666 | 276134 | 2620481 | 1 | 8.69 |
| 8 | 5.82 | | 0.000 | 515 | 10650 | 1 | |

File: C:\DX\DATA\METALS\319CR001.D15 Sample: 20892/PES/TEST 4A 2.5 PPB MSD



Custom Report Title of your choice

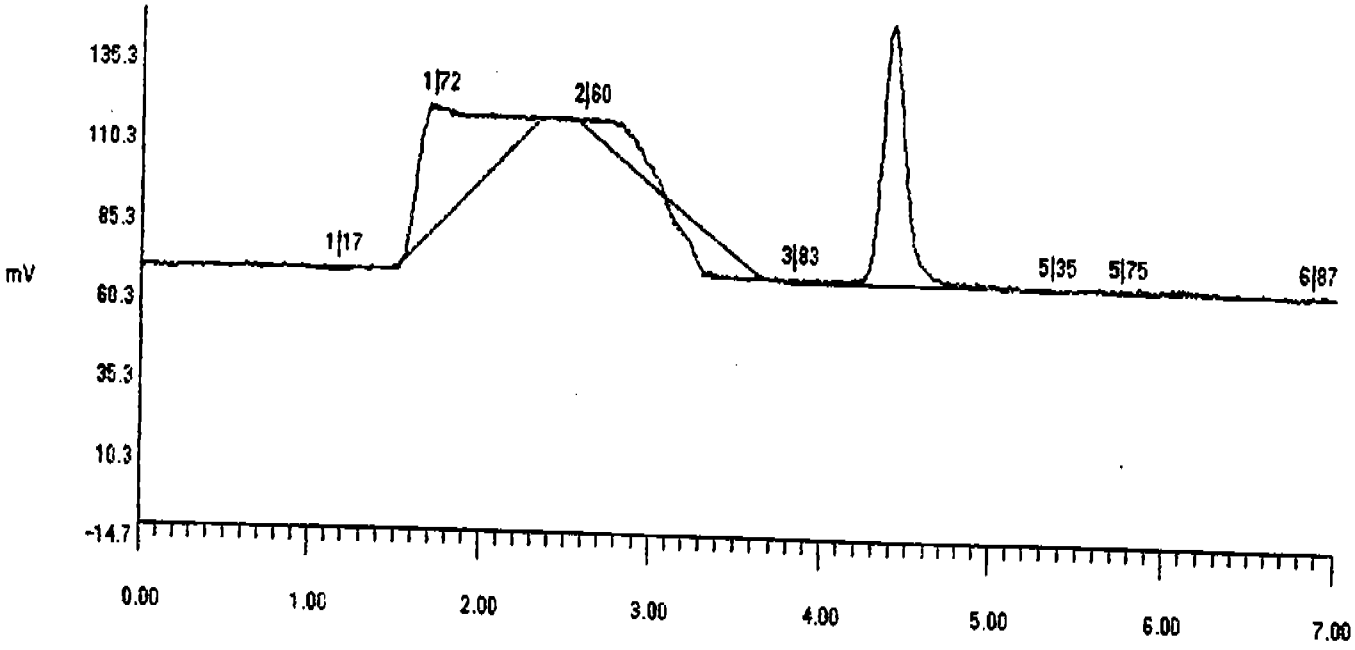
```
==================================================================================
| Sample Name: 20892/PES/TEST 4A + 0.5 PPB     Date: Thu Mar 19 15:45:43 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D19                                  |
| Method     : C:\DX\METHOD\MCLAREN.MET                                        |
| ACI Address: 1        System : 2        Inject#:  19  Detector: VDM-1       |
==================================================================================
**********************  PEAKS NOT FOUND IN THIS RUN  **************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.16 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 1 | 1.17 | | 0.000 | 844 | 10656 | 1 | |
| 2 | 1.72 | | 0.000 | 39045 | 955028 | 1 | |
| 3 | 2.60 | | 0.000 | 3390 | -42855 | 1 | |
| 4 | 3.83 | | 0.000 | 1016 | 14538 | 2 | |
| 5 | 4.38 | HEX. CHROME | 0.727 | 79312 | 760100 | 2 | 0.00 |

File: C:\DX\DATA\METALS\319CR001.D19 Sample: 20892/PES/TEST 4A + 0.5 PPB



Custom Report Title of your choice

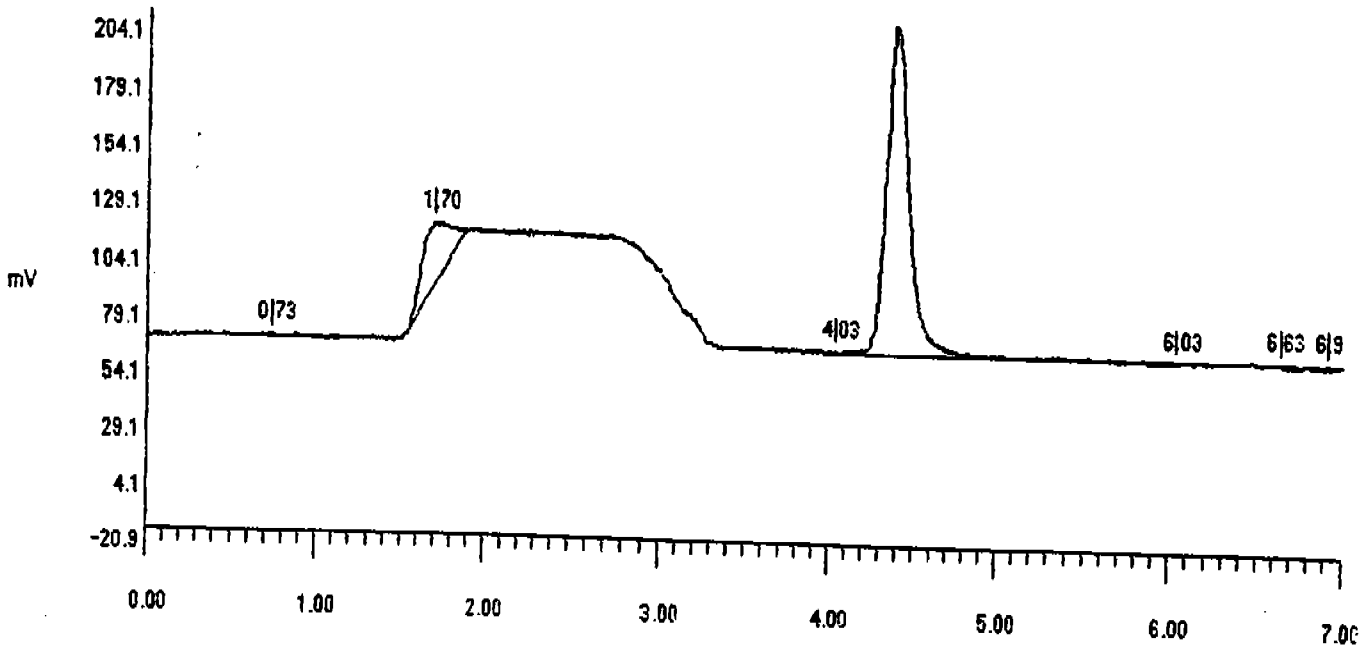
```
==================================================================================
| Sample Name: 20892/PES/TEST 4A + 1.0 PPB     Date: Thu Mar 19 15:55:57 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D20                                  |
| Method     : C:\DX\METHOD\MCLAREN.MET                                        |
| ACI Address: 1        System : 2        Inject#:  20  Detector: VDM-1       |
==================================================================================
*********************** PEAKS NOT FOUND IN THIS RUN ***************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.16 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 2 | 1.70 | | 0.000 | 27194 | 310345 | 1 | |
| 4 | 4.37 | HEX. CHROME | 1.326 | 139041 | 1335541 | 2 | 0.00 |

File: C:\DX\DATA\METALS\319CR001.D20 Sample: 20892/PES/TEST 4A + 1.0 PPB



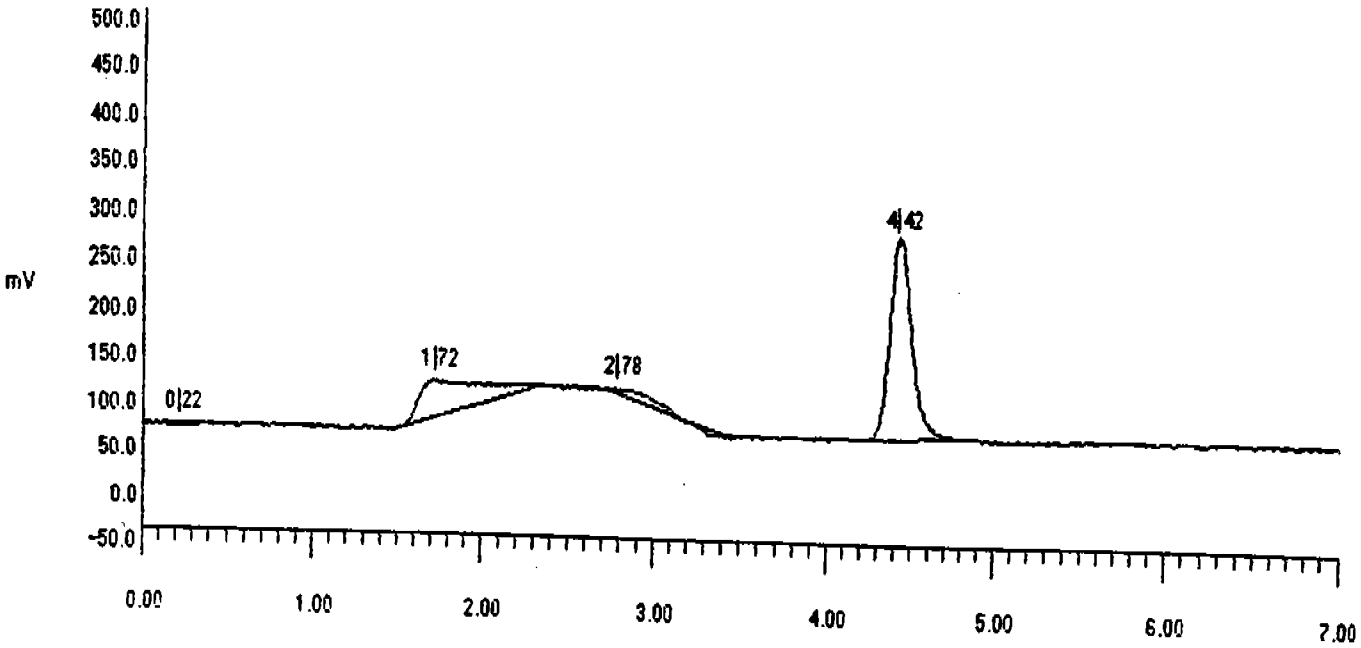
DATA REPROCESSED ON Thu Mar 19 16:23:44 1992

Sample Name: 20892/PES/TEST 4A + 1.5 PPB  Date: Thu Mar 19 16:06:09 1992
Data File : C:\DX\DATA\METALS\319CR001.D21
Method : C:\DX\METHOD\MCLAREN.MET
ACI Address: 1  System : 2  Inject#: 21  Detector: VDM-1

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 2 | 1.72 | | 0.000 | 38488 | 893715 | 1 | |
| 3 | 2.78 | | 0.000 | 4065 | 88070 | 1 | |
| 4 | 4.42 | | 1.923 | 207928 | 1907796 | 1 | |

File: C:\DX\DATA\METALS\319CR001.D21 Sample: 20892/PES/TEST 4A + 1.5 PPB



Custom Report Title of your choice

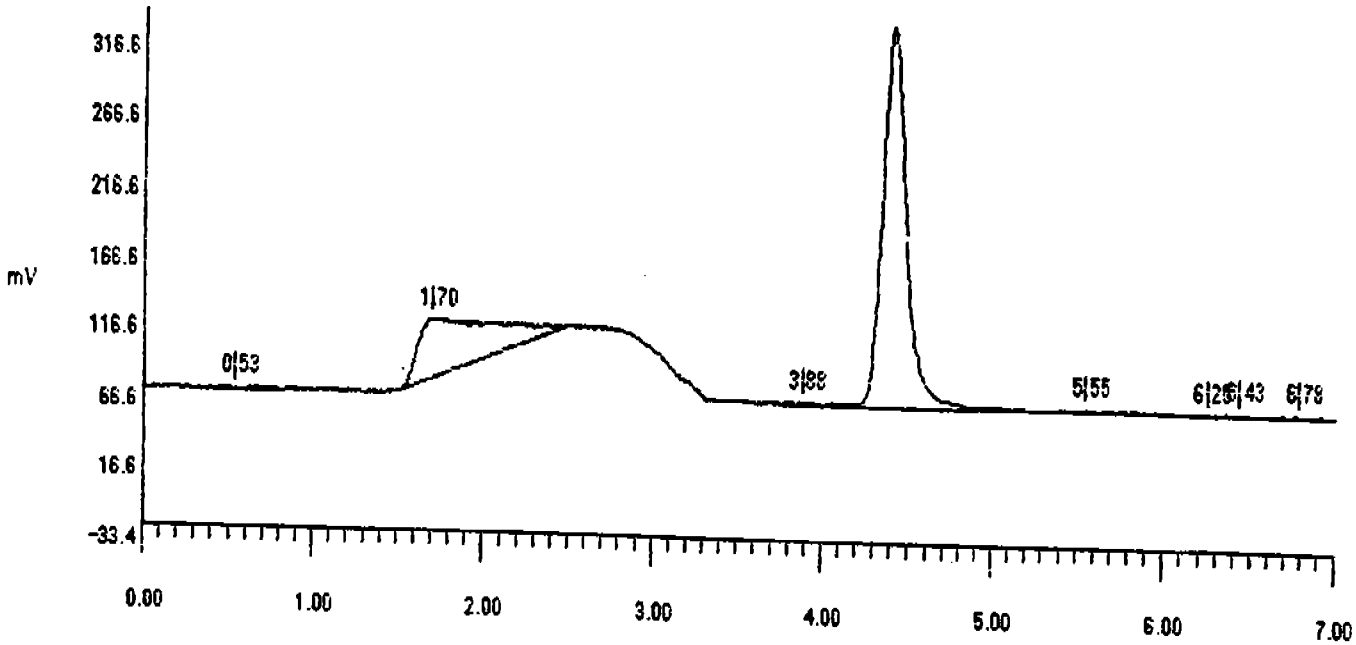
```
==================================================================================
| Sample Name: 20892/PES/TEST 4A + 2.0 PPB     Date: Thu Mar 19 16:27:26 1992|
| Data File  : C:\DX\DATA\METALS\319CR001.D22                                  |
| Method     : C:\DX\METHOD\MCLAREN.MET                                        |
| ACI Address: 1        System : 2        Inject#:  22  Detector: VDM-1       |
==================================================================================
**********************  PEAKS NOT FOUND IN THIS RUN  **************************
```

| Name | Adjusted Ret Time | Reference Peak |
|---|---|---|
| MATRIX | 0.16 | 2 |

| REPORT | VOLUME | DILUTION | POINTS | RATE | START | STOP | AREA REJ |
|---|---|---|---|---|---|---|---|
| External | 1 | 1 | 2105 | 5Hz | 0.00 | 7.02 | 10000 |

| Pk. Num | Ret Time | Component Name | Concentration | Height | Area | BL | %Delta |
|---|---|---|---|---|---|---|---|
| 2 | 1.70 | | 0.000 | 41513 | 1202218 | 1 | |
| 4 | 4.38 | HEX. CHROME | 2.542 | 264122 | 2501990 | 2 | 0.00 |
| 5 | 5.55 | | 0.000 | 1018 | 17656 | 3 | |

File: C:\DX\DATA\METALS\319CR001.D22 Sample: 20892/PES/TEST 4A + 2.0 PPB



# APPENDIX D

## Equipment Calibration Records

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

# R E P O R T  O F  C A L I B R A T I O N

## 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 METROLGIA 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 DISCUSION 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. 128239
NIST IDENTIFICATION NO. 88024

EVER READY THERMOMETER CO.

# DIGITAL THERMOMETER CALIBRATION

CALIBRATTED BY: Anja Müller

DATE: 12/26/91

| Digital Thermometer | (°F) | Thermometer (°C) |
|---|---|---|
| Fisher | 32 | 0 ( 32 °F) |
| | 72.5 | 22.5 ( 72.5 °F) |
| | 213 | 99.5 (211.1 °F) |

| Digital Thermometer | (°C) | Thermometer (°C) |
|---|---|---|
| Omega | 0 | 0 |
| | 22 | 22 |
| | 100 | 100 |

| Digital Thermometer | (°C) | Thermometer (°C) T1 | T2 |
|---|---|---|---|
| Fluke | 0 | 0 | 0 |
| | 22 | 22 | 22 |
| | 100 | 100 | 100 |

# THERMOCOUPLE CALIBRATION

CALIBRATED BY: Angie Mallen

DATE: 12/26/91

| Thermocouple number | Thermocouple reading (°C) | Thermometer reading (°C) |
|---|---|---|
| TC-1 | OUT OF SERVICE | |
| TC-2 | 22.5<br>1.8<br>100.5 | 22<br>0<br>100 |
| TC-3 | 22<br>1.7<br>100 | 22.5<br>0<br>100 |
| TC-4 | 20.6<br>1.6<br>100.4 | 22.5<br>0<br>100 |
| TC-5 | 24<br>1.7<br>100.9 | 23<br>1<br>100 |
| TC-6 | 22.4<br>1.3<br>100.4 | 23<br>0<br>100 |
| TC-7 | 24<br>1.5<br>97 | 23<br>0<br>101 |
| TC-8 | 22.4<br>2<br>99.9 | 22.4<br>1<br>100 |

| | | |
|---|---|---|
| TC-9 | 23<br>2<br>100.9 | 23<br>1<br>100 |

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

# SOURCE SAMPLING NOZZLE CALIBRATION

CALIBRATED/UPDATED BY: [illegible]

DATE: 12/24/91

| NOZZLE ID # | READING (INCHES) 1 | 2 | 3 | AVERAGE DIAMETER | SHAPE | COMMENTS |
|---|---|---|---|---|---|---|
| 02P | 0.301 | 0.298 | 0.300 | 0.300 | CURVED | |
| 03P | 0.303 | 0.302 | 0.300 | | CURVED | CHIPPED |
| 04P | 0.300 | 0.300 | 0.302 | 0.301 | CURVED | |
| 05P | 0.238 | 0.238 | 0.239 | 0.238 | CURVED | |
| 06P | 0.503 | 0.505 | 0.504 | 0.504 | B.H. | |
| 07O | | | | | | |
| 08P | 0.367 | 0.369 | 0.368 | 0.368 | CURVED | |
| 09P | | | | | | |
| 10O | 0.383 | 0.382 | 0.379 | 0.381 | 90 | |
| 11P | 0.500 | 0.497 | 0.498 | | CURVED | CHIPPED |
| 12O | 0.381 | 0.383 | 0.381 | 0.382 | 90 | |
| 13 | 0.264 | 0.262 | 0.265 | 0.264 | CURVED | |
| 14P | | | | | | |
| 16 | 0.498 | 0.497 | 0.500 | 0.498 | CURVED | |
| 17P | 0.494 | 0.496 | 0.493 | | CURVED | CHIPPED |
| 18P | 0.494 | 0.495 | 0.497 | 0.495 | CURVED | |
| 19O | | | | | | |
| 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. | |
| 24O | 0.519 | 0.515 | 0.518 | 0.517 | 90 | |
| 25O | | | | | | |
| 26S | 0.487 | 0.486 | 0.486 | 0.486 | B.H. | |
| 28PB | 0.435 | 0.439 | 0.438 | 0.437 | B.H. | |
| 30PB | 0.806 | 0.799 | 0.806 | | B.H. | |
| 38PB | 0.801 | 0.807 | 0.804 | | B.H. | |
| 40P | 0.224 | 0.225 | 0.222 | 0.224 | 90 | |
| 41P | | | | | | |
| 45PB | 0.375 | 0.379 | 0.375 | 0.376 | B.H. | |
| 46PB | 0.383 | 0.382 | 0.383 | 0.383 | B.H. | |
| 47PB | 0.246 | 0.248 | 0.245 | 0.246 | B.H. | |
| 112 | 0.374 | 0.375 | 0.375 | 0.375 | B.H. | |
| O | 0.142 | 0.141 | 0.140 | 0.141 | B.H. | |
| O1 | 0.141 | 0.142 | 0.141 | 0.141 | B.H. | |
| O2 | 0.141 | 0.141 | 0.142 | 0.141 | B.H. | |
| X1 | 0.311 | 0.308 | 0.307 | 0.309 | CURVED | |
| X2 | 0.369 | 0.372 | 0.369 | 0.370 | CURVED | |
| X3 | 0.241 | 0.241 | 0.241 | 0.241 | CURVED | |
| X4 | 0.243 | 0.242 | 0.241 | 0.242 | CURVED | |
| X5 | 0.238 | 0.238 | 0.238 | 0.238 | CURVED | |

PEC

# PITOT TUBE CALIBRATION DATA SHEET

Calibrated By: [illegible]

Date: 12-11-91

Pitot I.D. No.: S-3B

Effective Length: 29" ≈ 2.5'

Pitot Tube Assembly Level? Yes ✓ No ____

Pitot Tube Openings Damaged? Yes (explain below) ____ No ✓

$\alpha_1$ = 0 ° (<10°) $\alpha_2$ = 0 ° (<10°)

$\beta_1$ = 1.0 ° (<5°) $\beta_2$ = 0 ° (<5°)

$\gamma$ = 1.0 ° $\theta$ = 0 ° A = 1.150" ·

z = A sin = 0.020 cm (in.) 0.32 cm (<1/8 in.)

w = A sin = 0 cm (in.) 0.08 cm (<1/32 in.)

$P_A$ = 0.555 cm (in.)

$P_B$ = 0.555 cm (in.)

$D_t$ = 0.377 cm (in.)

Comments: ____

Calibration Required? Yes ____ No ✓

# DRY GAS METER AND ORIFICE CALIBRATION

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

Barometric Pressure 29.7 Calibration Date 03-03-92 Calibration Performed By: Anja Mellr

| Orifice Manometer Setting H="H20 | Initial Reference DGM Reading V=ft3 | Final Reference DGM Reading V=ft3 | Reference Gas Volume Vr=ft3 | Initial DGM Reading V=ft3 | Final DGM Reading V=ft3 | Test DGM Volume Vd=ft3 | Temperature: Reference DGM tr=F | Temperature: Box DGM Inlet t=F | Temperature: Box DGM Outlet t=F | Temperature: Box DGM Average td | Run Time Min. | Flow Rate Q=cfm | Meter Gamma | H@ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | 416.100 | 426.120 | 10.02 | 149.115 | 159.170 | 10.055 | 73 | 75 | 71 | 73 | 25.0 | 0.38 | 0.995 | 1.886 |
| 1.0 | 426.802 | 436.875 | 10.073 | 159.865 | 169.962 | 10.097 | 75 | 80 | 75 | 77.5 | 18.6 | 0.53 | 1.000 | 1.938 |
| 2.0 | 437.410 | 447.461 | 10.051 | 170.496 | 180.516 | 10.020 | 76 | 85 | 77 | 81 | 13.5 | 0.73 | 1.007 | 2.045 |
| 4.0 | 447.954 | 458.190 | 10.236 | 181.014 | 191.162 | 10.148 | 76 | 87 | 79 | 83 | 9.6 | 1.04 | 1.012 | 1.987 |

| | | |
|---|---|---|
| AVERAGE | 1.004 | 1.964 |

DRY GAS METER AND ORIFICE CALIBRATION

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

Barometric Pressure 29.7 Calibration Date 03-03-92 Calibration Performed By:

| Orifice Manometer Setting H="H2O | Initial Reference DGM Reading V=ft3 | Final Reference DGM Reading V=ft3 | Reference Gas Volume Vr=ft3 | Initial DGM Reading V=ft3 | Final DGM Reading V=ft3 | Test DGM Volume Vd=ft3 | Temperature: Reference DGM tr=F | Temperature: Box DGM Inlet t=F | Temperature: Box DGM Outlet t=F | Temperature: Box DGM Average td | Run Time Min. | Flow Rate Q=cfm | Meter Gamma | H@ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | 0.000 | 0.000 | 0 | 0.000 | 0.000 | 0.000 | 0 | 0 | 0 | 0 | 0 | ERR | ERR | ERR |
| 1.0 | 458.410 | 463.801 | 5.391 | 191.391 | 196.858 | 5.467 | 76 | 84 | 79 | 81.5 | 10 | 0.53 | 0.994 | 1.948 |

# Dick Munns Company

LIQUID AND GAS - FLOWMETER CALIBRATION SERVICE

**Phone (213) 596-1559 • FAX (714) 827-0823 • 10571 Calle Lee – 133 • Los Alamitos, CA 90720**


# Certificate

| | | | |
|---|---|---|---|
| CUSTOMER<br>PACIFIC ENVIRONMENTAL SERVICES, INC. | | TYPE OF INSTRUMENT:<br>P.D. Meter | |
| | | FLUID:<br>Air @ 14.7 PSIA & 70°F. | |
| DATE<br>6-4-91 | CALIBRATION INTERVAL<br>12 months | BAROMETER | HUMIDITY |
| SERIAL NO.<br>25507 | ASSET NO. | MODEL<br>190 CFH | MANUFACTURER<br>Rockwell |
| RATED ACCURACY<br>± .5% | TEST UNITS<br>A-3 & A-54 | N.I.S.T.<br>M-0122 | TEST RESULTS<br>☒ AS RECEIVED ☐ ADJUSTED |

| INDICATED | ACTUAL | | |
|---|---|---|---|
| S.C.F.M. | S.C.F.M. | | |
| | | | |
| .102 | .101 | | |
| .200 | .200 | | |
| .276 | .275 | | |
| .713 | .714 | | |
| 1.225 | 1.226 | | |
| 1.740 | 1.720 | | |
| 2.672 | 2.684 | | |
| 3.350 | 3.362 | | |
| | | | |
| | | | |
| | | | |

ALL TEST UNITS TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY AS PER MIL-STD-45662A.

| | |
|---|---|
| TECHNICIAN<br>RM | APPROVED BY<br>S Munns |

Source category: Electroplating
Plant name : Naval Aviation Depot
Process : Chromic acid anodizing

Filename: REF_4-84.WQ1
Location: San Diego, CA
Test date: March 17-18, 1992

Date: 04/16/96
Ref. No.: 4-84
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, ft2 | Emission factor g/hr-ft2 | Emission factor gr/hr-ft2 | Rat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chromic acid anodizing tank | PBS/ MPME | Total Cr | 1 | CARB 425 | 120 | 93.0 | 98.9 | 668 | 3.72 | 5.8E-07 | 3.32E-06 | 31 | 0.00052 | 0.00074 | |
| | | Total Cr | 2 | | 120 | 100.2 | 85.7 | 699 | 2.36 | 4.2E-07 | 2.55E-06 | 31 | 0.00040 | 0.00057 | |
| | | Total Cr | 3 | | 120 | 98.7 | 86.9 | 720 | 1.38 | 2.5E-07 | 1.51E-06 | 31 | 0.00024 | 0.00034 | |
| | | | | | | | | | | | | Average | 0.00038 | 0.00055 | B |
| | | Cr+6 | 1 | CARB 425 | 120 | 93.0 | 98.9 | 668 | 3.72 | 5.8E-07 | 3.32E-06 | 31 | 0.00052 | 0.00074 | |
| | | Cr+6 | 2 | | 120 | 100.2 | 85.7 | 699 | 2.96 | 5.3E-07 | 3.19E-06 | 31 | 0.00050 | 0.00071 | |
| | | Cr+6 | 3 | | 120 | 98.7 | 86.9 | 720 | 0.69 | 1.2E-07 | 7.56E-07 | 31 | 0.00012 | 0.00017 | |
| | | | | | | | | | | | | Average | 0.00038 | 0.00054 | B |

Notes: Cr+6 by IC/PCR; Run 3 below quantitation limit--1/2 limit assumed
Cr+6 Run 3 below quantitation limit--1/2 limit assumed
Total Cr Run 3 below quantitation limit--1/2 limit assumed