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**Background Chapter 4**

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**Title:** **NEESA 2-161. Particulate and Chromium Emission Testing at Plastic**

**Media Blasting Facility, BLDG 25, Naval Aviation Depot, Naval Air Station, Alameda, CA, Naval Energy and Environmental Support Activity, Port Hueneme, CA,**

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# PARTICULATE AND CHROMIUM EMISSION TESTING AT PLASTIC MEDIA BLASTING FACILITY, BLDG 25 NAVAL AVIATION DEPOT, NAVAL AIR STATION ALAMEDA, CA

**NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY**

**Port Hueneme, California 93043-5014**

UIC:N65885

NEESA 2-161 May 1990

# PARTICULATE AND CHROMIUM EMISSION TESTING AT PLASTIC MEDIA BLASTING FACILITY, BLDG 25 NAVAL AVIATION DEPOT, NAVAL AIR STATION ALAMEDA, CA

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## EXECUTIVE SUMMARY

The Naval Energy and Environmental Support Activity performed particulate and chromium emission tests for plastic media blasting (PMB) operations at Building 25, corrosion control facility, Naval Aviation Depot, Alameda, during 7-11 May, 1990.

The following table shows the maximum emissions of particulate, total chromium and hexavalent chromium encountered during testing of two dust collection systems (baghouses).

| | PARTICULATE (mg/dscm) | TOTAL CHROMIUM (gram/hr) | HEXAVALENT CHROMIUM (gram/hr) |
|---|---|---|---|
| MAXIMUM EMISSIONS OCCURRING DURING TESTING | 6.09 | 0.211 | 0.083 |

Results show that particulate emission concentrations do not exceed the BAAQMD limit of 343 mg/dscm. Results also show that hexavalent chromium emission rates do not exceed the BAAQMD limit of 0.1 gram/hour.

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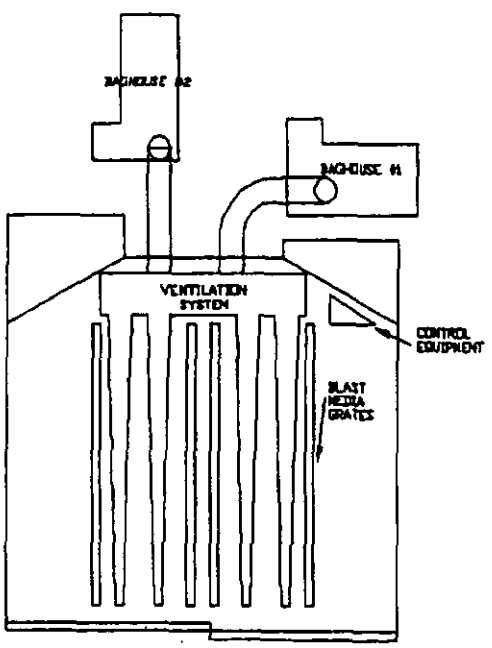
## 1.0 INTRODUCTION

Naval Aviation Depot, Naval Air Station, Alameda requested Naval Energy and Environmental Support Activity (NEESA) to perform chromium and particulate emission tests on the baghouse exhaust systems at Building 25, corrosion control facility. Building 25 houses three large aircraft paint stripping bays. Bay #1 is equipped to strip aircraft using plastic media blasting (PMB). The Bay Area Air Quality Management District required source emission tests to comply with S-343 Plastic Media Blasting Bay Authority to Construct. The Authority to Construct specifies hexavalent chromium emissions not to exceed 0.1 gram/hour. BAAQMD Regulation 6 specifies particulate emission rate not to exceed 343 mg/dscm (0.15 gr/dscf). We performed six valid modified EPA Method 5 stack outlet emission tests on bay #1 (four runs on baghouse #1 and 2 runs on baghouse #2) during 7-11 May, 1990. A contracted laboratory performed analyses for particulate, total chromium, and hexavalent chromium. We used the laboratory results to calculate emission rates and emission concentrations for compliance purposes.

## 2.0 PROCESS OPERATION

The plastic media blasting bay utilizes two under floor ventilation lines. One ventilation line consists of supply air fan, 60,000 cfm exhaust fan, media blasting equipment, media reclaim system and dust collection system (baghouse #1). The other ventilation line consists of a second supply air fan, a second 60,000 cfm exhaust fan and a second dust collection system (baghouse #2). Figures 1 and 2 show schematics of the ventilation system. We tested the ventilation line which includes the PMB equipment (baghouse #1) without the second ventilation line operating. These test runs represent the worst case scenario as the media reclaim system contributes additional particulate loading to the exhaust. We tested the second ventilation line (baghouse #2) with both ventilation lines operating because the media blasting equipment will not function without the media reclaim system operating.

A custom designed plastic media blasting unit is used with five simultaneous blast nozzles. The system utilizes a vibrating screen, cyclone, and ferrous metal particle separator within the media reclaim system. Two baghouses collect particulate emissions. During blasting operations, nozzle operators blast assorted aircraft components. Used blast media is then swept into floor ventilation grates equipped with screw conveyors which transport the used media to the reclaim system. We collected emission samples while the operators performed both blasting and media sweeping operations. Media is recycled in the reclaim system and exhaust air flows to the baghouse.




BAY #1
PLASTIC MEDIA BLASTING
NOT TO SCALE
PLAN VIEW

Figure 1

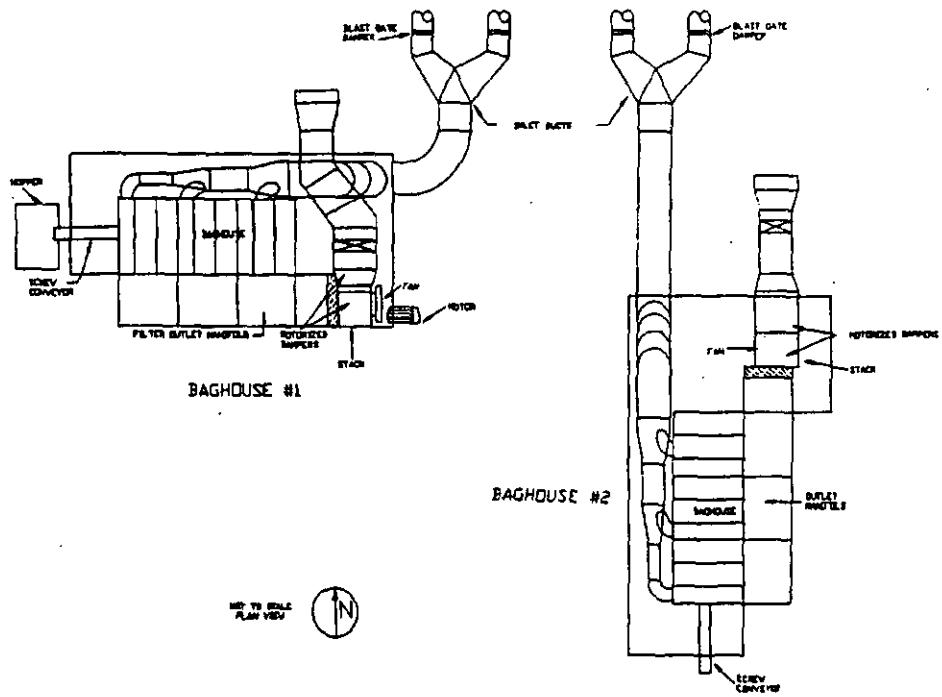
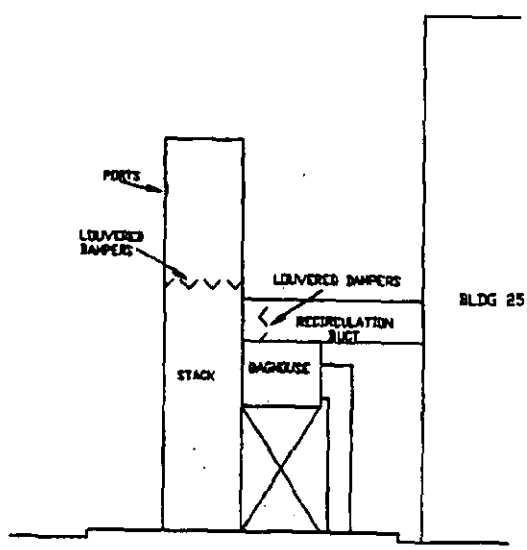



Figure 2

The original design for the PMB bay incorporated filtered exhaust air recirculation into the stripping bay. The exhaust stack, supply air vents and recirculation ducts have louvered dampers which are mechanically actuated controlling the exhaust and recirculation air flows. For the purpose of testing, we manually fixed the dampers so that no air was recirculated; recirculation duct dampers were fully closed, the stack exhaust dampers were fully open, and supply air dampers were set for 100% outside air, see Figure 3.




DAMPER SCHEMATIC

Figure 3

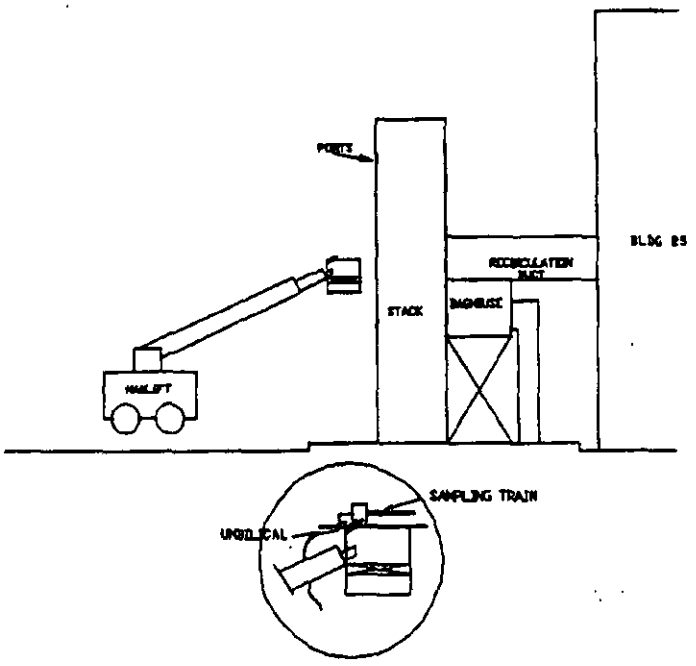
During testing various aircraft component parts, such as flaps, doors, canopies, side plates, hatches, and wing sections, were located in an area central to the operational exhaust system. All components had MIL-C-85285 Type I paint. Approximately 50% of the parts had gray topcoat, 45% had white topcoat, and 5% had heat resistant silver paint. The primer used under all topcoats except the heat resistant silver paint was MIL-P-85582. Appendix B contains material safety data sheets for representative paints.

The blasting load was maintained as high as possible throughout testing, subject to aircraft component supply constraints. Table 1 shows the number of nozzle hours during each test run.

TABLE 1
NOZZLE HOURS

| RUN # | NOZZLE 1 | NOZZLE 2 | NOZZLE 3 | NOZZLE 4 | NOZZLE 5 | TOTAL |
|---|---|---|---|---|---|---|
| BAGHOUSE #1 | | | | | | |
| RUNS 1 & 2 | 1.15 | 1.05 | 1.35 | 0.75 | 0.00 | 4.30 |
| RUNS 3 & 4 | 1.10 | 0.95 | 0.75 | 0.70 | 0.00 | 3.50 |
| BAGHOUSE #2 | | | | | | |
| RUNS 5 & 6 | 1.65 | 0.60 | 2.80 | 0.80 | 0.55 | 6.40 |

Figure 4 shows the sampling site and method used to access the ports.




SAMPLING SITE SCHEMATIC

Figure 4

## 3.0 PROCEDURE

Modified EPA Method 5 emission tests were performed on each baghouse to quantify moisture and particulate. Sampling procedures and equipment coincided with EPA methods specified in Code of Federal Regulations, Title 40, Part 60, Appendix A, of 1 July 1988, except as noted. California Air Resources Board Method 425 was used as the basis for the EPA Method 5 modifications and to analyze for both total and hexavalent chromium. While Method 425 calls for split filter analysis, we elected to collect duplicate emission samples to allow one sample for immediate hexavalent chromium analysis and an additional sample for particulate and total chromium analyses. A contracted laboratory performed initial filter preparations, particulate and chromium analyses.

US EPA Test Methods used:

EPA Method 1 - Sample and Velocity Traverses for Stationary Sources

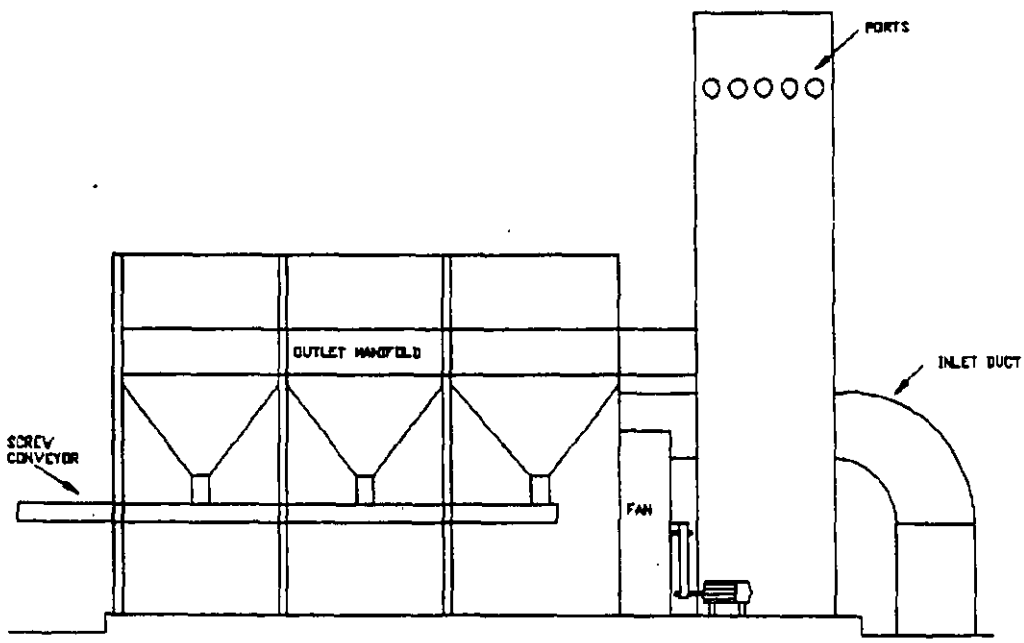
EPA Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

EPA Method 4 - Determination of Moisture in Stack Gases

EPA Method 5 - Determination of Particulate Emissions from Stationary Sources

California Air Resources Board Method 425 - Determination of Total Chromium and Hexavalent Chromium Emissions from Stationary Sources

We collected duplicate emission samples using two separate sampling trains operating simultaneously in order to minimize the quantity of aircraft components necessary to complete testing. Figures 5 and 6 show the sampling port location and traverse points used during testing. The site required 25 traverse points minimum per test run according to Method 1.




BAGHOUSE SCHEMATIC

Figure 5

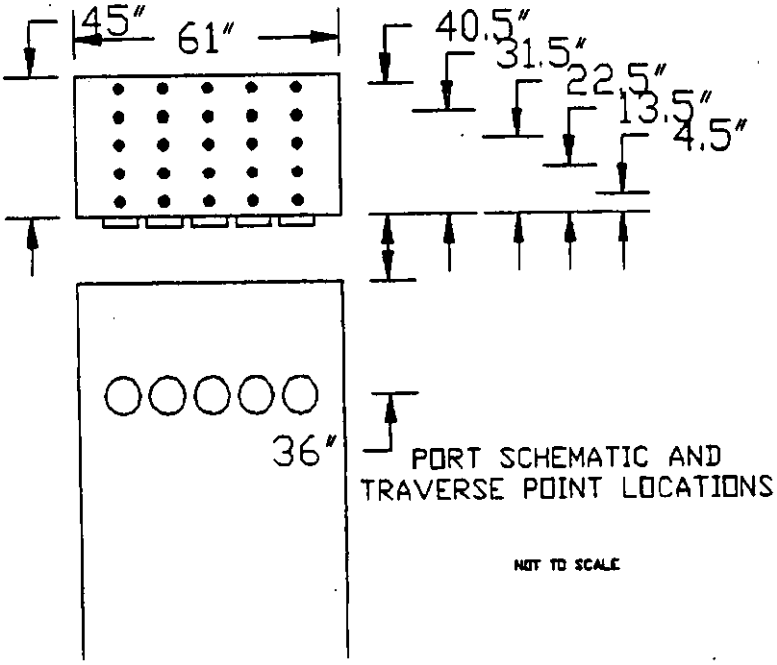
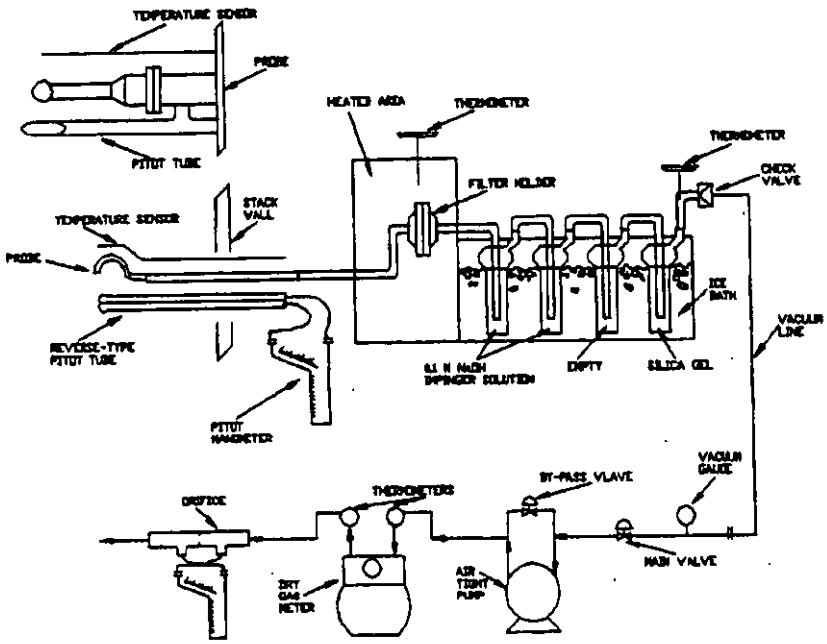



Figure 6

Figure 7 shows the modified Method 5 sampling train.




MODIFIED METHOD 5 SAMPLING TRAIN

Figure 7

The probe assembly consisted of an S-type pitot tube, a thermocouple, probe with borosilicate glass liner used to extract gas sample, and quartz glass nozzle.

Within the heated area, a Nutech filter holder with a Whatman QM-A quartz fiber filter was used for particulate collection. Filter preparation consisted of desiccating with magnesium sulfate, and consecutive weighing at a minimum of six hour intervals until constant weight was achieved. Filter preparations were performed by the contracted laboratory.

The impinger assembly consisted of three modified Greenburg-Smith impingers and one standard Greenburg-Smith impinger.

| IMPINGER TYPE | CONTENTS |
|---|---|
| 1st - Modified | 100 ml 0.1 Normal NaOH |
| 2nd - Standard | 100 ml 0.1 Normal NaOH |
| 3rd - Modified | Empty |
| 4th - Modified | 200 ml Silica Gel |

The pitot tube lines and main particulate sampling line were leak checked per Method 5, sections 4.1.4.1 and 4.1.4.3, before and after each test run.

Velocity traverses per Method 2 were performed for each test run.

Appendix A contains sample calculations for our emission analysis, including reduction of laboratory data. Appendix B contains all field data sheets.

Appendix C, pages C-1 to C-4, list the Hewlett Packard 41-CX program "Nomokin" which was used to ensure isokinetic sampling. A run was considered valid when percent isokinetic was between 90% and 110%. Appendix C, pages C-5 to C-8, lists the equations and constants "Nomokin" used for standard Method 5 calculations. Gas meter inlet temperatures were used to correct the indicated meter volume rather than the average of the inlet and the outlet. Appendix C, pages C-9 to C-11, contains an article showing use of average gas meter temperatures yield incorrect higher gas volumes.

After each run the particulate filter was transferred to a preweighed borosilicate petri dish. The front-half of the sampling train (nozzle, probe liner, and filter inlet glass) was washed with acetone into a non-reactive plastic sample bottle. We calculated water gain from the sample volume by subtracting the initial impinger weights from the final impinger weights. A calibrated Mettler PB 3000 electronic balance was used in the field for all impinger weighings. The back-half of the sampling train (filter outlet glass, cyclone bypass, connecting glassware, and impingers) was washed with 0.1 Normal NaOH solution into an non-reactive plastic sample bottle. All samples (filter, front-half and back-half) were delivered to the contracted laboratory promptly after each test.

Acetone blanks were analyzed for particulate and chromium content, both total and hexavalent. NaOH and filter blanks were analyzed for chromium content, both total and hexavalent.

Appendix D contains all laboratory data and analysis results. Appendix E contains our test equipment calibration records.

## 4.0 PERSONNEL AND CHAIN OF CUSTODY

### PERSONNEL

| | | |
|---|---|---|
| Cynthia H. Ruf | GS-11 | Lead Engineer |
| Brian Y. Quil, P.E. | GS-12 | Mechanical Engineer |
| Manual Perez | GS-7 | Engineering Technician |
| Dene Egami | GS-4 | Engineering Co-op |

### CHAIN OF CUSTODY

| | |
|---|---|
| Control Box Operation | Egami, Perez, Quil, Ruf |
| Probe Traverse | Egami, Quil |
| Sample Recovery | Ruf |
| Sample Transport | Quil, Perez, Ruf |
| Sample Analyses | Mid-Pacific Environmental Laboratory<br>Mountain View, CA |

## 5.0 RESULTS

Table 2 lists data associated with each emission test.

TABLE 2
EMISSION TEST DATA

| RUN # | PERCENT ISOKIN (%) | AVERAGE STACK FLOW RATE (acfm) | (dscfm) | TEMP. (Deg. F) | H2O (%) | SAMPLING TIME (min) |
|---|---|---|---|---|---|---|
| BAGHOUSE #1 | | | | | | |
| RUN 1 | 99.2 | 37841 | 36809 | 76 | 1.2 | 100 |
| RUN 2 | 95.3 | 37749 | 36761 | 76 | 1.2 | 100 |
| RUN 3 | 100.8 | 38499 | 37878 | 71 | 1.0 | 75 |
| RUN 4 | 102.6 | 38891 | 38253 | 70 | 1.1 | 75 |
| BAGHOUSE #2 | | | | | | |
| RUN 5 | 98.7 | 42166 | 41357 | 71 | 1.3 | 75 |
| RUN 6 | 99.8 | 43957 | 43301 | 68 | 1.3 | 75 |

### 5.1 PARTICULATE EMISSION TEST RESULTS

Table 3 summarizes the particulate emission test results. Appendix A contains sample calculations showing the particulate weight calculations for each test. Appendix B contains all field test data sheets. Appendix E contains our test equipment calibration records.

TABLE 3
PARTICULATE EMISSION TEST RESULTS

| RUN # | SAMPLE PARTICULATE WEIGHT (mg) | SAMPLE VOLUME (dscf) | STACK FLOW RATE (dscfm) | EMISSION RATE (lbs/hr) | (gm/hr) | EMISSION CONCENTRATION (mg/dscm) | (gr/dscf) |
|---|---|---|---|---|---|---|---|
| BAGHOUSE #1 | | | | | | | |
| RUN 1 | 9.8 | 56.99 | 36809 | 0.839 | 380.56 | 6.09 | 2.66E-03 |
| RUN 4 | 2.4 | 38.13 | 38253 | 0.318 | 144.46 | 2.22 | 9.71E-04 |
| BAGHOUSE #2 | | | | | | | |
| RUN 6 | 3.0 | 42.47 | 43301 | 0.407 | 184.75 | 2.51 | 1.10E-03 |
| AVERAGE | | | | 0.522 | 236.59 | 3.61 | 1.58E-03 |

As shown in Table 3, the maximum particulate concentration reported, 6.09 mg/dscm (2.66E-03 gr/dscf) is well below the BAAQMD emission limit of 343 mg/dscm (0.15 gr/dscf).

## 5.2 TOTAL CHROMIUM EMISSION TEST RESULTS

Table 4 summarizes the total chromium emission test results.

TABLE 4
TOTAL CHROMIUM EMISSION TEST RESULTS

| RUN # | TOTAL CHROME (μg) | SAMPLE VOLUME (dscf) | STACK FLOW RATE (dscfm) | EMISSION RATE (lb/hr) | EMISSION RATE (gm/hr) | EMISSION CONCENTRATION (mg/dscm) | EMISSION CONCENTRATION (gr/dscf) |
|---|---|---|---|---|---|---|---|
| BAGHOUSE #1 | | | | | | | |
| RUN 1 | 5.45 | 56.99 | 36809 | 4.66E-04 | 0.211 | 3.38E-03 | 1.48E-06 |
| RUN 4 | <1.00 | 38.13 | 38253 | <1.33E-04 | <0.060 | <9.26E-04 | <4.05E-07 |
| BAGHOUSE #2 | | | | | | | |
| RUN 6 | 1.57 | 42.47 | 43301 | 2.12E-04 | 0.096 | 1.31E-03 | 5.70E-07 |
| AVERAGE | | | | 2.70E-04 | 0.122 | 1.87E-03 | 8.17E-07 |

*NOTE: Run 4 results were below method detection limits

## 5.3 HEXAVALENT CHROMIUM EMISSION TEST RESULTS

Table 5 summarizes the hexavalent chromium emission test results.

TABLE 5
HEXAVALENT CHROMIUM EMISSION TEST RESULTS

| RUN # | HEX CHROME (μg) | SAMPLE VOLUME (dscf) | STACK FLOW RATE (dscfm) | EMISSION RATE (lbs/hr) | EMISSION RATE (gm/hr) | EMISSION CONCENTRATION (mg/dscm) | EMISSION CONCENTRATION (gr/dscf) |
|---|---|---|---|---|---|---|---|
| BAGHOUSE #1 | | | | | | | |
| RUN 2 | 1.78 | 47.20 | 36761 | 1.83E-04 | 0.083 | 1.33E-03 | 5.82E-07 |
| RUN 3 | <1.00 | 46.35 | 37878 | <1.08E-04 | <0.049 | <7.62E-04 | <3.33E-07 |
| BAGHOUSE #2 | | | | | | | |
| RUN 5 | <1.00 | 46.77 | 41357 | <1.17E-04 | <0.053 | <7.55E-04 | <3.30E-07 |
| AVERAGE | | | | 1.36E-04 | 0.062 | 9.50E-04 | 4.15E-07 |

*NOTE: Run 3 and 5 results were below method detection limits

As shown in Table 4, the maximum hexavalent chromium emission rate reported, 0.083 gm/hour (1.83E-04 lb/hr), does not exceed the BAAQMD Authority to Construct limit of 0.1 gm/hour.

## 6.0 DISCUSSION

As mentioned earlier, for testing we manually adjusted the exhaust and recirculation dampers for no recirculation (100% outside air supply). Manual adjustment was necessary because the control system would not allow the dampers to open or close fully. We inspected the exhaust stack dampers and verified they were full open for testing. The recirculation dampers, however, were not accessible for inspection. We manipulated controls and monitored air flow to determine the correct operational setting for the recirculation dampers.

Test runs 1 and 2 were performed using four minutes of sampling at each traverse point (total test time of 1 hour and 40 minutes). Due to the long sampling time used for runs 1 and 2, we encountered aircraft component supply limitations. For runs 3 and 4, we used only 3 minutes per traverse point (total test time of 1 hour and 15 minutes). Results for runs 3 and 4 show pollutant concentrations due to the lighter blasting load achieved during these runs.

The contracted laboratory did not perform back-half analysis for particulate because 0.1 Normal NaOH was used in the impingers. When dessicated, the NaOH leaves salt solids which adversely effect the particulate analysis; that is the error associated with the salt solids weight would be greater than the total particulate weight expected from the back-half.

# APPENDIX A
# SAMPLE CALCULATIONS

## SAMPLE CALCULATIONS

NET PARTICULATE WEIGHT = FILTER + ACETONE WASH (CORRECTED FOR BLANK)

= 0.0050 gm + 0.0048
= 0.0098 gm = 9.8 mg <-------

## PARTICULATE CALCULATIONS

| FILTER NO. | TARE WEIGHT (gm) | FINAL WEIGHT (gm) | PART. WEIGHT (gm) | ACETONE VOL (ml) | ACETONE WEIGHT (gm) | ACETONE PART. (gm) | TOTAL PART. (gm) |
|---|---|---|---|---|---|---|---|
| 51 | 65.0427 | 65.0477 | 0.0050 | 64 | 0.0068 | 0.0048 | 0.0098 |
| BLANK | 75.2112 | 75.2114 | 0.0002 | 100 | 0.0031 | 0.0000 | 0.0002 |
| 53 | 74.4555 | 74.4548 | -0.0007 | 10 | 0.0057 | 0.0024 | 0.0024 |
| 56 | 70.7270 | 70.7297 | 0.0027 | 96 | 0.0033 | 0.0003 | 0.0030 |

EMISSION RATE = NET PARTICULATE WEIGHT (gm) * STACK FLOW RATE (dscmm) * CONVERSION FACTORS (min/hour) / AIR SAMPLE VOLUME (dscm)

= 9.8 mg * 1042.32 (dscmm) * 60 (min/hr) / 1.6138 (dscm)
= 379.78 (gm/hr)

EMISSION CONCENTRATION = NET PARTICULATE WEIGHT (gm) * CONVERSION FACTOR (grain/gm) / SAMPLE VOLUME (dscf)

= 0.0098 gm * 15.432 (gr/gm) / 56.99
= 0.0027 gr/dscf

# APPENDIX B
# FIELD DATA SHEETS