South Coast
Air Quality Management District
South Coast AQMD
21865 Copley Drive, Diamond Bar, CA 91765-4178
(909) 396-2000 · www.aqmd.gov

SOURCE TEST REPORT

# 17-340

CONDUCTED AT

**Carlton Forge Works**
7743 Adams Street
Paramount, CA 90723

HEXAVALENT CHROMIUM EMISSIONS
FROM FURNACE #431

TESTED: May 18, 2017

ISSUED: September 1, 2017

REPORTED BY: P. Eric Padilla
Air Quality Engineer II

REVIEWED BY:

Michael Garibay
Supervising Air Quality Engineer

SOURCE TEST ENGINEERING BRANCH

MONITORING & ANALYSIS DIVISION

*Cleaning the air that we breathe...*

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**SECTION** **PAGE**

## SUMMARY

| | | |
|---|---|---|
| a. | Firm………………………………..........……. | Carlton Forge Works |
| b. | Test Location………………………………….... | 7743 Adams Street,<br>Paramount, CA 90723 |
| c. | Unit(s) Tested………………………………….. | Furnace #431 |
| d. | Test Required by………………………………. | Matt Miyasato, PhD (SCAQMD DEO),<br>(909)396-3249 |
| e. | Reason for Test Request……………………….. | High ambient monitor readings of<br>Cr (VI) |
| f. | Date of Test……………………………………..... | May 18, 2017 |
| g. | Source Test Performed by……………………... | Jason Aspell, Eric Padilla |
| h. | Test Arrangements Made Through…………..... | Armando Bautista (Environmental<br>Manager, Carlton Forge Works)<br>(562) 633-1131 |
| i. | Source Test Observed by……………………… | Armando Bautista, James Wright<br>(Division – Environmental Manager,<br>Wyman-Gordon) |
| j. | Company Facility I.D. ……………………….. | 22911 |
| k. | Permit/Application Number…………………… | N/A |

## EXECUTIVE SUMMARY

Due to ongoing citizen odor complaints regarding Carlton Forge Works and allegations that elevated nearby monitoring results were related to these complaints, Source Test engineers from the SCAQMD Source Test Branch conducted screening source testing on May 18, 2017 on Furnace #431 to determine hexavalent chromium emissions from the furnace. The testing resulted in hexavalent chromium emissions that were higher than the average ambient monitor readings in the days surrounding the test date, but on the lower end of the range of other furnace emissions that have been tested by the SCAQMD.

**Summary of Test Conditions**

During the source test, Furnace #431 was operating at approximately 1900° F. The parts within the furnace were Waspaloy®, which contains approximately 18% chromium. Because of the nature and configuration of the process, testing was performed non-isokinetically, as a screening test, due to the lack of sample ports or a stack to determine exhaust rate. The results are listed in Table 1. The emissions are expressed in nanograms per cubic meter ($ng/m^3$) for the source test as well as the ambient monitors.

Four ambient monitors are located near the Carlton Forgeworks facility. Figure 1 displays the locations of the monitors in relation to the facility (circled). Monitors #2 and #28 are just east of the plant site and monitors #3 and #25 are further east, on or near the premises of Lincoln Elementary School. Results from the ambient monitors in the timeframe near the time of the test are shown in Table 2.

## RESULTS

Below are the emissions from Furnace #431 (Table 1) and ambient air monitoring data for four monitors near the Carlton Forge Works facility. For locations of the monitors relative to the facility, see Figure 1.

**Table 1 – Hexavalent Chromium Emissions**
**May 18, 2017**

| Emissions Source | Concentration (ng/m$^3$) |
|---|---|
| Furnace #431 | 137 |

**Table 2 – Air Monitoring Data for the Area Near Carlton Forge Works (ng/m$^3$)**

| Monitor | May 10, 2017 | May 13, 2017 | May 16, 2017 | May 19, 2017 |
|---|---|---|---|---|
| 2 (SE of facility) | 0.12 | 0.03 | 0.18 | 0.32 |
| 3 (NE of facility) | --- | 0.56 | --- | 0.17 |
| 25 (E of facility) | 2.60 | 0.43 | 0.16 | 0.53 |
| 28 (NE of facility) | 1.87 | 0.18 | --- | 0.62 |

## INTRODUCTION

On May 18, 2017, Source Test Engineers from the South Coast Air Quality Management District (SCAQMD) Source Test Engineering Branch conducted source testing on Forging Furnace #431 at Carlton Forge Works in Paramount, CA. The purpose of the testing was to attempt to identify the source of elevated ambient hexavalent chromium levels measured near the facility.

Carlton Forge Works is a producer of open and closed die forged products primarily for the aerospace industry. The facility mainly forges billets from exotic metals to specific shapes and rolled rings. Testing was performed to determine hexavalent chromium in the exhaust from one of the forging furnaces, Furnace #431.

## EQUIPMENT & PROCESS DESCRIPTION

Billets are heated in forge furnaces until they reach the desired temperature. They are removed from the furnace and subjected to mechanical molding from presses, dies, and rollers. The process is repeated as necessary to cause the part to conform to the specified requirements. Throughout processing (pre-, during, and post-forming), parts may be subjected to grinding to eliminate defects. Testing for this source test was restricted to the furnace operations.

Furnace #431 contained parts composed of Waspaloy®, which contains approximately 18% chromium. At the time of the testing, the furnace was running at approximately 1900° F.

The refractory in the furnace was last re-bricked on February 17, 2016.

During testing, the furnace damper opened and closed slightly. The pressure within the furnace was +0.06 inches $H_2O$.

## SAMPLING & ANALYTICAL PROCEDURES

### General

One sampling train was utilized for a non-isokinetic screening test. Sampling was performed using train #50. Train #49 was retained as a blank sample.

Sampling was performed with the probe arranged at the opening of the damper to the furnace in such a way that it would not be damaged or interfere with the operation of the damper (see Figure 2). There was no sampling stack.

### Hexavalent Chromium Sampling

Testing was conducted based on California Air Resources Board Method 425 applied to the furnace exhaust, with the procedures of the method specific to stack sampling omitted because the furnace does not have a stack conducive to isokinetic sampling. One sample was taken at a single non-isokinetic sample point as described above for informational purposes. A second sampling train was used as a blank sample, without a probe or tubing. The furnace sampling train consisted of a quartz probe and teflon sampling line, which was used to draw the stack sample from the source. The sample was then drawn through two impingers each filled with an aqueous solution of 0.1N $NaHCO_3$ (per Section 21.2 of the Method), an empty impinger, a 2" glass filter, and an impinger filled with tared silica gel. The sampling train was connected to a leak free vacuum pump, a dry gas meter, and a calibrated orifice. The impingers were contained in an ice bath to condense water vapor and other condensable matter present in the sample stream (see Figure 2).

The samples were collected from the exhaust stream using the sampling train. The pH of the solution in the first impinger was measured after the test, but prior to recovery, at pH of at least 9 (the method requires a pH of 8.0 or higher). The impinger solutions were recovered within 24 hours and the SCAQMD laboratory analyzed the hexavalent chromium in the samples by CARB Method 425. Hexavalent chromium deposited in the filter, sample line and impingers were extracted and analyzed by an Ion Chromatograph equipped with a post-column reactor (IC/PCR) and a visible wavelength detector. Moisture content was determined gravimetrically and volumetrically.

## DISCUSSION/TEST CRITIQUE

The samples were not taken isokinetically because the stack was not conducive to isokinetic sampling on the furnace. The exhaust was extracted at a constant rate and the total volume of the sample was used to determine the mass emissions of the furnace exhaust. More precisely representative emissions samples would require a portable stack or other method for sampling isokinetically. The purpose of the screening samples are to identify potential sources of high hexavalent chromium levels so that further testing may be conducted, if necessary.

To more effectively interpret the test results, the results of the most recent Multiple Air Toxics Exposure Study (MATES), MATES IV, conducted by SCAQMD, should be considered. In that study, the typical ambient level of hexavalent chromium in the Los Angeles Basin averaged 0.06 $ng/m^3$. The emissions from Furnace #431, which were 137 $ng/m^3$, were orders of magnitude higher than this average. Though it should be noted that levels of source emissions are reduced over distance as dilution occurs, the elevated levels at the ambient monitors indicate that high levels of hexavalent chrome are being emitted in Paramount. The furnace testing indicates that Furnace #431 potentially contributes to the high ambient readings.

As of the issue date of this report, SCAQMD has measured a wide variation of furnace emissions concentrations from 19 to 24,400 $ng/m^3$. Although the emissions from Furnace #431 are on the lower end of the range and may not have a large impact on the ambient monitoring readings, it is thought that the overall effect of the numerous furnaces emitting at various emissions levels at the facility may individually and/or cumulatively have a significant effect on the measured ambient concentrations.

## FIGURES

**Figure 1: Air Monitor Map**

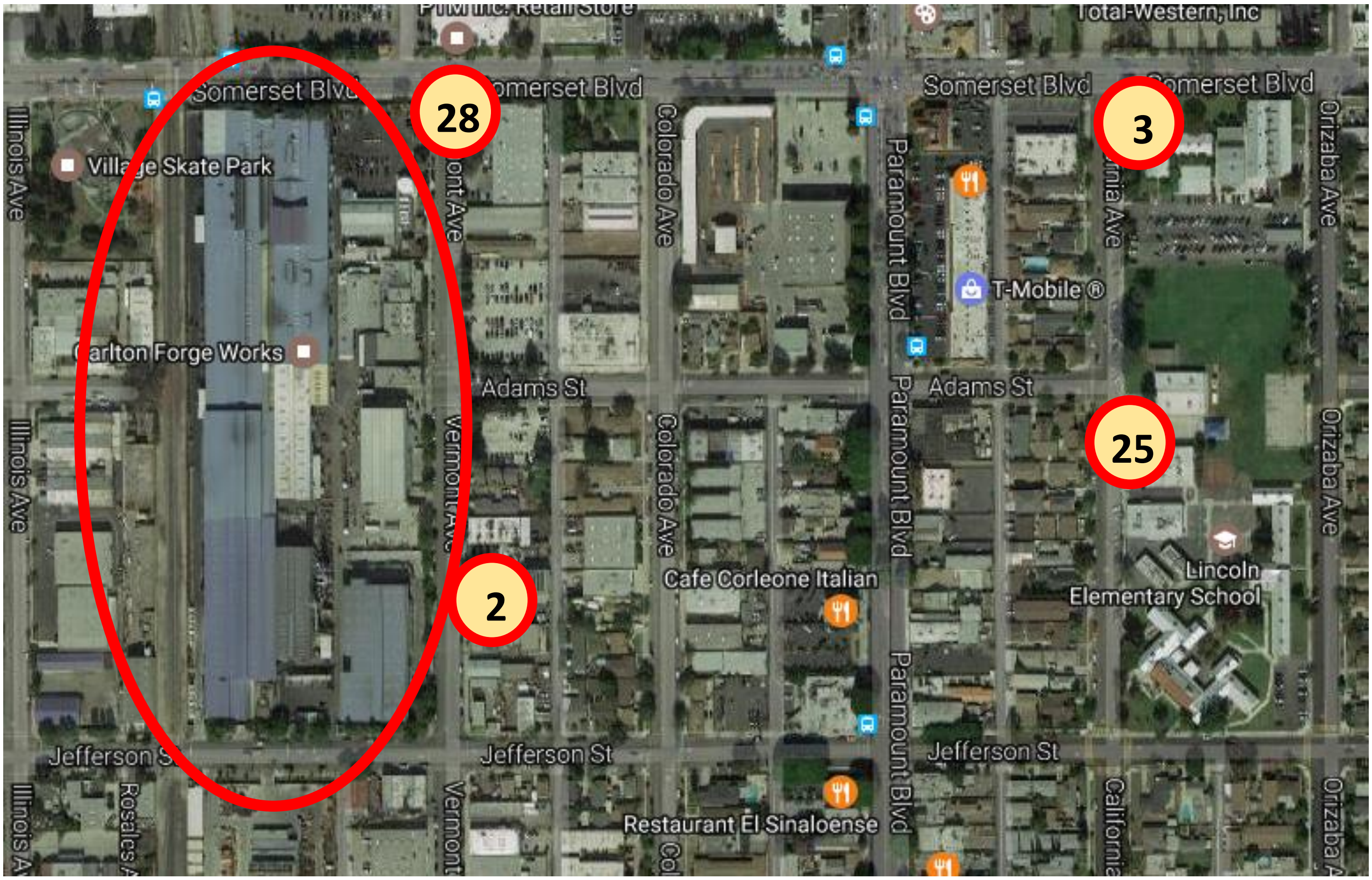
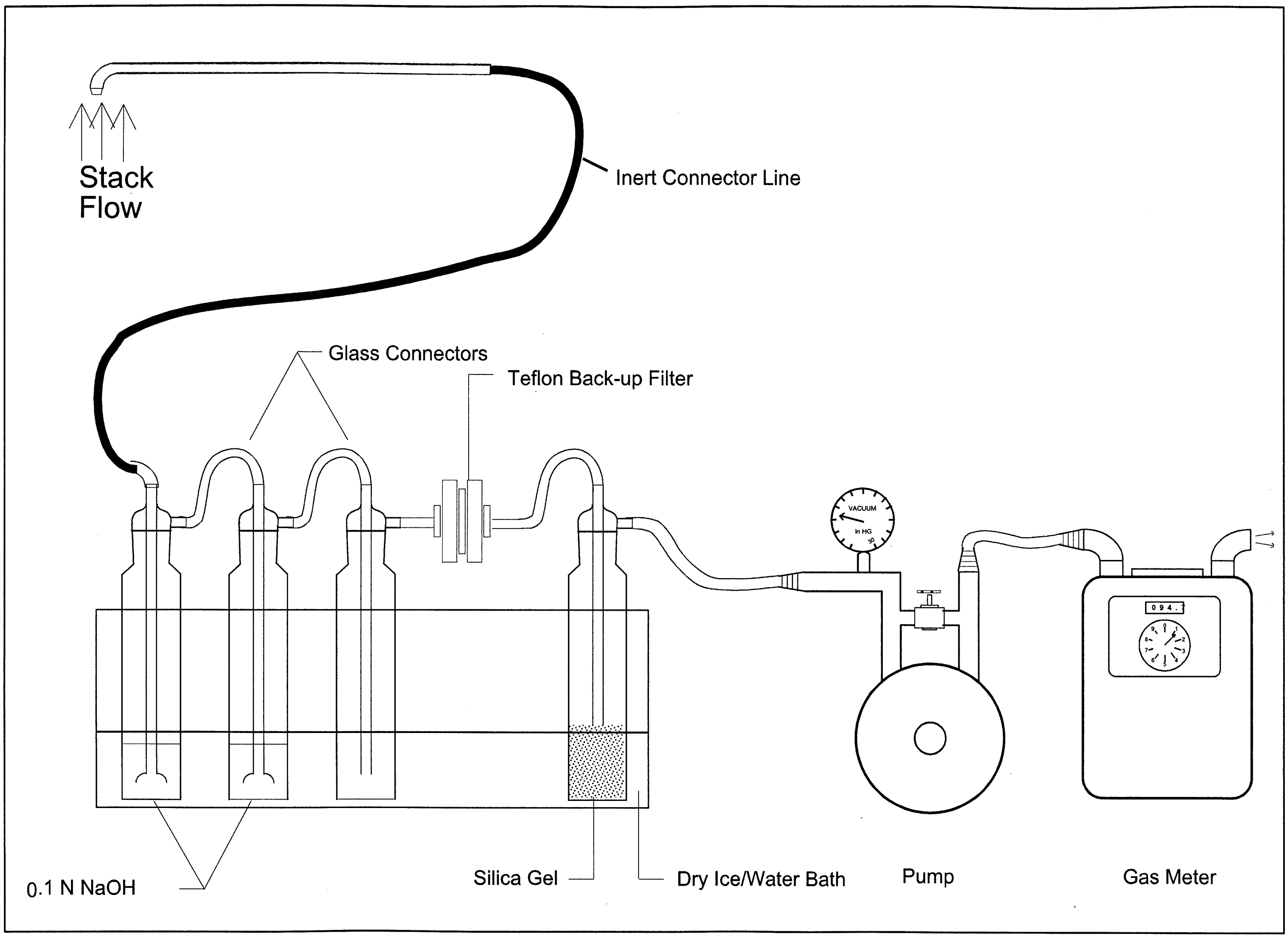


**Figure 2: Sampling Probe Placement**

**Figure 3: CARB Method 425 Train Diagram**



## CALCULATIONS

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
21865 E. Copley Dr. Diamond Bar, California 91765-4182

Test No. 1 Test Date: 3/29/17

SOURCE TEST CALCULATIONS

Sampling Location: Mattco Forge - Grinding Area
Sample Train: 11 Input by: E. Padilla

SUMMARY

| | | |
|---|---|---|
| A. Average Traverse Velocity | #DIV/0! | fps |
| B. Gas Meter Temperature (Use 60 deg.F for Temp Comp. Meters) | 95.8 | deg F |
| C. Gas Meter Correction Factor | 1.0024 | |
| D. Average Orifice Pressure | 2.95 | "H2O |
| E. Nozzle Diameter | | inch |

| | | | | | |
|---|---|---|---|---|---|
| F1. Stack Diameter or Dimension #1 | | inch | M. Pitot Correction Factor | 0.84 | |
| F2. Stack Dim #2 (blank if circular) | | inch | N. Sampling Time | 60 | min |
| G. Stack Cross Sect. Area | 0.000 | ft2 | O. Nozzle X-Sect. Area | 0.00000 | ft2 |
| H. Average Stack Temp | #DIV/0! | deg F | P. Net Hex Chrome Collection | 0.0002 | mg |
| I. Barometric Pressure | 29.89 | "HgA | Q. Hex Chrome Collection | 0.0002 | mg |
| J. Gas Meter Pressure (I+(D/13.6)) | 30.11 | "HgA | R. Water Vapor Condensed | 16.6 | ml |
| K. Static Pressure | | "H2O | S. Gas Volume Metered | 54.570 | dcf |
| L. Total Stack Pressure (I+(K/13.6)) | 29.89 | "HgA | S2. Amp-hr | | amp-hr |

T. Corrected Gas Volume [(S x J/29.92) x 520/(460+B) x C ........ 51.502 dscf

PERCENT MOISTURE/GAS DENSITY

U. Percent Water Vapor in Gas Sample ((4.64 x R)/((0.0464 x R) + T)) ........ 1.47 %

V. Average Molecular Weight (Wet):

| Component | Vol. Fract. | | x Moist. Fract. | x Molecular Wt. | = Wt./Mole |
|---|---|---|---|---|---|
| Water | 0.015 | | 1.000 | 18.0 | 0.27 |
| Carbon Dioxide | 0.00040 | Dry Basis | 0.985 | 44.0 | 0.02 |
| Carbon Monoxide | | Dry Basis | 0.985 | 28.0 | 0.00 |
| Oxygen | 0.20900 | Dry Basis | 0.985 | 32.0 | 6.59 |
| Nitrogen & Inerts | 0.791 | Dry Basis | 0.985 | 28.2 | 21.97 |
| | | | | Sum | 28.84 |

FLOW RATE

| | | |
|---|---|---|
| W. Gas Density Correction Factor (28.95/V)^.5 | 1.00 | |
| X. Velocity Pressure Correction Factor (29.92/L)^.5 | 1.00 | |
| Y. Corrected Velocity (A x M x W x X) | #DIV/0! | fps |
| Z. Flow Rate (Y x G x 60) | #DIV/0! | cfm |
| AA. Flow Rate (Standard) {Z x (L/29.92) x [520/(460+H)]} | #DIV/0! | scfm |
| BB. Dry Flow Rate (AA x (U/100)) | #DIV/0! | dscfm |

SAMPLE CONCENTRATION/EMISSION RATE

| | | |
|---|---|---|
| CC. Sample Concentration [0.01543 x (P/T)] | 5.992E-08 | gr/dscf |
| DD. Sample Concentration [54,143xC 100 (Molecular Wt.)] | 3.24E-05 | ppm |
| EE. Sample Emission Rate (0.00857 x BB xCC) | 1.371E+02 | ng/m3 |
| FF. Solid Emission Rate [(.0001322 x Q x BB)/T] | #DIV/0! | lb/hr |
| GG. Isokinetic Sampling Rate [(G x T x 100)/(N x O x BB)] | #DIV/0! | % |

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
21865 Copley Drive, Diamond Bar, California 91765



# APPENDICES

## Appendix A: Field Data

**South Coast Air Quality Management District**

Test No. 17-340 Company: CARLTON FORGE Date: 5/18/17
Sampling Location: FURN 431 Sample Train: 5C

**Traverse Source Test Data**

Pre-Test Leak Check:
Filter: ____ cfm @ ____ "Hg vac
Probe: 0 cfm @ 15 "Hg vac
Pitot Tube Leak Check: Pass / Fail

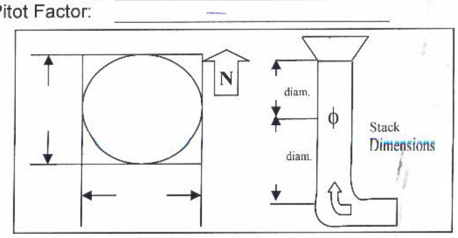
Post-Test Leak Check:
Filter: ____ cfm @ ____ "Hg vac
Probe: 0 cfm @ 15 "Hg vac
Pitot Tube Leak Check: Pass / Fail

| Time | Sample Point # | Gas Meter Reading (dcf) | Stack Velocity Head ("$H_2O$) | Stack Temp. °F | Calculated Velocity (fps) | Calculated Sampling Rate (cfm) | Calculated Orifice ΔP ("$H_2O$) | Probe Temp. °F | Filter Temp. °F | Imp. Temp. °F | Meter Temp. °F In | Meter Temp. °F Out | Vacuum " Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13:27 | | Start: 346.995 | | | | | | | | | | | |
| +15 | | 360.33 | | | | | 2.9 | | | 52 | 87 | 89 | 14 |
| +30 | | 373.85 | | | | | 2.9 | | | 49 | 97 | 90 | 14 |
| +45 | | 387.73 | | | | | 3.0 | | | 40 | 104 | 93 | 15 |
| +60 | | 401.565 | | | | | 3.0 | | | 42 | 108 | 96 | 15 |
| 14:27 | | | | | | | | | | | | | |
| (Net Vol. Uncorr.) | | | Avg. | | | | | | | | | | |

K-Factor: 0.5682
Nozzle Diameter: 0.50 "
Barometric Pressure: 29.89 " HgA
Static Pressure in Stack: + / - ____ " $H_2O$

Canister #: ____ Start: ____ "Hg vac
Recorded By: JA
Pitot Factor: –

Calibration Data
Inclined Manometer NO714 (Cal: N/A )
Magnehelic No. ____ (Cal: ____ )
Pitot Tube No. – (Cal: ____ )
Potentiometer No. NO314 (Cal: 3/24/17 )
Thermocouple No. ____ (Cal: ____ )
Gas Meter No. NO714 (Cal: 3/24/17 )
Meter Corr. Factor: 1.0024




Sampling Probe: Stainless Steel / Borosilicate / Quartz
Stack: Horizontal / Vertical Rectangular / Circular

FURNACE TEMP 1871 SP 1875-1925 ΔP ≠ 0.06 FURNACE DAMPER OPENING

## Appendix B: District Laboratory Data/Result

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
21865 Copley Dr., Diamond Bar, CA 91765-4182
Page 1 of 2

MONITORING & ANALYSIS
REPORT OF LABORATORY ANALYSIS

TO Mike Garibay
Supervising A.Q. Engineer
Source Test & Engineering

SAMPLE(S) DESCRIBED AS
2 Hexavalent Chromium Trains

SAMPLING LOCATION
Facility ID 22911
Carlton Forge
7743 Adams St.
Paramount, CA 90723

| | |
|---|---|
| LABORATORY NO | 1713606 |
| SOURCE TEST NO | 17-340 |
| DATE RECEIVED | 05/19/17 |
| RULE NO | NA |
| REQUESTED BY | Eric Padilla |
| DATE ANALYZED | 05/19/17 |
| DATE REPORTED | 6/9/2017 |

ANALYTICAL WORK PERFORMED, METHOD OF ANALYSIS AND RESULTS
Moisture and Hexavalent Chromium by CARB 425 (Sodium Bicarbonate($NaHCO_3$) solution)

| | Train 49 | Train 50 |
|---|---|---|
| Moisture gain, g | 0.2 | 16.6 |
| Silica gel% expended | 0.01 | 0.8 |
| Filter gain, g | -0.0013 | 0.0004 |
| Impinger 1 pH | 9 | 9 |
| Impinger 2 pH | 9 | 9 |
| $Cr^{+6}$ total ug | 0.00 | 0.20 |
| Cr 53 total ug | 0.16 | 1.44 |

Recovery Notes:
Train 49: The field blank remained in the truck during the source test.

NOTE: Additional significant figures provided for calculation purposes.

Reviewed By: [signature] Date Reviewed: 06/09/17
Joan Niertit, Principal A.Q. Chemist
Laboratory Services

Approved By: [signature] Date Approved: 6/13/17
Aaron Katzenstein, Ph.D.
Senior Manager
Laboratory Services
(909) 396-2219

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
21865 Copley Dr., Diamond Bar, CA 91765-4182
Page 2 of 2

MONITORING & ANALYSIS
REPORT OF LABORATORY ANALYSIS

LABORATORY NO 1713606

REQUESTED BY Eric Padilla

ANALYTICAL WORK PERFORMED, METHOD OF ANALYSIS AND RESULTS
Moisture and Hexavalent Chromium by CARB 425 (Sodium Bicarbonate(NaHCO3) solution)

QUALITY CONTROL

**BALANCE CHECK**

| Lab No. | Result (g) | Limit (g) | Check Status |
|---|---|---|---|
| B17E125-CCV1 | 100 | ±0.0005 | Pass |
| B17E125-CCV2 | 500.0 | ±0.2 | Pass |

**CCV RECOVERIES**

| Lab No. | Results (ppt) | Limit (%) | % Recovery |
|---|---|---|---|
| S17E058-CCV1 | 102 | 90-110 | 102 |
| S17E058-CCV2 | 98 | 90-110 | 98 |
| S17E058-CCV3 | 103 | 90-110 | 103 |

REF B17E125
S17E058

## SOURCE TEST REQUEST FOR EQUIPMENT/ANALYSIS

| | | | |
|---|---|---|---|
| Company | Carlton Forge | Source Test No. | 17-340 |
| Address | 7743 Adams Street, Paramount, CA 90723 | Request Date | 5/12/17 |
| Basic Equipment | Furnace Area - Ambient | Control Device | N/A |
| Analysis/Equipment Requested By | Eric Padilla | Date Equipment Needed | 5/18/17 |
| For Compliance, Rule(s) | | | |
| Other (specify) | Rule Development | Facility ID No. | 22911 |

Dry Ice Needed ☒
**(100 POUNDS)**

Laboratory No. 1713606

### SAMPLE EQUIPMENT ANALYSIS REQUEST

| Equipment Requested/ID # | Analysis Requested | Set ID |
|---|---|---|
| Two CARB 425 trains ($NaHCO_3$ with back-end filter) | Total Chrome, Cr6, moisture | |
| | Train No. 49, 50 | |
| | Reference: Blue Book No 41 Pages 136, 137 | |
| Tubing (two 8' sections) | Train 49: blank (stayed in truck), no probe, no tubing | |
| | Train 50: tubing, probe, train (furnace) | |

Recovery
Train 49 (-01) : Container 2 (-02), Container 3 (-03)
Train 50 (-04) : Container 1 (-05), Container 2 (-06), Container 3 (-07)
Trip Blank (-08)

### SAMPLE EQUIPMENT CHAIN OF CUSTODY

| Sample Equipment Set ID | From | To | For (S/T, Analysis, Cleanup, Not Used) | Date Received | Time |
|---|---|---|---|---|---|
| Trains 49,50 + tubing | C. Schmoehn | [illegible] | S/T | 05/17/17 | 13:36 |
| Trains 49,50 probe tubing | [illegible] | C. Schmoehn | Recovery | 05/19/17 | 07:57 |
| Recovery Samps | C. Schmoehn | [illegible] | Analysis | 05/19/17 | 14:22 |
| | | | | | |
| | | | | | |
| | | | | | |

## Appendix C: Equipment Calibrations

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
DATA SHEET FOR THERMOCOUPLE/POTENTIOMETER CALIBRATION

Field Meter STQC# : N0314 + N0315
Ref. Thermometer # : ASTM 08343
Temperature Source(s): Jofra Furnace

Date: 3-24-17
Calibration By: WS
Calibration Period:
Semiannual X
Bimonthly ____
Other ____

| Temp.* | A | N0314 Lead Wire STQC#____ B | | (B-A)100/A ** | | N0315 Lead Wire STQC#____ B | | (B-A)100/A ** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sensor STQC# | Ref. Temp. | Ch#1 | Ch#2 | Ch#1 | Ch#2 | Ch#1 | Ch#2 | Ch#1 | Ch#2 | COMMENTS |
| 10102 | 32 | 32 | 32 | | | 32 | 32 | | | |
| 20108 | 33 | 33 | 33 | | | 33 | 33 | | | |
| 50111 | 33 | 33 | 33 | | | 33 | 33 | | | |
| 20202 | 33 | 33 | 33 | | | 33 | 33 | | | |
| 60112 | 33 | 33 | 33 | | | 33 | 32 | | | |
| | | | | | | | | | | |
| 10102 | 211 | 211 | 212 | | | 212 | 212 | | | |
| 20108 | 211 | 211 | 211 | | | 211 | 211 | | | |
| 50111 | 211 | 211 | 211 | | | 211 | 211 | | | |
| 20202 | 212 | 215 | 214 | | | 212 | 212 | | | |
| 60112 | 212 | 211 | 211 | | | 212 | 211 | | | |
| | | | | | | | | | | |
| 10102 | 612 | 611 | 612 | | | 611 | 611 | | | |
| 20108 | 611 | 610 | 611 | | | 612 | 611 | | | |
| 50111 | 612 | 611 | 611 | | | 612 | 612 | | | |
| 20202 | 611 | 611 | 611 | | | 612 | 612 | | | |
| 60112 | 612 | 612 | 611 | | | 612 | 611 | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

* All temperatures are in degrees F.
**Percent (%) difference should not exceed +/- 1.5%.

Page Number____

**SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT**
**DRY GAS METER CALIBRATION WORKSHEET**

Page 1

DATE: March 24, 2017 PERFORMED BY: W. Stredwick

AMBIENT AIR 74 o F

PBAR: 29.87 In.Hg DRY GAS METER ID : N0714

STANDARD DRY GAS METER ID#: 7812470

| TRIAL | CFM | TOTAL cubicF | TEMP | H2O PRESSURE IN | OUT | H20 | METER READ1 ( in cubic F) | READ2 | TOTAL cubicF | HRS | MIN | SEC | TIME Decimal | UC FL RT CFM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1/4 | 1.6 | 74 | 1.2 | 1.2 | 1.2 | 343.2 | 344.8 | 1.6 | | 5 | 3.00 | 5.05 | 0.3168 |
| 2 | 1/4 | 1.1 | 74 | 1.2 | 1.2 | 1.2 | 345.2 | 346.3 | 1.1 | | 3 | 29.00 | 3.48 | 0.3158 |
| 3 | 1/4 | 1.3 | 74 | 1.2 | 1.2 | 1.2 | 346.4 | 347.7 | 1.3 | | 4 | 7.00 | 4.12 | 0.3158 |
| 1 | 1/2 | 4.7 | 74 | 2.8 | 2.8 | 2.8 | 349.3 | 354.0 | 4.7 | | 8 | 51.00 | 8.85 | 0.5311 |
| 2 | 1/2 | 11.5 | 74 | 2.8 | 2.8 | 2.8 | 354.6 | 366.1 | 11.5 | | 21 | 46.00 | 21.77 | 0.5283 |
| 3 | 1/2 | 2.9 | 74 | 2.8 | 2.8 | 2.8 | 366.2 | 369.1 | 2.9 | | 5 | 18.00 | 5.30 | 0.5472 |
| 1 | 3/4 | 3.8 | 74 | 5.2 | 5.2 | 5.2 | 370.4 | 374.2 | 3.8 | | 4 | 53.00 | 4.88 | 0.7782 |
| 2 | 3/4 | 5.1 | 74 | 5.2 | 5.2 | 5.2 | 374.4 | 379.5 | 5.1 | | 6 | 30.00 | 6.50 | 0.7846 |
| 3 | 3/4 | 4.9 | 74 | 5.2 | 5.2 | 5.2 | 379.8 | 384.7 | 4.9 | | 6 | 14.00 | 6.23 | 0.7861 |
| 1 | 1 | 5.2 | 74 | 9 | 9 | 9.0 | 386.3 | 391.5 | 5.2 | | 5 | 9.00 | 5.15 | 1.0097 |
| 2 | 1 | 7.0 | 74 | 9 | 9 | 9.0 | 391.7 | 398.7 | 7.0 | | 6 | 56.00 | 6.93 | 1.0096 |
| 3 | 1 | 6.5 | 74 | 9 | 9 | 9.0 | 399.0 | 405.5 | 6.5 | | 6 | 25.00 | 6.42 | 1.0130 |

**SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT**
**DRY GAS METER CALIBRATION WORKSHEET**

Page 2

DATE: March 24, 2017 PERFORMED BY: W. Stredwick

DRY GAS METER ID : N0714

| TRIAL | CFM | TOTAI cubicF | TEMP | H2O PRESSURE IN | H2O PRESSURE OUT | H20 | METER READ1 (in cubic F) | METER READ2 (in cubic F) | CubicF | HRS | MIN | SEC | TIME Decimal | UC FL RT CFM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1/4 | 1.7 | 74 | 1.2 | 0.4 | 0.8 | 810.0 | 811.7 | 1.7 | | 5 | 20.00 | 5.33 | 0.3188 |
| 2 | 1/4 | 1.2 | 74 | 1.2 | 0.4 | 0.8 | 812.0 | 813.2 | 1.2 | | 3 | 48.00 | 3.80 | 0.3158 |
| 3 | 1/4 | 1.2 | 74 | 1.2 | 0.4 | 0.8 | 813.4 | 814.6 | 1.2 | | 3 | 46.00 | 3.77 | 0.3186 |
| 1 | 1/2 | 4.9 | 74 | 2.8 | 1.0 | 1.9 | 816.2 | 821.1 | 4.9 | | 9 | 13.00 | 9.22 | 0.5316 |
| 2 | 1/2 | 11.5 | 74 | 2.8 | 1.0 | 1.9 | 821.5 | 833.0 | 11.5 | | 21 | 50.00 | 21.83 | 0.5267 |
| 3 | 1/2 | 2.9 | 74 | 2.8 | 1.0 | 1.9 | 833.2 | 836.1 | 2.9 | | 5 | 29.00 | 5.48 | 0.5289 |
| 1 | 3/4 | 4.0 | 74 | 5.2 | 2.0 | 3.6 | 837.4 | 841.4 | 4.0 | | 5 | 6.00 | 5.10 | 0.7843 |
| 2 | 3/4 | 5.2 | 74 | 5.2 | 2.0 | 3.6 | 841.6 | 846.8 | 5.2 | | 6 | 36.00 | 6.60 | 0.7879 |
| 3 | 3/4 | 4.8 | 74 | 5.2 | 2.0 | 3.6 | 847.0 | 851.8 | 4.8 | | 6 | 5.00 | 6.08 | 0.7890 |
| 1 | 1 | 5.4 | 74 | 9.0 | 3.1 | 6.1 | 853.4 | 858.8 | 5.4 | | 5 | 19.00 | 5.32 | 1.0157 |
| 2 | 1 | 6.7 | 74 | 9.0 | 3.1 | 6.1 | 859.5 | 866.2 | 6.7 | | 6 | 35.00 | 6.58 | 1.0177 |
| 3 | 1 | 6.3 | 74 | 9.0 | 3.1 | 6.1 | 866.5 | 872.8 | 6.3 | | 6 | 11.00 | 6.18 | 1.0189 |

DATE: March 24, 2017

**SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT**
**DRY GAS METER CALIBRATION WORKSHEET**

Page 3

DATE : March 24, 20
PERFORMED BY: W. Stredwick

DRY GAS METER COEFFICIENT CALCULATIONS

STANDARD DRY GAS METER ID#: 7812470
With Coefficient of 1.0000

DRY GAS METER N0714

| TRIAL | CFM | U/C FlowRate | TEMP | H2O | Corrected FlowRate | U/' FlowRate | TEMP | H2O | Corrected FlowRate | COEF | AVE: | OVERALL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1/4 | 0.3168 | 74 | 1.2 | 0.3089 | 0.3188 | 74 | 0.8 | 0.3105 | 0.9950 | 0.9960 | 1.0024 |
| 2 | 1/4 | 0.3158 | 74 | 1.2 | 0.3079 | 0.3158 | 74 | 0.8 | 0.3076 | 1.0010 | | |
| 3 | 1/4 | 0.3158 | 74 | 1.2 | 0.3079 | 0.3186 | 74 | 0.8 | 0.3103 | 0.9922 | | |
| 1 | 1/2 | 0.5311 | 74 | 2.8 | 0.5198 | 0.5316 | 74 | 1.88 | 0.5192 | 1.0012 | 1.0145 | |
| 2 | 1/2 | 0.5283 | 74 | 2.8 | 0.5172 | 0.5267 | 74 | 1.88 | 0.5144 | 1.0053 | | |
| 3 | 1/2 | 0.5472 | 74 | 2.8 | 0.5356 | 0.5289 | 74 | 1.88 | 0.5165 | 1.0369 | | |
| 1 | 3/4 | 0.7782 | 74 | 5.2 | 0.7662 | 0.7843 | 74 | 3.6 | 0.7692 | 0.9960 | 0.9986 | |
| 2 | 3/4 | 0.7846 | 74 | 5.2 | 0.7725 | 0.7879 | 74 | 3.6 | 0.7727 | 0.9997 | | |
| 3 | 3/4 | 0.7861 | 74 | 5.2 | 0.7740 | 0.7890 | 74 | 3.6 | 0.7739 | 1.0002 | | |
| 1 | 1 | 1.0097 | 74 | 9 | 1.0033 | 1.0157 | 74 | 6.05 | 1.0021 | 1.0012 | 1.0006 | |
| 2 | 1 | 1.0096 | 74 | 9 | 1.0032 | 1.0177 | 74 | 6.05 | 1.0041 | 0.9991 | | |
| 3 | 1 | 1.0130 | 74 | 9 | 1.0066 | 1.0189 | 74 | 6.05 | 1.0052 | 1.0013 | | |

CORRECTION FACTOR: 1.0024