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South Coast Air Quality Management District

BEFORE THE HEARING BOARD OF THE

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

In the Matter of SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT, Petitioner, v. LUBECO INC., [Facility ID# 41229] Respondent.	**Case No. 6089-1** **DISTRICT EXHIBITS** Hearing Date: August 17, 2017 Time: 9:00 a.m. Place: 21865 Copley Drive Diamond Bar, CA 91765

DISTRICT EXHBITS

1. Aerial Map of Lubeco;
2. Aerial Map of Lubeco with Roll-Up Doors;
3. Photograph of Front Roll-Up Door from Downey Avenue;
4. Photograph of Side Roll-Up Door from 69th Street;
5. Photograph of Front Roll-Up Door from Inside Lubeco;
6. Photograph of Front Roll-Up Door from Inside Lubeco;
7. Photograph of Back Roll-Up Door from Inside Lubeco;
8. Photograph of Duplex Across Downey Avenue and Air Monitor No. 29;
9. Photograph of Stonewood Apartments;
10. Photograph of Tank 14 (Sodium Dichromate Seal Tank);
11. Notice of Violation (NOV) P66001;
12. Map of Lubeco, Surrounding Residences and Schools;
13. Source Test Report dated April 27, 2017 re Lubeco;
14. EPA Report Summarizing Cancer Risks Associated with Hexavalent Chromium;
15. Air Monitoring Results through August 8, 2017;
16. (Draft) Proposed Findings and Decision.

EXHIBIT 1


Mokler
Flower St
Indiana Ave
Stonewood Apartments
Verdura Ave
Hayler Ave
30
33
E 69th St
Lubeco
29
N
Passage Ave
E 68th Way
Seacliff Cir
Downey Ave
© 2017 Google

EXHIBIT 2


Verdura-Ave
30
33
E-69th-St
Lubeco
29
N
th-Way
Seacliff-Cir
Downey-Ave
- Roll-Up Door
(Not to scale)

EXHIBIT 3


SHIPPING / RECEIVING

EXHIBIT 4

EXHIBIT 5

EXHIBIT 6

EXHIBIT 7

EXHIBIT 8


STOP

EXHIBIT 9

EXHIBIT 10

EXHIBIT 11

South Coast Air Quality Management District
21865 COPLEY DRIVE, DIAMOND BAR, CA 91765-4178

South Coast AQMD

NOTICE OF VIOLATION

P 66001

DATE OF VIOLATION		
Month	Day	Year
05	22	2017

Facility Name:	Facility ID#	Sector
LUBECO, INC	041229	LG

Location Address:	City:	Zip:
6859 DOWNEY AVENUE	LONG BEACH	90805
Mailing Address:	**City:**	**Zip:**
SAME		

YOU ARE HEREBY NOTIFIED THAT YOU HAVE BEEN CITED FOR ONE OR MORE VIOLATIONS OF THE SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD) RULES, STATE LAW OR FEDERAL LAW. IF PROVEN, SUCH VIOLATION(S) MAY RESULT IN THE IMPOSITION OF CIVIL OR CRIMINAL PENALTIES.

EACH DAY A VIOLATION OCCURS MAY BE HANDLED AS A SEPARATE OFFENSE REGARDLESS OF WHETHER OR NOT ADDITIONAL NOTICES OF VIOLATION ARE ISSUED.

DESCRIPTION OF VIOLATIONS

#	Authority*	Code Section or Rule No.	SCAQMD Permit to Operate or CARB Registration No.	Condition No. (If Applicable)	Description of Violation
1	☒ SCAQMD ☒ CH&SC ☐ CCR ☐ CFR	R402 41700(a)	—	—	Discharging from LUBECO INC air contaminants, specifically, hexavalent chromium, a known human carcinogen, which causes injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property.
2	☐ SCAQMD ☐ CH&SC ☐ CCR ☐ CFR				
3	☐ SCAQMD ☐ CH&SC ☐ CCR ☐ CFR				
4	☐ SCAQMD ☐ CH&SC ☐ CCR ☐ CFR				
5	☐ SCAQMD ☐ CH&SC ☐ CCR ☐ CFR				

Served To:	Phone:	Served By:	Date Notice Served:
Steven Rossi	(562)602-1791	Beverly Caldwell	06/30/2017
Title:	**Email:**	**Phone No:**	**Email:**
President	Lubecoinc@Gmail.c	☒ 909-396-2375 ☐ 310-233-	bcaldwell@aqmd.gov

*Key to Authority Abbreviations:
SCAQMD – South Coast Air Quality Management District
CCR – California Code of Regulations
CH&SC – California Health and Safety Code
CFR – Code of Federal Regulations

Method of Service: ☒ In Person ☐ Certified Mail

ORIGINAL

EXHIBIT 12

Exhibit 12

Lubeco Inc., the surrounding residential areas and schools

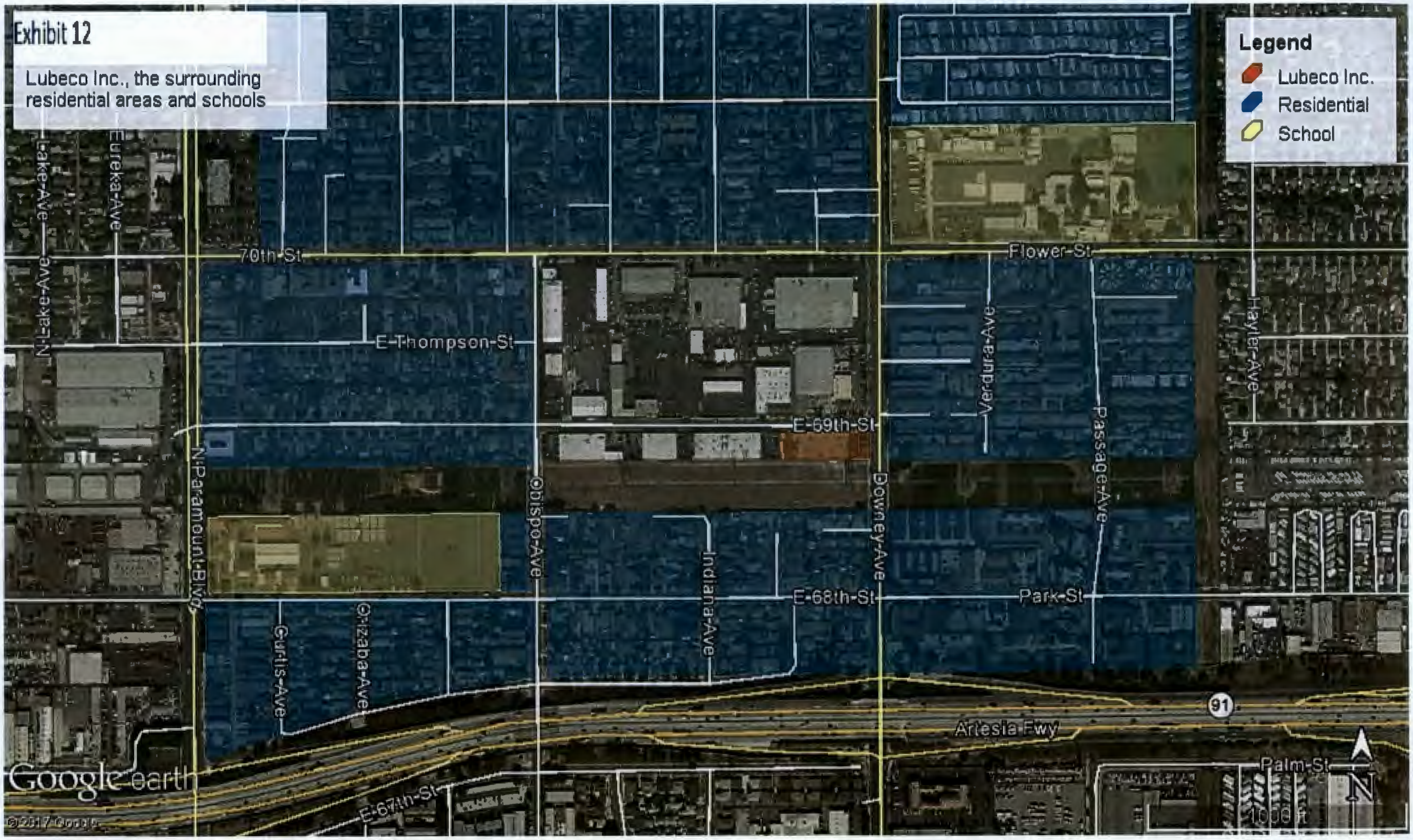

EXHIBIT 13

South Coast
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(909) 396-2000 · www.aqmd.gov

SOURCE TEST REPORT

17-337

Conducted at

Lubeco Inc.
6859 Downey Ave.
Long Beach, CA 90805

HEXAVALENT CHROMIUM EMISSIONS FROM A HEATED SODIUM DICHROMATE SEAL TANK AND A SCREENING TEST FOR A CHROMATE SPRAY BOOTH

TESTED: April 27, 2017

ISSUED: June 9, 2017

REPORTED BY: Wayne Stredwick
Air Quality Engineer II

REVIEWED BY:

Michael Garibay
Supervising Air Quality Engineer

SOURCE TEST ENGINEERING BRANCH

MONITORING AND ANALYSIS DIVISION

BACKGROUND

a. Firm. ....Lubeco Inc. Facility ID No. 41229

b. Test Location...6859 Downey Ave. Long Beach, CA 90805

c. Unit Tested ....Sodium Dichromate Seal Tank

d. Test Requested by ....Susan Nakamura, Planning, Rule Development, and Area Sources, (PRDAS) (909)396-3105

e. Reason for Test Request............................To Determine Emission Factors

f. Dates of Test ....April 27, 2017

g. Source Test Performed by.........................Bill Welch, Wayne Stredwick Eric Padilla, Jason Aspell

h. Test Arrangements Made Through ....Steve Rossi, President Lubeco Inc. (562) 602-1791

i. Source Test Observed by ....Steve Rossi, Lubeco Inc. (562) 602-1791 Bruce Armbruster, JE Comp. Services (909) 483-3300

RESULTS for Hexavalent (Cr VI) at Lubeco Inc.

Parameter	Cr VI (ng/dscm)	Cr VI (lb/hr)	Cr VI (lb/hr-ft^2 tank)	Cr VI (lb/hr-ft^2 tank-% dichromate)
Run #1 Sodium Dichromate Seal Tank	232,000	1.58×10^{-4}	5.27×10^{-6}	9.94×10^{-7}
Run #2 Sodium Dichromate Seal Tank	292,000	2.03×10^{-4}	6.77×10^{-6}	1.28×10^{-6}
Run #3 Sodium Dichromate Seal Tank	208,000	1.51×10^{-4}	5.03×10^{-6}	9.49×10^{-7}
Sodium Dichromate Seal Tank Average	244,000	1.71×10^{-4}	5.69×10^{-6}	1.07×10^{-6}
Facility Upwind of Dichromate Seal Tank	17	N/A	N/A	N/A
Chromate Spray Booth Exhaust	33	N/A	N/A	N/A

INTRODUCTION

On April 27, 2017, personnel from the South Coast Air Quality Management District (SCAQMD) Source Test Engineering Branch conducted triplicate source tests for hexavalent chromium emissions from a heated sodium dichromate seal tank at Lubeco Inc., Long Beach, CA. The main objective of the testing was to provide a mass emission rate, which can be used to determine an emissions factor for heated sodium dichromate seal tanks used in plating operations. The second objective was to identify potential sources of emissions as measured by SCAQMD ambient air monitoring in the nearby south Paramount area.

The main focus of this report was to determine an emission factor for sodium dichromate seal tanks. However, Lubeco, Inc. also has three spray booths that are permitted to use chromate based paints. A screening test (sampling for hexavalent chromium concentration only) was also conducted to determine if the chromate spray booths could be a source of the elevated hexavalent chromium ambient levels in the surrounding area in addition to the sodium dichromate seal tank.

The test was requested by the SCAQMD Planning, Rule Development, and Area Sources (PRDAS) Division subsequent to previous screening tests on these tanks. PRDAS will evaluate the test results presented in this report and use the data for determining emission factors for these types of facilities.

The testing on the sodium dichromate seal tank consisted of 3-one hour sampling runs. The dichromate seal tank temperature and bath composition were also determined for a measure of operating conditions.

EQUIPMENT AND PROCESS DESCRIPTION

Aluminum has been used for many years in the military and aerospace industries. It is essential, however, that improved corrosion properties are imparted in the metal to improve corrosion resistance. Aluminum anodizing has been used for many years to enhance the corrosion performance of aluminum alloys by imparting a thin layer of chromium metal on the aluminum alloy's surface. The surface of the anodized aluminum consists of an inner thin barrier chromium layer and an outer thick chromium porous layer. The outer layer must be sealed or the microscopic holes on the surface will develop corrosion, and so the corrosion resistance of anodized aluminum depends largely on the effectiveness of the sealing operation.

During the sealing, the pores of the anodized aluminum alloy is hydrated, which fills the pores and provides improved corrosion resistance. However, the commonly used sealer contains hexavalent chromium, which is listed as a known carcinogenic. Other sealing processes include; hot water, cobalt acetate, nickel acetate, and trivalent chromium.

Lubeco, Inc. is a plating company located in Long Beach. Lubeco, Inc. was selected as the host facility for the testing due to elevated ambient monitoring readings in the nearby south Paramount area. All tests were conducted on a single tank measuring 10 feet long x 3 feet wide x 4 feet high. The tank was heated to between 200-203 °F, and had a mechanical mixer to keep a uniform temperature throughout the entire sealing process tank. There were no parts in the seal tank during testing.

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Tank Dimensions	Type of Tank
10'L x 3'L x 4'H	Sodium Dichromate Seal

Operating Conditions Recorded During Run #1

Plating Solution Temperature	203	°F
Plating Solution Chromic Acid Content	5.3	% by wt.
Duration of Test Run	60	min /test run
Average Capture Velocity into the Enclosure	80	ft. /min
Capture Efficiency of Ventilation System	100	%
Ventilation Rate	242	acfm

Operating Conditions Recorded During Run #2

Plating Solution Temperature	201	°F
Plating Solution Chromic Acid Content	5.3	% by weight
Duration of Test Run	60	min /test run
Average Capture Velocity into the Enclosure	100	ft. /min
Capture Efficiency of Ventilation System	100	%
Ventilation Rate	246	acfm

Operating Conditions Recorded During Run #3

Plating Solution Temperature	200	°F
Plating Solution Chromic Acid Content	5.3	% by weight
Duration of Test Run	60	min /test run
Average Capture Velocity into the Enclosure	70	ft. /min
Capture Efficiency of Ventilation System	100	%
Ventilation Rate	254	acfm

TESTING METHODOLOGY

The testing on the sodium dichromate seal tank consisted of triplicate one hour sampling runs.

A temporary reduced draft ventilation system was designed and constructed both to isolate the process and collect the resulting chromium emissions in a manner to facilitate the emissions measurement. This approach has been successfully employed in past SCAQMD testing on nickel, and chromium plating tanks and is recognized in a chrome testing protocol developed for the SCAQMD and the California Air Resources Board (ARB) (SCAQMD Technical Guidance Document for Rule 1469, dated June 18, 2013). A main concern was that a high flow ventilation system, such as a dedicated side-draft ventilation system may produce higher emissions due to entrainment of large splashed droplets that potentially fall back into the tanks or to the ground and may not become emissions to the atmosphere.

The temporary reduced draft system was designed to simulate emissions to the atmosphere of an unventilated tank. Mass emissions collected in the duct of a ventilated tank may be higher due to this effect. The temporary ventilation system consisted of 5 feet long x 3 feet wide x 5 feet high hood suspended at a distance of 8 inches above the solution surface, covering half of the host tank tested (see Figure 1). The other half of the tank was covered over with plastic. The hood was vented to a small blower which was set to achieve a specific velocity vertically through the hood. A straight run of ducting between the hood and the blower was used to isolate and measure the emissions from the tank. The facility's roll-up doors were left open during all tests so that fresh air was continuously allowed to flow through the building, along with fresh air entering the building from evaporative coolers on the building's roof. The outlet of the test blower was oriented so that the air stream discharged away from the tank being tested and in the downstream direction of the airflow in the building to avoid re-entrainment in the test hood.

The hood and tank cover vent system operated as follows: The air flowed into the hood and traveled upwards through the hood at the specified velocity. Both the hood and the space above the tank acted as a settling zone where larger droplets that would normally not be carried away from the tank are allowed to fall back into the tank. By using a hood that has a similar or lower cross section than the tank, a low dilution air rate can be employed. The use of this low dilution air rate has the advantage of increasing the concentration in the duct which results in a lower relative error in the emission measurement. The approach also has the advantage of making the effects of contamination such as that in the ambient air to be less significant.

At a ventilation rate of 80-120 ft. /min as determined by a calibrated hot wire anemometer, the height of the hood was sufficient to create a uniform velocity over the lower cross-section of the hood and maintain this uniformity for the lower one third of the hood. This was done to ensure that no high or low velocity zones were present as to defeat the purpose of the hood in its lower section.

As previously approved and documented in the Rule 1469 Technical Guidance Document, the specific velocity was chosen to be approximately 100 ft. /min. This specific velocity was chosen for the following reasons:

1. The velocity is considered as the minimum velocity at which 100% capture of actual emissions to the atmosphere can be achieved. This was verified using the small scale capture hood and a smoke test.

2. The velocity is sufficiently low as to not overestimate the range of velocities that may be encountered in a building that houses the process. This is important since these internal air currents are responsible for transporting the emissions to the atmosphere. For purposes of comparison, 100 ft. /min equates to 1.14 miles per hour. Assuming that outdoor wind speeds typically vary from 3 -10 mph, it is not unreasonable to assume that 1.14 mph indoor air movements can be induced either by open doors, or the building's ventilation system.

3. According to the *American Conference of Governmental Industrial Hygienist Industrial Ventilation Manual,* 50 fpm is the indoor air speed created by an effective air conditioning system.

4. Calculations of settling velocity of small aerosols shows that small aerosol droplets less than 10 microns in diameter are capable of remaining airborne for several minutes, and much longer in moving air.

5. Past testing has been successfully employed using similar capture velocities during mist suppressant testing on chromic anodizing tanks.

SAMPLING AND ANALYTICAL PROCEDURES

Flow Rate

The gas velocity within the sampling duct was measured during each sampling run at eight points within the duct cross section as according to SCAQMD Methods 1.2 and 2.3. This was performed simultaneously with the pollutant sampling using a calibrated standard type Pitot tube with a differential pressure manometer, and a calibrated type "K" thermocouple with a potentiometer (Figure 2). The apparatus was checked for leaks both before and after use by introducing a pressure head and blocking the flow at the Pitot tip. An observation of the resulting stabilization in pressure at the manometer verified the absence of leaks in the system. The stack's access ports were located using the approach of SCAQMD Method 2.3 for ducts of less than 12 inches in diameter. Using this approach, the sampling access ports were located approximately eight stack diameters downstream and greater than two stack diameters upstream from flow disturbances. The velocity access ports were located approximately five stack diameters downstream from the sampling access ports and greater than two stack diameters upstream from flow disturbances. This configuration meets the SCAQMD Method 1.2 requirements for measurement site location.

The volumetric flow rate was calculated for each sampling run using the stack's cross sectional area and average gas velocity. The flow rate was corrected to standard conditions by using the stack temperature and pressure along with the barometric pressure measured with a calibrated aneroid barometer. The flow rate was also corrected to dry conditions using the moisture content as determined by the SCAQMD Method 4.1 weight gain from the chromium sampling trains as described in the following section.

Total and Hexavalent Chromium Sampling – CARB Method 425

A chromium sample was collected during each sampling run using CARB Method 425. The sample was collected from the locations within the sampling duct previously described in the velocity measurements. Each sample was collected over a period of 60 minutes using a sampling train consisting of a glass probe and nozzle connected by a six foot length of non-reactive tubing to the first of two Greenburg-Smith impingers each containing 100 ml of 0.1N sodium bicarbonate, an empty bubbler, and a bubbler containing tared silica gel desiccant (see Figures 3 & 4).

The impinger assembly was connected to a vacuum pump and a calibrated dry gas meter. The sampling apparatus was checked for leaks both before and after sampling by blocking the flow at the probe tip. An observation of the resulting decrease in flow at the meter to less than 0.02 cfm or four percent of the sampling rate indicated an acceptable leak rate. The impinger train was contained within an ice bath to condense water and other condensable matter present in the sample stream.

The impinger train was returned to the SCAQMD laboratory for recovery. The pH of the recovered solution was verified of being greater than 8.0 as specified in CARB Method 425. Hexavalent chromium collected in the nozzle, probe, and impingers was determined using ion chromatography with post column reactor (IC/PCR). Blank, and facility air upwind of the dichromate seal tank sample trains were also brought onto the test site, assembled, leak checked, and analyzed as above for quality control purposes.

Plating Solution Analysis

Samples of the plating solution were collected at the end of testing. The samples were analyzed for parameters typically monitored in the plating industry and reported with the process information.

Capture Efficiency

The capture efficiency was determined by a smoke test. The smoke test was accomplished using the steam generated by the dichromate seal tank. This technique can be used to verify 100% capture or conversely less than 100% capture by observing the flow of the steam into the capture hood. The observation of complete capture of the steam indicated 100% capture efficiency (see Figure 1).

The height of the capture hood and the ventilation rates were adjusted in an attempt to achieve the 50-100 ft. /min horizontally into the capture hood to ensure complete capture. The vertical velocity did not exceed 50 feet/min so that emissions would not be forced into the sampling ductwork that would otherwise be allowed to settle back into the tank.

TEST CRITIQUE

Overall, the sampling and analysis was successfully completed and the reported results are all considered to be accurate for the conditions that were tested. This report is limited to the presentation of the test results and a discussion of their accuracy. All issues related to the application of the emission factor results will be left for discussion outside the scope of the presentation of the results.

The blank train result indicated that there was no hexavalent chromium in the sample. The conclusion from this is that the sampling train media did not contribute to contamination of the sampling and that the sampling volumes were sufficient to bring the measured values well above the blank levels and lower detection limits of the analytical methods.

The results of the sampling taken from the ambient air in the workplace background (17 ng/dscm) represented 0.007% of the average hexavalent chromium concentrations during testing. This suggests that the temporary vent system did not contribute to the workplace background readings. Also, the third test run had the lowest hexavalent chromium emissions. With everything being the same during testing, this would say that the exhaust from the temporary enclosure was being exhausted from the incoming air and not being returned to the enclosure.

Parts were not processed during testing, since sealing tanks sit for extended periods of time without parts in them. It is also thought that the heating of the dichromate seal tanks is the cause of hexavalent chromium emissions and processing of parts does not have an effect on emissions.

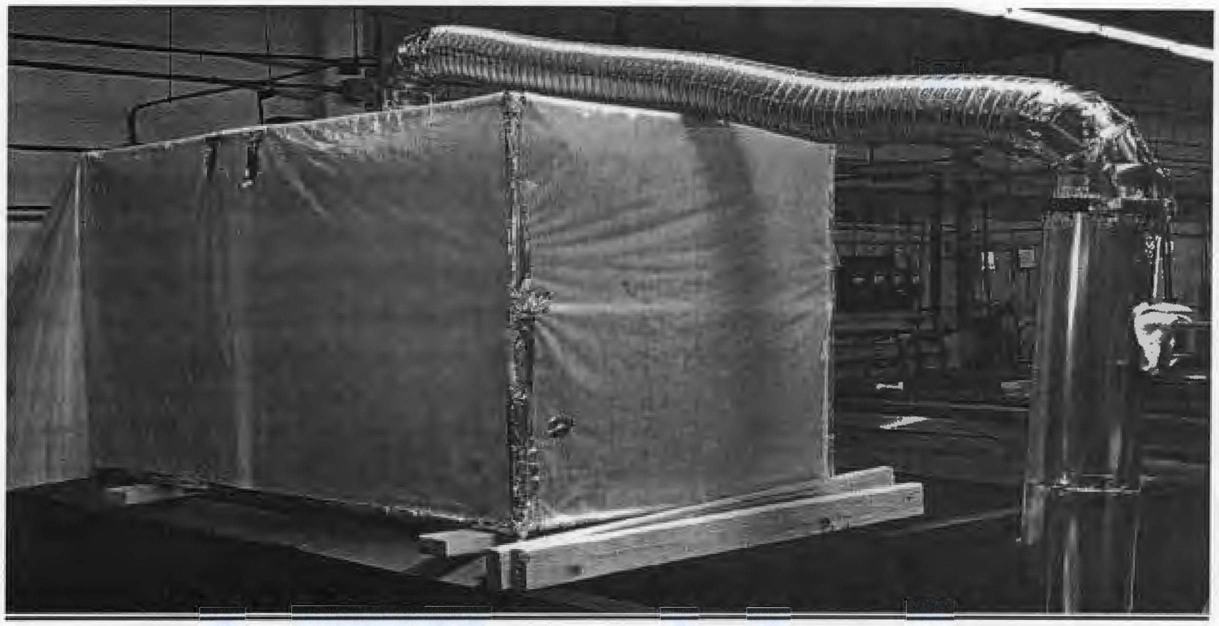
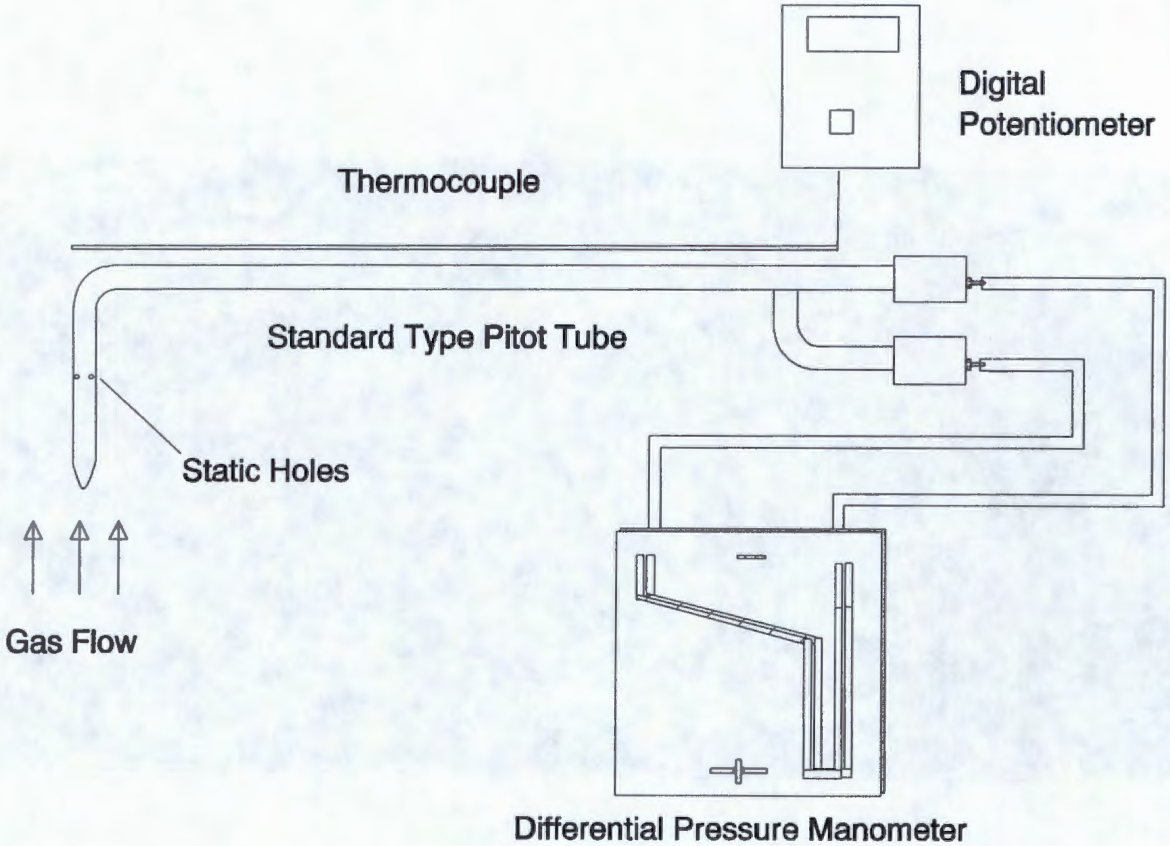
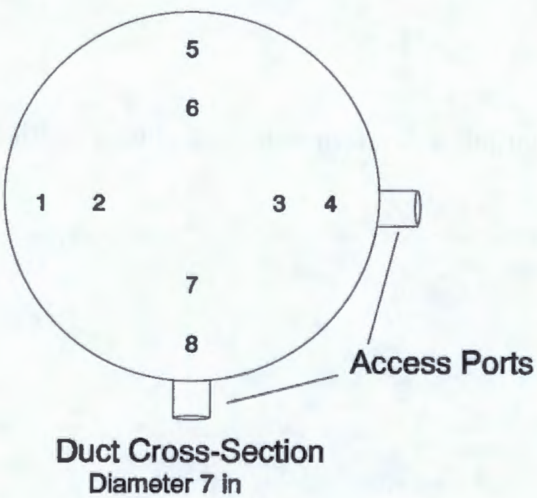


Figure 1 - Photograph of Temporary Ventilation System with Sampling Location.





Traverse Point #	Distance from Inner Stack Wall (in)
1, 5	0.5
2, 6	1.75
3, 7	5.25
4, 8	6.5

Figure 2 - Flow Rate Measuring Apparatus.

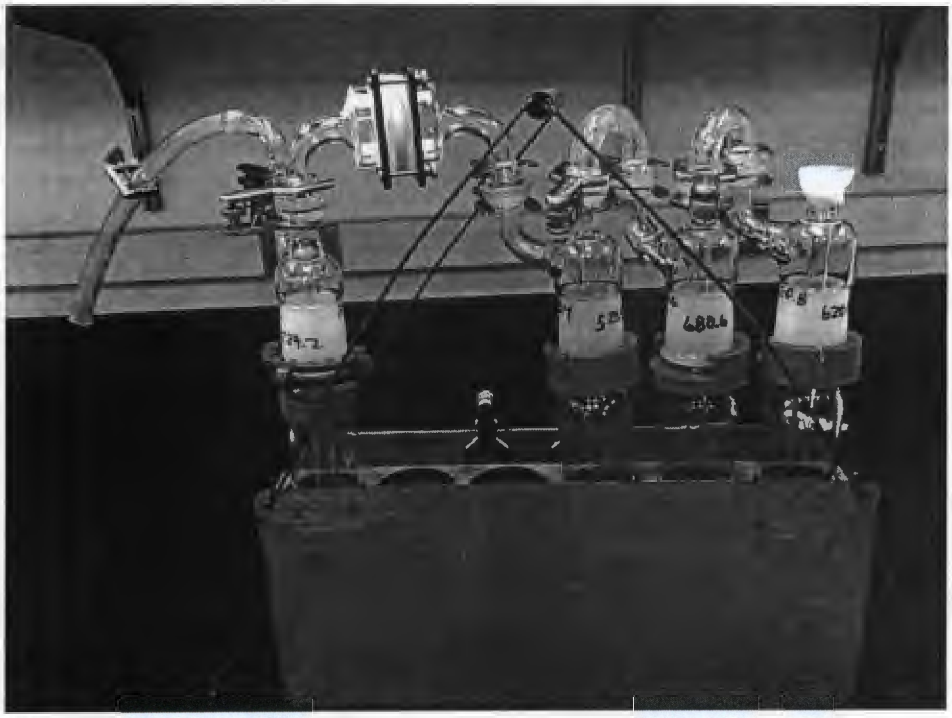


Figure 3 – Photograph of Chromium Sampling Train.

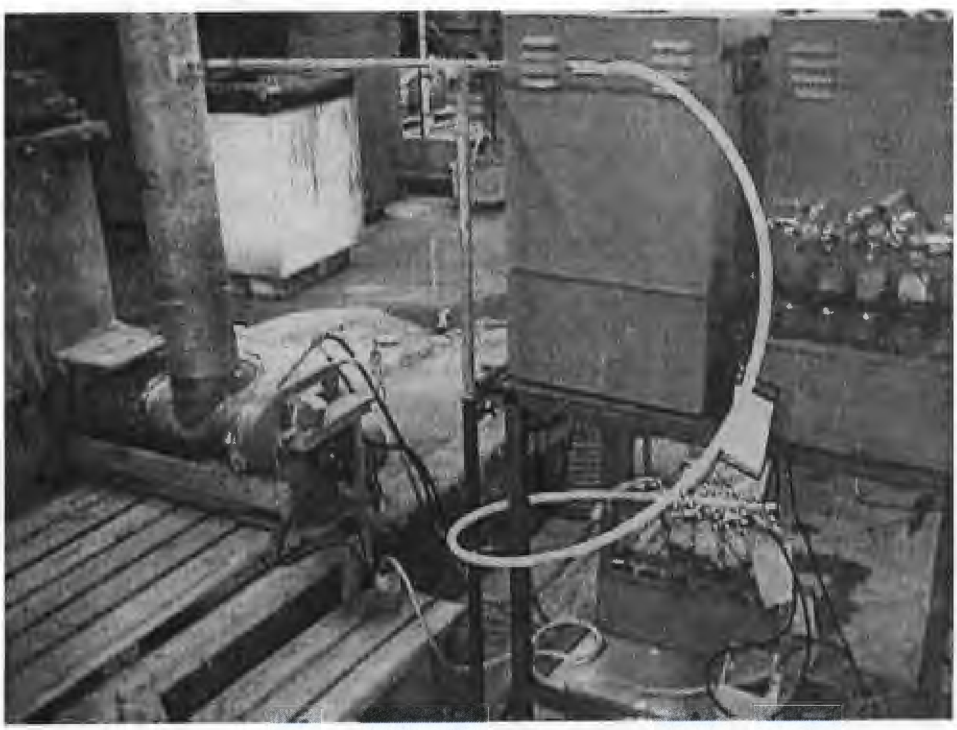


Figure 4 – Photograph of Chromium Sampling System.

APPENDIX 1

(Source Test Calculations)

SOURCE TEST CALCULATIONS

Average Velocity and Temperature

Run #1

Traverse Point #	Velocity Head #1 ("H_2O)	Temp. (°F)	Calculated Velocity (fps)	Traverse Point #	Velocity Head #2 ("H_2O)	Temp. (°F)	Calculated Velocity (fps)	Traverse Point #	Velocity Head #3 ("H_2O)	Temp. (°F)	Calculated Velocity (fps)
1	0.040	128.3	14.07	1	0.030	126.7	12.17	1	0.030	127.7	12.18
2	0.040	127.1	14.05	2	0.040	128.1	14.07	2	0.040	127.7	14.06
3	0.040	125.9	14.04	3	0.050	126.0	15.70	3	0.040	127.5	14.06
4	0.040	125.4	14.03	4	0.040	125.4	14.03	4	0.040	126.7	14.05
5	0.030	126.6	12.17	5	0.050	127.3	15.71	5	0.050	127.0	15.71
6	0.040	127.4	14.06	6	0.050	127.0	15.71	6	0.050	126.1	15.70
7	0.050	126.0	15.70	7	0.050	127.0	15.71	7	0.050	125.5	15.69
8	0.050	126.3	15.70	8	0.050	127.1	15.71	8	0.050	125.1	15.69
	0.041	126.6	14.23		0.045	126.8	14.85		0.044	126.7	14.64

Average Temperature (°F) - 127 Average Velocity (fps) - 14.57

Run #2

Traverse Point #	Velocity Head #1 ("H_2O)	Temp. (°F)	Calculated Velocity (fps)	Traverse Point #	Velocity Head #2 ("H_2O)	Temp. (°F)	Calculated Velocity (fps)	Traverse Point #	Velocity Head #3 ("H_2O)	Temp. (°F)	Calculated Velocity (fps)
1	0.060	126.6	17.20	1	0.060	128.2	17.23	1	0.060	128.0	17.23
2	0.040	127.2	14.05	2	0.050	127.3	15.71	2	0.040	127.5	14.06
3	0.040	126.5	14.05	3	0.050	127.2	15.71	3	0.040	127.9	14.06
4	0.040	126.9	14.05	4	0.050	127.0	15.71	4	0.040	127.3	14.06
5	0.030	128.4	12.18	5	0.040	127.2	14.05	5	0.030	127.4	12.17
6	0.030	127.7	12.18	6	0.050	127.4	15.72	6	0.040	127.8	14.06
7	0.040	128.1	14.07	7	0.050	127.5	15.72	7	0.040	128.3	14.07
8	0.050	128.6	15.73	8	0.060	128.2	17.23	8	0.050	128.3	15.73
	0.041	127.5	14.19		0.051	127.5	15.89		0.043	127.8	14.43

Average Temperature (°F) 128 Average Velocity (fps) - 14.83

Where: Calculated Velocity = 2.9 x [Velocity Head x (460 + Temperature)]$^{0.5}$

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SOURCE TEST CALCULATIONS

Run #3

Traverse Point #	Velocity Head #1 ("H_2O)	Temp. (^oF)	Calculated Velocity (fps)	Traverse Point #	Velocity Head #2 ("H_2O)	Temp. (^oF)	Calculated Velocity (fps)	Traverse Point #	Velocity Head #3 ("H_2O)	Temp. (^oF)	Calculated Velocity (fps)
1	0.040	122.0	14.0	1	0.040	121.4	13.99	1	0.040	121.0	13.98
2	0.040	120.5	14.0	2	0.040	122.4	14.00	2	0.040	120.8	13.98
3	0.050	120.9	15.6	3	0.050	121.0	15.63	3	0.050	121.4	15.64
4	0.050	120.5	15.6	4	0.050	120.4	15.62	4	0.050	120.6	15.63
5	0.040	120.5	14.0	5	0.040	119.2	13.96	5	0.040	118.3	13.95
6	0.050	120.9	15.6	6	0.050	121.3	15.63	6	0.050	118.4	15.60
7	0.040	120.4	14.0	7	0.050	121.9	15.64	7	0.050	119.6	15.61
8	0.050	121.3	15.6	8	0.050	121.4	15.64	8	0.050	119.9	15.62
	0.045	120.9	14.8		0.046	121.1	15.01		0.046	120.0	15.00
Average Temperature (^oF) -			121	Average Velocity (fps) -			14.94				

Where: Calculated Velocity = 2.9 x [Velocity Head x (460 + Temperature)]$^{0.5}$

SOURCE TEST CALCULATIONS
Flow Rate and Emissions

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

Test No. 17-337 Test Date: 4/27/2017

SOURCE TEST CALCULATIONS

Tank Tested: Sodium Dichromate Seal Tank (#14)
Sample Train: Run #1 - Chrome Train #27 Input by: W. Stredwick

SUMMARY

A. Average Traverse Velocity	14.57	fps
B. Gas Meter Temperature (Use 60 deg.F for Temp Comp. Meters)	83.6	deg F
C. Gas Meter Correction Factor	1.0024	
D. Average Orifice Pressure	0.11	"H2O
E. Nozzle Diameter	0.2110	inch

F. Stack Inside Diameter	7	inch	M. Pitot Correction Factor	0.99	
G. Stack Cross Sect. Area	0.267	ft2	N. Sampling Time	60	min
H. Average Stack Temp	126.7	deg F	O. Nozzle X-Sect. Area	0.00024	ft^2
I. Barometric Pressure	29.35	"HgA	P. Hex Chrome Sample Collection	0.07119	mg
J. Gas Meter Pressure (I+(D/13.6))	29.36	"HgA	Q. Total Chrome Sample Collection		mg
K. Static Pressure	-0.420	"H2O	R. Water Vapor Condensed	34.2	ml
L. Total Stack Pressure (I+(K/13.6))	29.32	"HgA	S. Gas Volume Metered	11.499	dcf

T. Corrected Gas Volume [(S x J/29.92) x 520/(460+B) x C ..... 10.820 dscf

PERCENT MOISTURE/GAS DENSITY

U. Percent Water Vapor in Gas Sample ((4.64 x R)/((0.0464 x R) + T)) ..... 12.79 %

V. Average Molecular Weight (Wet):

Component	Vol. Fract.		x	Moist. Fract.	x	Molecular Wt.	=	Wt./Mole
Water	0.128			1.000		18.0	,	2.30
Carbon Dioxide	0.0000	Dry Basis		0.872		44.0	,	0.00
Carbon Monoxide	0.0000	Dry Basis		0.872		28.0	,	0.00
Oxygen	0.2090	Dry Basis		0.872		32.0	,	5.83
Nitrogen & Inerts	0.791	Dry Basis		0.872		28.2	,	19.45
							Sum	27.59

FLOW RATE

W. Gas Density Correction Factor (28.95/V)^.5	1.02	
X. Velocity Pressure Correction Factor (29.92/L)^.5	1.01	
Y. Corrected Velocity (A x M x W x X)	14.93	fps
Z. Flow Rate (Y x G x 60)	239	cfm
AA. Flow Rate (Standard) {Z x (L/29.92) x [520/(460+H)]}	208	scfm
BB. Dry Flow Rate (AA x (1-U/100))	181	dscfm

SAMPLE CONCENTRATION/EMISSION RATE

CC. Sample Concentration [0.01543 x (P/T)]	1.02E-04	gr/dscf
CC1. Sample Concentration (CC x 2288379600)	232,322	ng/dscm
DD. Sample Concentration [54,143xCC/ 51.996 (Molecular Wt.)]	1.06E-01	ppm
EE. Hexavalent Chrome Emission Rate (0.00857 x BB xCC)	1.58E-04	lb/hr
FF. Isokinetic Sampling Rate [(G x T x 100)/(N x O x BB)]	109.5	%

South Coast
Air Quality Management District
21865 E. Copley Drive, Diamond Bar, CA 91765-4182 (909) 396-2000

SOURCE TEST CALCULATIONS
Flow Rate and Emissions

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

Test No. 17-337 Test Date: 4/27/2017

SOURCE TEST CALCULATIONS

Tank Tested: Sodium Dichromate Seal Tank (#14)
Sample Train: Run #2 - Chrome Train #5 Input by: W. Stredwick

SUMMARY

A. Average Traverse Velocity	14.83	fps
B. Gas Meter Temperature (Use 60 deg.F for Temp Comp. Meters)	93.5	deg F
C. Gas Meter Correction Factor	1.0024	
D. Average Orifice Pressure	3.30	"H_2O
E. Nozzle Diameter	0.4800	inch

F. Stack Inside Diameter	7	inch	M. Pitot Correction Factor	0.99	
G. Stack Cross Sect. Area	0.267	ft2	N. Sampling Time	60	min
H. Average Stack Temp	127.6	deg F	O. Nozzle X-Sect. Area	0.00126	ft^2
I. Barometric Pressure	29.35	"HgA	P. Hex Chrome Sample Collection	0.47374	mg
J. Gas Meter Pressure (I+(D/13.6))	29.59	"HgA	Q. Total Chrome Sample Collection		mg
K. Static Pressure	-0.400	"H_2O	R. Water Vapor Condensed	169.2	ml
L. Total Stack Pressure (I+(K/13.6))	29.32	"HgA	S. Gas Volume Metered	61.425	dcf

T. Corrected Gas Volume [(S x J/29.92) x 520/(460+B) x C .... 57.212 dscf

PERCENT MOISTURE/GAS DENSITY

U. Percent Water Vapor in Gas Sample ((4.64 x R)/((0.0464 x R) + T)) .... 12.07 %

V. Average Molecular Weight (Wet):

Component	Vol. Fract.		x Moist. Fract.	x Molecular Wt.	=	Wt./Mole
Water	0.121		1.000	18.0	,	2.17
Carbon Dioxide	0.0000	Dry Basis	0.879	44.0	,	0.00
Carbon Monoxide	0.0000	Dry Basis	0.879	28.0	,	0.00
Oxygen	0.2090	Dry Basis	0.879	32.0	,	5.88
Nitrogen & Inerts	0.791	Dry Basis	0.879	28.2	,	19.61
					Sum	27.67

FLOW RATE

W. Gas Density Correction Factor (28.95/V)^.5	1.02	
X. Velocity Pressure Correction Factor (29.92/L)^.5	1.01	
Y. Corrected Velocity (A x M x W x X)	15.17	fps
Z. Flow Rate (Y x G x 60)	243	cfm
AA. Flow Rate (Standard) {Z x (L/29.92) x [520/(460+H)]}	211	scfm
BB. Dry Flow Rate (AA x (1-U/100))	186	dscfm

SAMPLE CONCENTRATION/EMISSION RATE

CC. Sample Concentration [0.01543 x (P/T)]	1.28E-04	gr/dscf
CC1. Sample Concentration (CC x 2288379600)	292,377	ng/dscm
DD. Sample Concentration [54,143xCC/ 51.996 (Molecular Wt.)]	1.33E-01	ppm
EE. Hexavalent Chrome Emission Rate (0.00857 x BB xCC)	2.03E-04	lb/hr
FF. Isokinetic Sampling Rate [(G x T x 100)/(N x O x BB)]	109.3	%

South Coast
Air Quality Management District
21865 E. Copley Drive, Diamond Bar, CA 91765-4182 (909) 396-2000

SOURCE TEST CALCULATIONS
Flow Rate and Emissions

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

Test No. 17-337 Test Date: 4/27/2017

SOURCE TEST CALCULATIONS

Tank Tested: Sodium Dichromate Seal Tank (#14)
Sample Train: Run #3 - Chrome Train #4 Input by: W. Stredwick

SUMMARY

A. Average Traverse Velocity	14.94	fps
B. Gas Meter Temperature (Use 60 deg.F for Temp Comp. Meters)	95.9	deg F
C. Gas Meter Correction Factor	1.0024	
D. Average Orifice Pressure	0.15	"H2O
E. Nozzle Diameter	0.2240	inch

F. Stack Inside Diameter	7	inch	M. Pitot Correction Factor	0.99	
G. Stack Cross Sect. Area	0.267	ft2	N. Sampling Time	60	min
H. Average Stack Temp	120.7	deg F	O. Nozzle X-Sect. Area	0.00027	ft^2
I. Barometric Pressure	29.35	"HgA	P. Hex Chrome Sample Collection	0.07207	mg
J. Gas Meter Pressure (I+(D/13.6))	29.36	"HgA	Q. Total Chrome Sample Collection		mg
K. Static Pressure	-0.400	"H2O	R. Water Vapor Condensed	28.6	ml
L. Total Stack Pressure (I+(K/13.6))	29.32	"HgA	S. Gas Volume Metered	13.268	dcf

T. Corrected Gas Volume [(S x J/29.92) x 520/(460+B) x C .... 12.209 dscf

PERCENT MOISTURE/GAS DENSITY

U. Percent Water Vapor in Gas Sample ((4.64 x R)/((0.0464 x R) + T)) .... 9.80 %

V. Average Molecular Weight (Wet):

Component	Vol. Fract.	x	Moist. Fract.	x	Molecular Wt.	=	Wt./Mole
Water	0.098		1.000		18.0	,	1.76
Carbon Dioxide	0.0000 Dry Basis		0.902		44.0	,	0.00
Carbon Monoxide	0.0000 Dry Basis		0.902		28.0	,	0.00
Oxygen	0.2090 Dry Basis		0.902		32.0	,	6.03
Nitrogen & Inerts	0.791 Dry Basis		0.902		28.2	,	20.12
						Sum	27.92

FLOW RATE

W. Gas Density Correction Factor (28.95/V)^.5	1.02	
X. Velocity Pressure Correction Factor (29.92/L)^.5	1.01	
Y. Corrected Velocity (A x M x W x X)	15.21	fps
Z. Flow Rate (Y x G x 60)	244	cfm
AA. Flow Rate (Standard) {Z x (L/29.92) x [520/(460+H)]}	214	scfm
BB. Dry Flow Rate (AA x (1-U/100))	193	dscfm

SAMPLE CONCENTRATION/EMISSION RATE

CC. Sample Concentration [0.01543 x (P/T)]	9.11E-05	gr/dscf
CC1. Sample Concentration (CC x 2288379600)	208,433	ng/dscm
DD. Sample Concentration [54,143xCC/ 51.996 (Molecular Wt.)]	9.48E-02	ppm
EE. Hexavalent Chrome Emission Rate (0.00857 x BB xCC)	1.51E-04	lb/hr
FF. Isokinetic Sampling Rate [(G x T x 100)/(N x O x BB)]	102.9	%

SOURCE TEST CALCULATIONS
Flow Rate and Emissions

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

Test No. 17-337 Test Date: 4/27/2017

SOURCE TEST CALCULATIONS

Tank Tested: Ambient Sample
Sample Train: Ambient Background Chrome Train #7 Input by: W. Stredwick

SUMMARY

A. Average Traverse Velocity.................... fps
B. Gas Meter Temperature (Use 60 deg.F for Temp Comp. Meters).................... 93.3 deg F
C. Gas Meter Correction Factor.................... 0.9910
D. Average Orifice Pressure.................... 3.40 "$H_2$0
E. Nozzle Diameter.................... inch
E1. Plating Amps .... A
F. Stack Inside Diameter.................... inch
G. Stack Cross Sect. Area.................... ft2
H. Average Stack Temp.................... deg F
I. Barometric Pressure.................... 28.80 "HgA
J. Gas Meter Pressure (I+(D/13.6)).... 29.05 "HgA
K. Static Pressure.................... "$H_2$0
L. Total Stack Pressure (I+(K/13.6)).................... "HgA
M. Pitot Correction Factor....................
N. Sampling Time.................... 60 min
O. Nozzle X-Sect. Area.................... ft2
P. Hex Chrome Sample Collection.... 0.0001 mg
Q. Total Chrome Sample Collection.................... mg
R. Water Vapor Condensed............. 20 ml
S. Gas Volume Metered.................... 118.607 dcf

T. Corrected Gas Volume [(S x J/29.92) x 520/(460+B) x C.................... 107.253 dscf

PERCENT MOISTURE/GAS DENSITY

U. Percent Water Vapor in Gas Sample ((4.64 x R)/((0.0464 x R) + T)).................... 0.86 %

V. Average Molecular Weight (Wet):

Component	Vol. Fract.		x	Moist. Fract.	x	Molecular Wt.	=	Wt./Mole
Water	0.009			1.000		18.0	,	0.15
Carbon Dioxide	0.0000	Dry Basis		0.991		44.0	,	0.00
Carbon Monoxide	0.0000	Dry Basis		0.991		28.0	,	0.00
Oxygen	0.2090	Dry Basis		0.991		32.0	,	6.63
Nitrogen & Inerts	0.791	Dry Basis		0.991		28.2	,	22.11
							Sum	28.90

FLOW RATE

W. Gas Density Correction Factor (28.95/V)^.5.................... 1.00
X. Velocity Pressure Correction Factor (29.92/L)^.5....................
Y. Corrected Velocity (A x M x W x X).................... fps
Z. Flow Rate (Y x G x 60).................... cfm
AA. Flow Rate (Standard) {Z x (L/29.92) x [520/(460+H)]}.................... scfm
BB. Dry Flow Rate (AA x (1-U/100)).................... dscfm

SAMPLE CONCENTRATION/EMISSION RATE

CC. Sample Concentration [0.01543 x (P/T)].................... 1.44E-08 gr/dscf
CC1. Sample Concentration (CC x 2289714134).................... 32.9 ng/dscm
DD. Sample Concentration [54,143xC 51.996 (Molecular Wt.)].................... 1.50E-05 ppm
EE. Hexavalent Chrome Emission Rate (0.00857 x BB xCC).................... lb/hr
FF. Isokinetic Sampling Rate [(G x T x 100)/(N x O x BB)]....................: %

APPENDIX 2

Equipment Information, Field Data, Calibration Data, and Laboratory Results

Western Analytical Laboratories

13744 Monte Vista Ave · Chino, CA 91710-5512 · Phone (909) 627-3628 · Fax (909) 627-0491 · www.walab.com

Customer:	South Coast AQMD	S465	**WAL No.:**	7050256
Address:	21865 E Copley Dr Diamond Bar , CA 91765-4182		**Date Received:**	05/12/17
Attention:	Joan Niertit		**Date Of Report:**	05/18/17
Sample Id:	Sodium Dichromate Seal 1710328-25		**Date Sampled:**	
			P.O.#	2017001307
Tank No:	SDS		**Gallons:**	

Analysis	**Results**	
DICHROMATE	5.30	% by wt

This analysis has been carried out under controlled laboratory conditions and any suggestions are made solely on that basis.

GC
Fax to 909- 396-2099

Report reviewed by Gregory Conti, Laboratory Director

SOURCE TEST REQUEST FOR EQUIPMENT/ANALYSIS

Company: Lubeco Inc. fac ID# 41229
Source Test No.: 17-337
Address: 6859 Downey Ave., Long Beach, CA 90805
Request Date: April 5, 2017
Basic Equipment: Sodium Dichromate Seal Tank, and Chromate Spray Booth
Control Device: Un-controlled
Analysis/Equipment Requested By: W. Stredwick
Date Equipment Needed: April 14, 2017 26 CAS
For Compliance, Rule(s): Rule Development
Other (specify):
Facility ID No.: 41229
Dry Ice Needed: Yes
Laboratory No. 1710328

SAMPLE EQUIPMENT ANALYSIS REQUEST

Equipment Requested/ID #	Analysis Requested	Set ID
6-CARB Method 425 Trains	Hexavalent and Total Chromium, % moisture	
with sodium bicarbonate solution	Train Nos: 4, 5, 7, 13, 20, 27	
and filter in the back of train	Reference: Blue Book No. 41 Pages. 128	
	129, 132.	
Probes, tubing and tube fittings	Acid washed and sodium bicarbonate rinsed	
3 short probes	Return	
6 lengths tubing	Train 27: tubing, probe	
	20: tubing, no probe	
	13: blank	
	7: no tubing (ambient sample), fitting	
	5: probe + tubing	
	4: probe + tubing	
Sample start: 4/27/17 09:00	per Wayne Stredwick	
Sample end: 4/27/17 16:00		

SAMPLE EQUIPMENT CHAIN OF CUSTODY

Sample Equipment Set ID	From	To	For (S/T, Analysis, Cleanup, Not Used)	Date Received	Time
Trains 4,5,7,13,20,27	C. Schmalz	W. Stredwick	S/T	3-26-2017	2:30 PM
Tr. 4,5,7,13,20,27	W. Stredwick	C. Schmalz	Recovery	04/28/17	08:45 AM
Recovery Samples	C. Schmalz	[illegible]	Analysis	05/01/17	10:00 am

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
6 Hexavalent Chromium Trains

SAMPLING LOCATION
Facility ID 41229
Lubeco Inc.
6859 Downey Ave
Long Beach, CA 90805

LABORATORY NO 1710328
SOURCE TEST NO 17-337
DATE RECEIVED 04/28/17
RULE NO NA
REQUESTED BY Wayne Stredwick
DATE ANALYZED 4/28/2017
DATE REPORTED 5/4/2017

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

	Train 4	Train 5	Train 7	Train 13	Train 20	Train 27
Moisture gain, g	28.6	169.2	9.0	-0.2	20.0	34.2
Silica gel% expended	10	99	90	0	99	60
Filter gain, g	-0.0001	0.0052	0.0071	-0.0008	0.0007	-0.0009
Impinger 1 pH	9-10	9	9-10	9	9	9-10
Impinger 2 pH	9-10	9	9-10	9	9	9-10
Cr^{+6} total ug	72.07	473.74	0.03	0.00	0.10	71.19

Recovery Notes:
Train 4: Probe was ~5 feet long and contained moisture. Tubing was ~12 feet long. Container 1 pH = 9
Train 5: Probe had a significant amount of moisture, Tubing: ~10.5 feet, Probe: ~6 feet. Container 1 pH = 9
Train 7: Ambient sample. No probe, no tubing. Container 1 pH = 9
Train 13: Blank sample. No probe, no tubing. The inlet to the first impinger was left uncovered near the facility for an undertermined amount of time.
Train 20: No probe. Tubing length ~13 feet. Container 1 pH = 9
Train 27: Probe had a significant amount of moisture. Tubing: ~13 feet. Probe: ~4 feet. Container 1 pH = 9.

NOTE: Additional significant figures provided for calculation purposes.

Reviewed By: [signature] Date Reviewed: 05/05/17
Joan Niertit, Principal A.Q. Chemist
Laboratory Services

Approved By: [signature] Date Approved: 5/5/17
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 1710328

REQUESTED BY Wayne Stredwick

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
B17D164-CCV1	100	±0.0005	Pass
B17D164-CCV2	500.0	±0.2	Pass

CCV RECOVERIES

Lab No.	Results (ppt)	Limit (%)	% Recovery
S17E004-CCV1	100	90-110	100
S17E004-CCV2	99	90-110	99
S17E004-CCV3	98	90-110	98
S17E007-CCV1	99	90-110	99
S17E007-CCV2	94	90-110	94
S17E007-CCV3	101	90-110	101
S17E007-CCV4	104	90-110	104
S17E007-CCV5	100	90-110	100
S17E007-CCV6	98	90-110	99

REF B17D164
S17E004
S17E007

South Coast Air Quality Management District

Test No. 17-337 Company: Loheco Inc. Date: 4-27-17
Sampling Location: Sodium Di Chromate Seal Tank #14

Gas Velocity Data Run #1

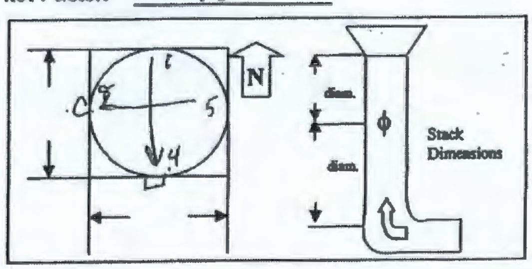
Pitot Tube Leak Check: (Pass) / Fail Pitot Tube Leak Check: (Pass) / Fail

Time	Sample Point #	Velocity Head ("H_2O)	Temp. (°F)	Calc. Velocity (fps)	Velocity Head ("H_2O)	Temp. (°F)	Calc. Velocity (fps)	Velocity Head ("H_2O)	Temp. (°F)	Calc. Velocity (fps)
	1	.04	128.3		.03	126.7		.03	127.7	
	2	.04	127.1		.04	125.1		.04	127.7	
	3	.04	125.9		.05	126.0		.04	127.5	
	4	.04	125.4		.04	125.4		.04	126.7	
	5	.03	126.6		.05	127.3		.05	127.0	
	6	.04	127.4		.05	127.0		.05	126.1	
	7	.05	126.0		.05	127.0		.05	125.5	
	8	.05	126.3		.05	127.1		.05	125.7	
								(Average)		

Static Pressure in Stack: [illegible] "HgA (+/-) 0.42 "H_2O)
Barometric Pressure: 29.35 "HgA Pitot Factor: 1.0
Recorded By: WS

Calibration Data

Inclined Manometer	✓	(Cal: N/A)
Magnehelic No.		(Cal:)
Pitot Tube No.		(Cal:)
Potentiometer No.	20364	(Cal: 4-26-17)
Thermocouple No.	10102	(Cal: 4-26-17)



Stack: Horizontal / Vertical Rectangular / Circular

South Coast Air Quality Management District

Test No. 17-337 Company: Cube CO Inc. Date: 4-27-17
Sampling Location: Sodium Dichromate Seal Tank #14 Sample Train: 27

Traverse Source Test Data Run #1

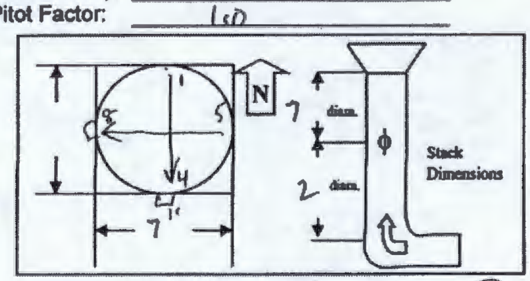
Pre-Test Leak Check:	Post-Test Leak Check:
Filter: ____ cfm @ ____ "Hg vac	Filter: ____ cfm @ ____ "Hg vac
Probe: 0 cfm @ 15 "Hg vac	Probe: 0 cfm @ 3 "Hg vac
Pitot Tube Leak Check: (Pass) / Fail	Pitot Tube Leak Check: (Pass) / Fail

Time	Sample Point #	Gas Meter Reading (dcf)	Stack Velocity Head ("H₂O)	Stack Temp. °F	Calculated Velocity (fps)	Calculated Sampling Rate (cfm)	Calculated Orifice ΔP ("H₂O)	Probe Temp. °F	Filter Temp. °F	Imp. Temp. °F	Meter Temp. °F In	Meter Temp. °F Out	Vacuum "Hg
		Start: ~~7537~~											
10:45		75.343											
+7.5	1	76.820	.04	127.6	14.06	0.176	0.10			63	76	76	2.0
+15	2	78.170	.04	127.6	14.06	0.176	0.10			41	81	79	2.0
+22.5	3	79.470	.04	126.5	14.04	0.177	0.10			43	83	80	2.0
+30	4	80.700	.04	125.7	14.04	0.170	0.10			43	85	83	2.0
+37.5	5	82.100	.05	127.0	15.71	0.189	0.12			51	86	84	2.0
+45	6	83.525	.05	126.8	15.71	0.189	0.12			43	87	85	2.5
+52.5	7	85.135	.05	126.2	15.70	0.189	0.12			42	89	86	2.5
+60	8	86.842	.05	126.2	15.70	0.189	0.13			43	90	87	2.5
(Net Vol. Uncorr.)			Avg.										

K-Factor: 0.5682 Stack Moisture: 6% Canister #: ____ Start: ____ "Hg vac

Nozzle Diameter: 0.211 "
Barometric Pressure: 29.35 " HgA
Static Pressure in Stack: +/(-) 0.42 " H₂O

Recorded By: W.S.
Pitot Factor: 1.0



Calibration Data

Inclined Manometer		(Cal: N/A)
Magnehelic No.		(Cal:)
Pitot Tube No.		(Cal:)
Potentiometer No.	20304	(Cal: 4-26-17)
Thermocouple No.	10102	(Cal: 4-26-17)
Gas Meter No.	N0714	(Cal: 3-24-17)
Meter Corr. Factor:	1.0024	

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

Revision 01/09

Tank Temp = 203 °F
mechanical agitation

South Coast
Air Quality Management District
21865 E. Copley Drive, Diamond Bar, CA 91765-4182 (909) 396-2000

South Coast Air Quality Management District

Test No. 17-337 Company: LubeCo Inc. Date: 4-27-17
Sampling Location: Sodium Dichromate Seal Tank #14

Gas Velocity Data Run #2

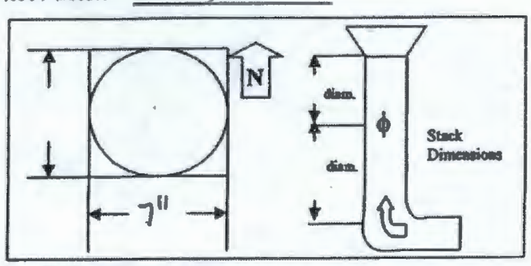
Pitot Tube Leak Check: (Pass) / Fail Pitot Tube Leak Check: (Pass) / Fail

Time	Sample Point #	Velocity Head ("H2O)	Temp. (°F)	Calc. Velocity (fps)	Velocity Head ("H2O	Temp. (°F)	Calc. Velocity (fps)	Velocity Head ("H2O	Temp. (°F)	Calc. Velocity (fps)
12:20										
	15	.03	126.4		.04	127.2		.03	127.4	
	26	.03	127.7		.05	127.4		.04	127.8	
	37	.04	129.1		.05	127.5		.04	128.3	
	48	.05	128.6		.06	128.2		.05	128.3	
	51	.06	126.6		.06	128.2		.06	125.0	
	62	.04	127.2		.05	127.3		.04	127.5	
	73	.04	126.5		.05	127.2		.04	127.9	
	84	.04	126.9		.05	127.2		.04	127.3	
								(Average)		

Static Pressure in Stack: ______ " HgA (+/-) 0.40 " H_2O)
Barometric Pressure: 29.75 " HgA Pitot Factor: 1.0
Recorded By: WS

Calibration Data

Inclined Manometer		(Cal: N/A)
Magnehelic No.		(Cal:)
Pitot Tube No.	[illegible]	(Cal:)
Potentiometer No.	[illegible]-2004	(Cal: 4-26-17)
Thermocouple No.	10102	(Cal: 4-26-17)



Stack: Horizontal / Vertical Rectangular / Circular

South Coast Air Quality Management District

Test No. 17-337 Company: Lube Co. Inc. Date: 4-27-17
Sampling Location: Sodium Dichromate Seal Tank #14 Sample Train: 5

Traverse Source Test Data Run #2

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

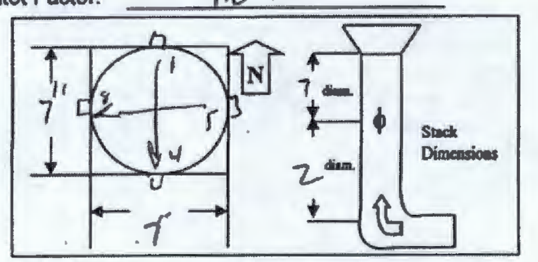
Post-Test Leak Check:
Filter: ______ cfm @ ______ "Hg vac
Probe: 0 cfm @ 12 "Hg vac
Pitot Tube Leak Check: (Pass) / Fail

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
		Start: 89.875											
+7.5	1 5	94.110	0.04	127.5	14.06	0.91	2.88			58	89	86	10
+15	2 6	101.400	0.04	127.7	14.06	0.91	2.88			57	91	87	10
+22.5	3 7	108.6500	.045	128.0	14.92	0.97	3.26			59	93	90	12
+30	4 8	116.3300	.055	127.6	16.48	1.07	4.04			51	96	93	12
+37.5	8 1	121.4500	.049	127.6	14.91	0.97	3.28			46	94	91	12
+45	6 2	132.8600	.045	127.2	14.91	0.97	3.33			47	98	95	12
+52.5	7 3	140.3500	.045	127.2	14.91	0.97	3.34			45	99	96	12
+60	8 4	149.3000	.045	127.0	14.90	0.97	3.36			53	100	98	12
(Net Vol. Uncorr.)			Avg.										

K-Factor: 0.5682 Stack Moisture: 6% Canister #: ______ Start: ______ "Hg vac

Nozzle Diameter: 0.48 "
Barometric Pressure: 29.35 " HgA
Static Pressure in Stack: +/(-) 0.40 " H_2O

Recorded By: WS
Pitot Factor: 1.0



Calibration Data

Inclined Manometer		(Cal: N/A)
Magnehelic No.		(Cal:)
Pitot Tube No.		(Cal:)
Potentiometer No.	20304	(Cal: 4-26-17)
Thermocouple No.	10102	(Cal: 4-26-17)
Gas Meter No.	N0714	(Cal: 3-29-17)
Meter Corr. Factor:	1.0024	

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

Tank temp = 201 °F / mechanical agitation

Revision 01/09

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Air Quality Management District
AQMD
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South Coast Air Quality Management District

Test No. 17-337 Company: LubeCo Inc. Date: 4-27-17
Sampling Location: Sodium Pichromate Seal Tank

Gas Velocity Data Row #3

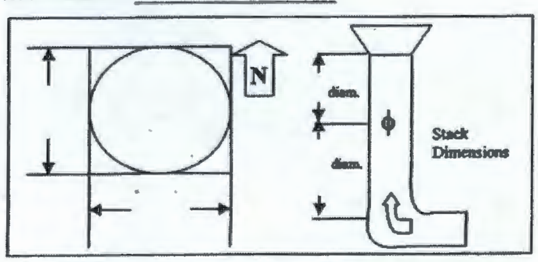
Pitot Tube Leak Check: (Pass) / Fail Pitot Tube Leak Check: (Pass) / Fail

Time	Sample Point #	Velocity Head ("H₂O)	Temp. (°F)	Calc. Velocity (fps)	Velocity Head ("H₂O)	Temp. (°F)	Calc. Velocity (fps)	Velocity Head ("H₂O)	Temp. (°F)	Calc. Velocity (fps)
	1	.04	122		.04	121.4		.04	121.0	
	2	.04	120.5		.04	122.4		.04	120.8	
	3	.05	120.4		.05	121.0		.05	121.4	
	4	.05	120.5		.05	120.4		.05	120.6	
	5	.04	120.5		.04	119.2		.04	118.3	
	6	.05	120.9		.05	121.3		.05	119.4	
	7	.04	120.4		.05	121.9		.05	119.6	
	8	.05	121.3		.05	121.4		.05	119.9	
								(Average)		

Static Pressure in Stack: ______ " HgA (+/-) 0.40 " H_2O)
Barometric Pressure: 29.35 " HgA Pitot Factor: 1.0
Recorded By: WS

Calibration Data

Inclined Manometer		(Cal: N/A)
Magnehelic No.		(Cal:)
Pitot Tube No.	10102	(Cal: 4-26-17)
Potentiometer No.		(Cal:)
Thermocouple No.	~~1002~~ 20304	(Cal: 42017)



Stack: Horizontal / Vertical Rectangular / Circular

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Air Quality Management District

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South Coast Air Quality Management District

Test No. 17-337 Company: Lubeco Inc. Date: 4-27-17
Sampling Location: Sodium Dichromate Seal Tank Sample Train: 4

Traverse Source Test Data Run #3

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

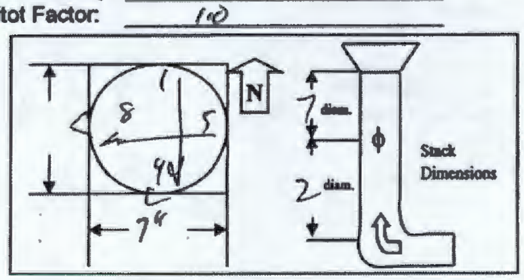
Post-Test Leak Check:
Filter: ____ cfm @ ____ "Hg vac
Probe: 0 cfm @ 3 "Hg vac
Pitot Tube Leak Check: (Pass) / Fail

Time	Sample Point #	Gas Meter Reading (dcf)	Stack Velocity Head ("H₂O)	Stack Temp. °F	Calculated Velocity (fps)	Calculated Sampling Rate (cfm)	Calculated Orifice ΔP ("H₂O)	Probe Temp. °F	Filter Temp. °F	Imp. Temp. °F	Meter Temp. °F In	Meter Temp. °F Out	Vacuum " Hg
2:07		Start: 150,282											
+7.5	1	151.900	0.04	121.5	13.99	0.192	0.13			64	95	94	2.0
+15	2	153.500	0.04	121.2	13.98	0.192	0.13			58	96	95	2.0
+22.5	3	155.155	0.05	121.1	15.63	0.214	0.16			55	97	96	2.5
+30	4	156.700	0.05	119.3	15.61	0.215	0.16			48	96	95	2.5
+37.5	5	158.350	0.04	119.3	13.96	0.192	0.13			59	96	95	2.0
+45	6	160.150	0.05	120.2	15.62	0.215	0.16			60	97	96	2.5
+52.5	7	161.950	0.05	120.6	15.63	0.215	0.16			57	97	96	2.5
+60	8	163.550	0.05	120.9	15.63	0.215	0.16			54	97	96	2.5
(Net Vol. Uncorr.)			Avg.										

K-Factor: 0.5682 Stack Moisture: 6% Canister #: ____ Start ____ "Hg vac

Nozzle Diameter: 0.224 "
Barometric Pressure: 29.35 " HgA
Static Pressure in Stack: +/(-) 0.40 " H₂O

Recorded By: WS
Pitot Factor: 1.0



Calibration Data

Inclined Manometer		(Cal: N/A)
Magnehelic No.		(Cal:)
Pitot Tube No.		(Cal:)
Potentiometer No.	20304	(Cal: 4-26-17)
Thermocouple No.	10102	(Cal: 4-26-17)
Gas Meter No.	10714	(Cal: 3-24-17)
Meter Corr. Factor:	1.0024	

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

Tank Temp = 208 °F
mechanical agitator

90-180 ft³/min into enclosure

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Air Quality Management District
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South Coast Air Quality Management District

Test No. 17-~~338~~ ~~339~~ 337 Company: Lubeco Date: 4-27-17
Sampling Location: Ambient (SW corner of roof) Sample Train: 7

Traverse Source Test Data

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

Time	Sample Point #	Gas Meter Reading (dcf) Start:	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
2:25 PM		584.777					4.60			44	92	91	10
+15		602.22					4.60			55	99	93	10
+30		619.65					4.50			55	97	92	10
+45		636.83					4.40			39	95	91	10
+60		653.723					4.40			48	94	89	10
(Net Vol. Uncorr.)			Avg.										

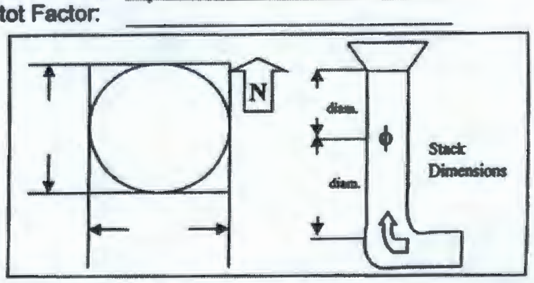
K-Factor: 0.5526 Stack Moisture: ________ Canister #: ________ Start: ________ "Hg vac

Nozzle Diameter: ________ "
Barometric Pressure: 28.80 " HgA
Static Pressure in Stack: +/- ________ " H_2O

Recorded By: SP
Pitot Factor: ________

Calibration Data

Inclined Manometer ________	(Cal: N/A)
Magnehelic No. ________	(Cal: ________)
Pitot Tube No. ________	(Cal: ________)
Potentiometer No. N0315	(Cal: 3/23/17)
Thermocouple No. ________	(Cal: ________)
Gas Meter No. N0715	(Cal: 3/23/17)
Meter Corr. Factor: 0.9910	



Sampling Probe: Stainless Steel / Borosilicate / Quartz

Stack: Horizontal / Vertical Rectangular / Circular

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South Coast Air Quality Management District

Test No. 17-~~335~~ ~~339~~ 337 Company: Lubeco Date: 4/27/17
Sampling Location: Spray Booth Stack Sample Train: 20

Traverse Source Test Data

Pre-Test Leak Check:	Post-Test Leak Check:
Filter: ____ cfm @ ____ "Hg vac	Filter: ____ cfm @ ____ "Hg vac
Probe: 0.006 cfm @ 17 "Hg vac	Probe: 0.003 cfm @ 13 "Hg vac
Pitot Tube Leak Check: Pass / Fail (Pass circled)	Pitot Tube Leak Check: Pass / Fail

Time	Sample Point #	Gas Meter Reading (dcf)	Stack		Calculated			Probe Temp. °F	Filter Temp. °F	Imp. Temp. °F	Meter Temp. °F		Vacuum " Hg
		Start: 465.708	Velocity Head ("H_2O)	Temp. °F	Velocity (fps)	Sampling Rate (cfm)	Orifice ΔP ("H_2O)				In	Out	
11[10]		480.08					3.40			37	86	84	10
+15		495.52					3.40			39	91	86	10
+30		509.88					3.40			38	95	88	10
+45		524.755	Stopped - operator lunch				3.40			41	99	92	10
+60		539.72					3.40			47	99	93	10
+75		554.57					3.30			36	94	90	10
+90		569.28					3.30			39	99	94	10
+105		584.315					3.30			37	100	94	10
+120													
(Net Vol. Uncorr.)		118.607	Avg.										

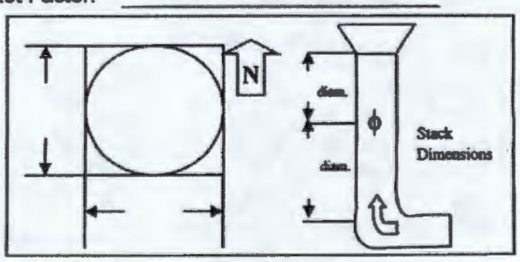
K-Factor: 0.5526 Stack Moisture: ______ Canister #: ______ Start: ______ "Hg vac

Nozzle Diameter: ______ "
Barometric Pressure: 28.80 " HgA
Static Pressure in Stack: +/- ______ " H_2O

Recorded By: EP
Pitot Factor: ______

Calibration Data

Inclined Manometer		(Cal: N/A)
Magnehelic No.		(Cal:)
Pitot Tube No.		(Cal:)
Potentiometer No.	N0315	(Cal: 3/23/17)
Thermocouple No.		(Cal:)
Gas Meter No.	N0715	(Cal: 3/23/17)
Meter Corr. Factor:	0.9910	



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

Revision 01/09

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
DRY GAS METER CALIBRATION WORKSHEET

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

DRY GAS METER COEFFICIENT CALCULATIONS

STANDARD DRY GAS METER ID#: 7812470 DRY GAS METER N0714
With Coefficient of 1.0000

TRIAL	CFM	U/C FlowRate	TEMP	H2O	Corrected FlowRate	U/C 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

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
DRY GAS METER CALIBRATION WORKSHEET

DATE: 3/23/2017

PERFORMED BY:
W.Stredwick

DRY GAS METER COEFFICIENT CALCULATIONS

DRY GAS METER ID : N0715

TRIAL	CFM	U/C FlowRate	TEMP	H2O	Corrected FlowRate	U/C FlowRate	TEMP	H2O	Corrected FlowRate	COEF	AVE:	OVERALL
1	1/4	0.2976	74	1.1	0.2904	0.2969	74	0.7	0.2894	1.0032	0.8697	0.9910
2	1/4	0.1764	74	1.1	0.1721	0.2948	74	0.7	0.2874	0.5988		
3	1/4	0.2959	74	1.1	0.2887	0.2941	74	0.7	0.2867	1.0072		
1	1/2	0.5498	74	2.2	0.5380	0.5351	74	1.975	0.5233	1.0280	1.0278	
2	1/2	0.5500	74	2.2	0.5381	0.5350	74	1.975	0.5232	1.0286		
3	1/2	0.5496	74	2.2	0.5377	0.5355	74	1.975	0.5237	1.0268		
1	3/4	0.7928	74	5.6	0.7822	0.7697	74	3.85	0.7561	1.0345	1.0347	
2	3/4	0.7907	74	5.6	0.7800	0.7678	74	3.85	0.7543	1.0342		
3	3/4	0.7907	74	5.6	0.7801	0.7668	74	3.85	0.7533	1.0355		
1	1	1.0267	74	9.6	1.0227	1.0046	74	6.55	0.9934	1.0295	1.0317	
2	1	1.0289	74	9.6	1.0249	1.0033	74	6.55	0.9921	1.0331		
3	1	1.0302	74	9.6	1.0262	1.0052	74	6.55	0.9939	1.0324		

DRY GAS METER ID : N0715

CORRECTION FACTOR: **0.9910**

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

Field Meter STQC# : C0301 + 20304
Ref. Thermometer # : ASTM 08343
Temperature Source(s): Julia Furnace

Date: 4-26-17
Calibration By: W.S.
Calibration Period:
Semiannual
Bimonthly
Other

		C0301 Lead Wire STQC#				20304 Lead Wire STQC#				
Temp.*	A	B		(B-A)100 / A **		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			33	33			
10102	215	214	215			214	214			
10102	655	655	656			655	656			

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

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

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

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

		N0314 Lead Wire STQC#				N0315 Lead Wire STQC#				
Temp.*	A	B		(B-A)100/A **		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			
C0112	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			
C0112	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			
C0112	612	612	611			612	611			

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

Page Number___

EXHIBIT 14

Chromium (VI) ; CASRN 18540-29-9

Human health assessment information on a chemical substance is included in the IRIS database only after a comprehensive review of toxicity data, as outlined in the IRIS assessment development process. Sections I (Health Hazard Assessments for Noncarcinogenic Effects) and II (Carcinogenicity Assessment for Lifetime Exposure) present the conclusions that were reached during the assessment development process. Supporting information and explanations of the methods used to derive the values given in IRIS are provided in the guidance documents located on the IRIS website.

STATUS OF DATA FOR Chromium (VI)

File First On-Line 03/31/1987

Category (section)	Assessment Available?	Last Revised
Oral RfD (I.A.)	yes	09/03/1998
Inhalation RfC (I.B.)	yes	09/03/1998
Carcinogenicity Assessment (II.)	yes	09/03/1998

I. Chronic Health Hazard Assessments for Noncarcinogenic Effects

I.A. Reference Dose for Chronic Oral Exposure (RfD)

Substance Name — Chromium (VI)
CASRN — 18540-29-9
Last Revised — 09/03/1998

The oral Reference Dose (RfD) is based on the assumption that thresholds exist for certain toxic effects such as cellular necrosis. It is expressed in units of mg/kg-day. In general, the RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Please refer to the Background Document for an elaboration of these concepts. RfDs can also be derived for the noncarcinogenic health effects of substances that are also carcinogens. Therefore, it is essential to refer to other sources of information concerning the carcinogenicity of this substance. If the U.S. EPA has evaluated this substance for potential human carcinogenicity, a summary of that evaluation will be contained in Section II of this file.

I.A.1. Oral RfD Summary

Critical Effect	Experimental Doses*	UF	MF	RfD
None Reported **Rat, 1-year drinking water study** **MacKenzie et al., 1958**	NOAEL: 25 mg/L of chromium as K_2CrO_4 2.5 mg/kg-day (adj.) LOAEL: None	300	3	3E-3 mg/kg-day

*Conversion Factors and Assumptions — Drinking water consumption = 0.1 L/kg-day (reported).

I.A.2. Principal and Supporting Studies (Oral RfD)

MacKenzie, RD; Byerrum, RU; Decker, CF, et al. (1958) Chronic toxicity studies. II. Hexavalent and trivalent chromium administered in drinking water to rats. Am Med Assoc Arch Ind Health 18:232-234.

Groups of eight male and eight female Sprague-Dawley rats were supplied with drinking water containing 0.45-11.2 ppm (0.45-11.2 mg/L) hexavalent chromium (as K_2CrO_4) for 1 year. The control group (10/sex) received distilled water. A second experiment involved three groups of 12 male and 9 female rats. One group was given 25 ppm (25 mg/L) chromium (as K_2CrO_4), a second received 25 ppm chromium in the form of chromic chloride, and the controls again received distilled water. No significant adverse effects were seen in appearance, weight gain, or food consumption, and there were no pathologic changes in the blood or other tissues in any treatment group. The rats receiving 25 ppm of chromium (as K_2CrO_4) showed an approximate 20% reduction in water consumption. Based on the body weight of the rat (0.35 kg) and the average daily drinking water consumption for the rat (0.035 l/day), this dose can be converted to give an adjusted NOAEL of 2.5 mg/kg-day chromium(VI).

For rats treated with 0-11 ppm (in drinking water), blood was examined monthly, and tissues (livers, kidneys, and femurs) were examined at 6 mo and 1 year. Spleens were also examined at 1 year. The 25 ppm groups (and corresponding controls) were examined similarly, except that no animals were killed at 6 mo. An abrupt rise in tissue chromium concentrations was noted in rats treated with more than 5 ppm. The authors stated that "apparently, tissues can accumulate considerable quantities of chromium before pathological changes result." In the 25 ppm treatment groups, tissue concentrations of chromium were approximately 9 times higher for those treated with hexavalent chromium than for the trivalent group. Similar no-effect levels have been observed in dogs. Anwar et al. (1961) observed no significant effects in female dogs (2/dose group) given up to 11.2 ppm chromium(VI) (as K_2CrO_4) in drinking water for 4 years. The calculated doses were 0.012-0.30 mg/kg of chromium(VI).

I.A.3. Uncertainty and Modifying Factors (Oral RfD)

UF = 300.

The uncertainty factor of 300 represents two 10-fold decreases in dose to account for both the expected interhuman and interspecies variability in the toxicity of the chemical in lieu of specific data, and an additional factor of 3 to compensate for the less-than-lifetime exposure duration of the principal study.

MF = 3.

The modifying factor of 3 is to account for concerns raised by the study of Zhang and Li (1987).

I.A.4. Additional Studies/Comments (Oral RfD)

This RfD is limited to soluble salts of hexavalent chromium. Examples of soluble salts include potassium dichromate ($K_2Cr_2O_7$), sodium dichromate ($Na_2Cr_2O_7$), potassium chromate ($K_2Cr_2O_4$), and sodium chromate (Na_2CrO_4). Trivalent chromium is an essential nutrient. There is evidence to indicate that hexavalent chromium is reduced in part to trivalent chromium in vivo (Petrilli and DeFlora, 1977, 1978; Gruber and Jennette, 1978).

In 1965, a study of 155 subjects exposed to drinking water at concentrations of approximately 20 mg/L was conducted outside Jinzhou, China. Subjects were observed to have sores in the mouth, diarrhea, stomachache, indigestion, vomiting, elevated white blood cell counts with respect to controls, and a higher per capita rate of cancers, including lung cancer and stomach cancer. Precise exposure concentrations, exposure durations, and confounding factors were not discussed, and this study does not provide a NOAEL for the observed effects. However, the study suggests that gastrointestinal effects may occur in humans following exposures to hexavalent chromium at levels of 20 ppm in drinking water (Zhang and Li, 1987).

Zahid et al. (1990) fed BALB/C albino Swiss mice trivalent (chromium disulfate) and hexavalent (potassium dichromate) chromium at concentrations of 100, 200, and 400 ppm for 35 days in the diet. The author concluded that a small but significant increase of hexavalent chromium in the testes of fed animals induced significant degeneration. The National Toxicology Program (1996a,b, 1997) recently conducted a three-part study to investigate the potential reproductive toxicity of hexavalent chromium in rats and mice. The study included oral administration of potassium dichromate in Sprague-Dawley rats, a repeat of the study of Zahid et al. (1990) using BALB/C mice, and a reproductive assessment by continuous breeding study in BALB/C mice. The reproductive assessment indicated that potassium dichromate administered at 15-400 ppm in the diet is not a reproductive toxicant in either sex of BALB/C mice or Sprague-Dawley rats.

Several reports of possible fetal damage caused by chromium compounds were located in the literature. High doses (250-1,000 ppm) of orally administered chromium (VI) compounds have been reported to cause developmental toxicity in mice (Trivedi et al., 1989). The authors observed significant increases in preimplantation and postimplantation losses and dose-dependent reductions in total weight and crown-rump length in the lower dose groups. Additional effects included treatment-related increases in abnormalities in the tail and wrist forelimbs, and subdermal hemorrhagic patches in the offspring.

Junaid et al. (1996) and Kanojia et al. (1996) exposed female Swiss albino mice and female Swiss albino rats, respectively, to 250, 500, or 750 ppm potassium dichromate in drinking water to determine the potential embryotoxicity of hexavalent chromium during days 6-14 of gestation. The authors reported retarded fetal development and embryo- and fetotoxic effects including reduced fetal weight, reduced number of fetuses (live and dead) per dam, and higher incidences of stillbirths and post-implantation loss in the 500 and 750 ppm dosed mothers. Significantly reduced ossification in bones was also observed in the medium- and high-dose groups. Based on the body weight and the drinking water ingested by the animals in the 250 ppm dose group, the exposure levels in the 250 ppm groups can be identified as 67 mg/kg-day and 37 mg/kg-day in mice and rats, respectively.

The Junaid et al. (1996) and Kanojia et al. (1996) studies utilized doses approximately 10-fold higher than those used in Mackenzie et al (1958), but neither of the reproductive studies identified a clear NOAEL for the embryotoxic effects of hexavalent chromium. On the basis of the body weight and the drinking water ingested by the animals in the low-dose groups (250 ppm), the LOAELs of 67 mg/kg-day and 37 mg/kg-day can be identified from Junaid et al. (1996) and Kanojia et al. (1996) in mice and rats, respectively. Application of 10-fold uncertainty factor to extrapolate from LOAELs to NOAELs in these studies would generate NOAELs of 6.7 mg/kg-day and 3.7 mg/kg-day, respectively. These extrapolated NOAEL values are similar to, and support the use of, the NOAEL of 2.5 mg/kg-day identified from the study of MacKenzie et al. (1958) for development of the reference dose.

Elbetieha and Al-Hamood (1997) reported impacts on fertility following potassium dichromate exposures in mice; however, many of the observed effects did not occur in a clear dose-dependent fashion. The authors did not indicate the amount of water ingested by the animals, and stated only that water ingestion was reduced in the treatment groups relative to the controls.

Chromium is one of the most common contact sensitizers in males in industrialized countries and is associated with occupational exposures to numerous materials and processes, including chrome plating baths, chrome colors and dyes, cement, tanning agents, wood preservatives, anticorrosive agents, welding fumes, lubricating oils and greases, cleaning materials, and textiles and furs (Burrows and Adams, 1990; Polak et al., 1973). Solubility and pH appear to be the primary determinants of the capacity of individual chromium compounds to elicit an allergic response (Fregert, 1981; Polak et al., 1973). The low solubility chromium (III) compounds are much less efficient contact allergens than chromium (VI) (Spruit and van Neer, 1966).

Dermal exposure to chromium has been demonstrated to produce irritant and allergic contact dermatitis (Bruynzeel et al., 1988; Polak, 1983; Cronin, 1980; Hunter, 1974). Primary irritant dermatitis is related to the direct cytotoxic properties of chromium, while allergic contact dermatitis is an inflammatory response mediated by the immune system. Allergic contact dermatitis is a cell-mediated immune response that occurs in a two-step process. In the first step (induction), chromium is absorbed into the skin and triggers an immune response (sensitization). Sensitized individuals will exhibit an allergic dermatitis response when exposed to chromium above a threshold level (Polak, 1983). Induction is generally considered to be irreversible. Concentrations of hexavalent chromium in environmental media that are protective of carcinogenic and noncarcinogenic effects are likely to be lower than the concentrations required to cause induction of allergic contact dermatitis. However, these concentrations may not be lower than concentrations required to elicit an allergic response in individuals who have been induced.

The RfD was updated in 1998. The RfD is similar to the previous value on IRIS but now incorporates a threefold uncertainty factor to account for the less-than-lifetime exposure in the principal study and a threefold modifying factor to account for uncertainties related to reports of gastrointestinal effects following drinking water exposures in a residential population in China.

For more detail on other Hazard Identification Issues, exit to the toxicological review, Section 4.7 (PDF).

I.A.5. Confidence in the Oral RfD

Study — Low
Database — Low
RfD — Low

The overall confidence in this RfD assessment is low. Confidence in the chosen study is low because of the small number of animals tested, the small number of parameters measured, and the lack of toxic effect at the highest dose tested.

Confidence in the database is low because the supporting studies are of equally low quality and the developmental toxicity endpoints are not well studied.

For more detail on Characterization of Hazard and Dose Response, exit to the toxicological review, Section 6 (PDF).

I.A.6. EPA Documentation and Review of the Oral RfD

Source Document — U.S. EPA, 1998

This assessment was peer reviewed by external scientists. Their comments have been evaluated carefully and incorporated in finalization of this IRIS Summary. A record of these comments is included as an appendix to the Toxicological Review of Acetonitrile in Support of Summary Information (a PDF document) on the Integrated Risk Information System (IRIS) (U.S. EPA, 1998). ***To review this appendix, exit to the toxicological review, Appendix A, External Peer Review -- Summary of Comments and Disposition (PDF)***.

Other EPA Documentation —

U.S. EPA. (1984) Health effects assessment for hexavalent chromium. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Solid Waste and Emergency Response, Washington, DC.

U.S. EPA. (1985) Drinking water health advisory for chromium. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Drinking Water, Washington, DC (Draft).

Agency consensus date -- 04/28/1998

Screening-Level Literature Review Findings — A screening-level review conducted by an EPA contractor of the more recent toxicology literature pertinent to the RfD for Chromium (VI) conducted in August 2003 did not identify any critical new studies. IRIS users who know of important new studies may provide that information to the IRIS Hotline at hotline.iris@epa.gov or 202-566-1676.

I.A.7. EPA Contacts (Oral RfD)

Please contact the IRIS Hotline for all questions concerning this assessment or IRIS, in general, at (202)566-1676 (phone), (202)566-1749 (fax), or hotline.iris@epa.gov (Internet address).

I.B. Reference Concentration for Chronic Inhalation Exposure (RfC)

Chromium (VI)
CASRN — 18540-29-9
Last Revised — 09/03/1998

The inhalation reference concentration (RfC) is analogous to the oral RfD and is likewise based on the assumption that thresholds exist for certain toxic effects such as cellular necrosis. The inhalation RfC considers toxic effects for both the respiratory system (portal-of-entry) and for effects peripheral to the respiratory system (extrarespiratory effects). It is generally expressed in units of mg/m^3. In general, the RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Inhalation RfCs were derived according to the Interim Methods for Development of Inhalation Reference Doses (U.S. EPA, 1989) and subsequently, according to Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry (U.S. EPA, 1994). RfCs can also be derived for the noncarcinogenic health effects of substances that are carcinogens. Therefore, it is essential to refer to other sources of information concerning the carcinogenicity of this substance. If the U.S. EPA has evaluated this substance for potential human carcinogenicity, a summary of that evaluation will be contained in Section II of this file.

I.B.1. Inhalation RfC Summary

Critical Effect	Experimental Doses*	UF	MF	RfC
(1) Chromic acid mists and dissolved Cr (VI) aerosols:				
Nasal septum atrophy **Human subchronic occupational study Lindberg and Hedenstierna, 1983**	NOAEL: none LOAEL: 2E-3 mg/m^3 7.14 E-4 mg/m^3 (adj.)	90	1	8E-6 mg/m^3
(2) Cr(VI) particulates:				
Lactate dehydrogenase in bronchioalveolar lavage fluid **Rat subchronic study** **Glaser et al., 1990** **Malsch et al., 1994**	BMD: 0.016 mg/m^3 0.034 mg/m^3 (adj.)	300	1	1E-4 mg/m^3

*Conversion Factors and Assumptions — Breathing rate for 8-hour occupational exposure = 10 m^3; breathing rate for 24-hour continuous exposure = 20 m^3; occupational exposure = 5 days/week; continuous exposure = 7 days/week. RDDR (regional deposited dose ratio for particulates to account for differences between rats and humans) = 2.16

Nasal mucosal irritation, atrophy, and perforation have been widely reported following occupational exposures to chromic acid mists and dissolved hexavalent chromium aerosols. However, there is uncertainty regarding the relevance of occupational exposures to chromic acid mists and dissolved hexavalent chromium aerosols to exposures to Cr(VI) dusts in the environment. Lower respiratory effects have been reported in laboratory animals following exposures to Cr(VI) dusts. However, these studies have not reported on nasal mucosal effects following the exposures. The uncertainties in the database have been addressed through the development of two RfCs; one based on nasal mucosal atrophy following occupational exposures to chromic acid mists and dissolved hexavalent chromium aerosols, and a second based on lower respiratory effects following inhalation of Cr(VI) particulates in rats.

I.B.2. Principal and Supporting Studies (Inhalation RfC)

(1) Chromic acid mists and dissolved Cr (VI) aerosols

Three studies have focused on nasal mucosal irritation, atrophy, and perforation following occupational exposures to chromic acid mists (Cohen et al., 1974; Lucas and Kramkowski, 1975; Lindberg and Hedenstierna, 1983). Of these, the study of Lindberg and Hedenstierna provides the most information on exposure levels and symptoms reported by exposed workers. Respiratory symptoms, lung function, and changes in nasal septum were studied in 104 workers (85 males, 19 females) exposed in chrome plating plants. Workers were interviewed using a standard questionnaire for the assessment of nose, throat, and chest symptoms. Nasal inspections and pulmonary function testing were performed as part of the study.

The median exposure time for the entire group of exposed subjects (104) in the study was 4.5 years (0.1-36 years). A total of 43 subjects exposed almost exclusively to chromic acid experienced a mean exposure time of 2.5 years (0.2-23.6 years). The subjects exposed almost exclusively to chromic acid were divided into a low-exposure group (8-hr TWA below 0.002 mg/m^3, N=19) and a high-exposure group (8-hr TWA above 0.002 mg/m^3, N=24). Exposure measurements using personal air samplers were performed for 84 subjects in the study on 13 different days. Exposure for the remaining 20 workers was assumed to be similar to that measured for workers in the same area. Nineteen office employees were used as controls for nose and throat symptoms. A group of 119 auto mechanics whose lung function had been evaluated by similar techniques was selected as controls for lung functionmeasurements. Smoking habits of workers were evaluated as part of the study.

At mean exposures below 0.002 mg/m^3, 4/19 workers from the low-exposure group of subjective nasal symptoms. Atrophied nasal mucosa were reported in 4/19 subjects from this group and 11/19 had smeary and crusty septal mucosa, which was statistically higher than controls. No one exposed to levels below 0.001 mg/m^3 complained of subjective symptoms. At mean concentrations of 0.002 mg/m^3 or above, approximately one-third of the subjects had reddened, smeary, or crusty nasal mucosa. Atrophy was seen in 8/24 workers, which was significantly different from controls. Eight subjects had ulcerations in the nasal mucosa and five had perforations of the nasal septum. Atrophied nasal mucosa was not observed in any of the 19 controls, but smeary and crusty septal mucosa occurred in 5/19 controls.

Short-term effects on pulmonary function were evaluated by comparing results of tests taken on Monday and Thursday among exposed groups and controls. No significant changes were seen in the low-exposure group or the control group. Nonsmokers in the high-exposure group experienced significant differences in pulmonary function measurements from the controls, but the results were within normal limits.

The authors concluded that 8-hour mean exposures to chromic acid above 0.002 mg/m^3 may cause a transient decrease in lung function, and that short-term exposures to greater than 0.02 mg/m^3 may cause septal ulceration and perforation. Based on the results of this study, a LOAEL of 0.002 mg/m^3 can be identified for incidence of nasal septum atrophy following exposure to chromic acid mists in chromeplating facilities. At TWA exposures greater than 0.002 mg/m^3, nasal septum ulceration and perforations occurred in addition to the atrophy reported at lower concentrations. The LOAEL is based on an 8-hour TWA occupational exposure. The LOAEL is adjusted to account for continuous exposure according to the following equation:

$$LOAELc = 0.002\ mg/m^3 \times (MVho/MVh) \times 5\ days/7\ days$$

where:

LOAELc is the LOAEL for continuous exposure
MVho is the breathing volume for an 8 hour occupational exposure (10 m^3)
MVh is the breathing volume for a 24 hour continuous exposure (20 m^3)

The LOAEL of 0.002 mg/m^3 based on a TWA exposure to chromic acid is converted to a LOAEL for continuous exposure of 7.14 E-4 mg/m^3. An uncertainty factor of 3 is applied to the LOAEL to extrapolate from a subchronic to a chronic exposure, an uncertainty factor of 3 is applied to account for extrapolation from a LOAEL to a NOAEL, and an uncertainty factor of 10 is applied to the LOAEL to account for interhuman variation. The total uncertainty factor applied to the LOAEL is 90. Application of the uncertainty factor of 90 to the LOAEL of 7.14E-4 mg/m^3 generates an RfC of 8 E-6 mg/m^3 for upper respiratory effects caused by chromic acid mists and dissolved hexavalent chromium aerosols.

(2) Cr (VI) Particulates:

Two studies provide high-quality data on lower respiratory effects following exposures to chromium particulates (Glaser et al., 1985, 1990). Glaser et al. (1990) exposed 8-week-old male Wistar rats to sodium dichromate at 0.05 - 0.4 mg Cr(VI)/m^3 22 hr/day, 7 days/wk for 30-90 days. Chromium-induced effects occurred in a strong dose-dependent manner. The authors observed obstructive respiratory dyspnea and reduced body weight following subacute exposure at the higher dose levels. The mean white blood cell count was increased at all doses ($p < 0.05$) and was related to significant dose-dependent leukocytosis following subacute exposures. Mean lung weights were significantly increased at exposure levels of 0.1 mg/m^3 following both the subacute and subchronic exposures. Accumulation of macrophages was seen in all of the exposure groups and was postulated to be a chromium-specific irritation effect that accounted for the observed increases in lung weights. Focal inflammation was observed in the upper airways following the subchronic exposure, and albumin and lactate dehydrogenase (LDH) in bronchioalveolar lavage fluid (BALF) were increased following the exposure. The authors concluded that chromium inhalation induced pneumocyte toxicity and suggested that inflammation is essential for the induction of most chromium inhalation effects and may influence the carcinogenicity of Cr(VI) compounds.

Glaser et al. (1985) exposed 5-week-old male Wistar rats to aerosols of sodium dichromate at concentrations ranging from 0.025 to 0.2 mg Cr(VI)/m^3, 22 hr/day in subacute (28 day) or subchronic (90 day) protocols. Chromium-induced effects occurred in a dose-dependent manner. Lung and spleen weights were significantly increased ($p < 0.005$) after both subacute and subchronic exposures at concentrations greater than 0.025 mg/m^3. Differences in the mean total serum immunoglobulin were also significant at exposures above 0.025 mg/m^3, while exposures to aerosol concentrations greater than 0.1 mg/m^3 resulted in depression of the immune system stimulation. The immune stimulating effect of subchronic exposure was not reversed after 2 mo of fresh air regeneration. Bronchoalveolar lavage (BAL) cell counts were significantly decreased following subchronic exposure to levels above 0.025 mg/m^3 chromium. The number of lymphocytes and granulocytes showed a slight but significant increase in the lavage fluids of the subacute and subchronically exposed groups. At subacute exposure concentrations up to 0.05 mg/m^3 the phagocytic activity of the alveolar macrophages increased; however, subchronic exposure at 0.2 mg/m^3 decreased this function significantly. The spleen T-lymphocyte subpopulation was stimulated by subchronic exposure to 0.2 mg/m^3 chromium, and serum contents of triglycerides and phospholipids differed significantly from controls ($p < 0.05$) at this concentration.

Together, these studies provide useful information on chromium exposure-related impacts including lung and spleen weight, LDH in BALF, protein in BALF, and albumin in BALF. The cellular content of BALF is considered representative of initial pulmonary injury and chronic lung inflammation, which may lead to the onset of pulmonary fibrosis (Henderson, 1988). While these studies present dose-dependent results on sensitive indicators of lower respiratory toxicity, potential upper respiratory impacts resulting from the exposures were not addressed. Glaser et al. (1990) state that the upper respiratory tract was examined, but these data were not reported.

One approach for development of an RfC using the data of Glaser et al. (1985, 1990) was offered by Malsch et al. (1994), who generated an inhalation RfC for chromium dusts using a benchmark concentration (BMC) approach. The Agency developed its RfC for particulates based on this approach. After excluding exposures for periods of less than 90 days from the BMC analysis, Malsch et al. (1994) developed BMCs for lung weight, LDH in BALF, protein in BALF, albumin in BALF, and spleen weight. The Malsch et al. (1994) analysis defined the benchmark concentration as the 95% lower confidence limit on the dose corresponding to a 10% relative change in the endpoint compared to the control. Dose-effect data were adjusted to account for discontinuous exposure (22 hr/day) and the maximum likelihood model was used to fit continuous data to a polynomial mean response regression, yielding maximum likelihood estimates of 0.036 - 0.078 mg/m^3 and BMCs of 0.016 - 0.067 mg/m^3. Malsch et al. (1994) applied dosimetric adjustments and uncertainty factors to determine a RfC based on the following equation:

RfC =
BMC x RDDR

UF_A x UF_F x UF_H

where:

- **RfC** is the inhalation reference concentration
- **BMC** is the benchmark concentration (lower 95% confidence limit on thedose corresponding to a 10% relative change in the endpoint compared to the control)
- **RDDR** is the regional deposited dose ratio to account for pharmacokineticdifferences between species
- **UF_A** is a threefold uncertainty factor to account for pharmacodynamicdifferences not addressed by the RDDR
- **UF_F** is a threefold uncertainty factor to account for extrapolating from subchronic to chronic exposures; and
- **UF_H** is a 10-fold uncertainty factor to account for the variation in sensitivity among members of the human population

The RDDR factor is incorporated to account for differences in the deposition pattern of inhaled hexavalent chromium dusts in the respiratory tract of humans and the Wistar rat test animals (Jarabek et al., 1990). The RDDR of 2.1576 was determined based on the mass median aerodynamic diameter (0.28 µm for dose levels of 0.05-0.1 mg/m^3 and 0.39 for dose levels of 0.1-0.4 mg/m^3) and the geometric standard deviation (1.63 for dose levels of 0.05-0.1 mg/m^3 and 1.72 for dose levels of 0.1-0.4 mg/m^3) of the particulates reported in Glaser et al. (1990). A 3.16-fold uncertainty factor (midpoint between 1 and 10 on a log scale) was incorporated to account for the pharmacodynamic differences not accounted for by the RDDR. An additional 3.16-fold uncertainty factor was incorporated to account for the less-than-lifetime exposure in Glaser et al. (1990), and a 10-fold uncertainty factor was applied to account for variation in the human population. A total uncertainty factor of 100 was applied to the BMC in addition to the RDDR.

Glaser et al. (1990) reported that LDH in BALF increased in a dose-dependent fashion from 0.05 to 0.4 mg/m^3 sodium dichromate, and this endpoint generated the lowest BMC (0.016 mg/m^3) and RfC (3.4 E-4 mg/m^3). LDH in BALF is considered the among the most sensitive indicators of potential lung toxicity (Henderson, 1984, 1985, 1988; Beck et al., 1982; Venet et al., 1985), as LDH is found extracellularly after cell damage and BALF is the closest site to the original lung injury. LDH in BALF may also reflect chronic lung inflammation, which may lead to pulmonary fibrosis through prevention of the normal repair of lung tissue (Henderson, 1988).

Several uncertainties must be addressed with regard to the BMC and RfC developed by Malsch et al. (1994). Potentially important endpoints, including upper airway effects and potential renal or immunological toxicity, were not addressed in the Glaser et al. (1985, 1990) studies and could not be included in the BMC analysis. While LDH in BALF resulted in the lowest BMC and RfC, all of the effects noted in Glaser et al. (1985, 1990) can be considered indicative of an inflammatory response, and might be equally suited to development of the RfC. LDH in BALF did not generate the best fit on the regression curve of the endpoints considered in the BMC analysis. In addition, the threefold uncertainty factor accounting for the use of a subchronic study may not be sufficiently protective for long-term effects. While the analysis acknowledged the importance of particle size and airway deposition in the development of the RDDR, the potential impact of different particle sizes in respiratory toxicity by hexavalent chromium particulates was not addressed.

Several of these uncertainties were conservatively addressed in the analysis of Malsch et al. (1994). LDH in BALF generated the lowest estimate of the BMC from the effects noted by Glaser et al. (1985, 1990). This effect can be considered to be indicative of cell damage that occurs prior to fibrosis, as LDH appears in BALF following cell lysis. While the Malsch et al. (1994) analysis demonstrated a relatively poor curve fit for this endpoint, the model generated a conservative fit in the data that is unlikely to overestimate the BMC. LDH in BALF as reported in Glaser et al. (1990) is considered to be an acceptable endpoint for development of an RfC for inhalation of hexavalent chromium particulates, and Malsch et al. (1994) used a reasonable approach for development of a BMC based on this endpoint.

The threefold uncertainty factor used by Malsch et al. (1994) to account for the subchronic study is insufficient for development of the RfC for inhalation of chromium particulates. Glaser et al. (1985) demonstrated that at the end of the 90-day exposure period, chromium was still accumulating in the lung tissue of the test animals, suggesting that lower long-term exposures might lead to accumulation of a critical concentration in the lung. Subchronic studies also may not adequately predict the presence of inflammatory effects from lower long-term exposures. The Agency has therefore determined that a 10-fold uncertainty factor accounting for the use of a subchronic study is more appropriate in this case for the development of an RfC for inhalation of chromium particulates.

Selection of a threefold uncertainty factor to account for the pharmacodynamic differences not accounted for by the RDDR, an additional 10-fold uncertainty factor to account for the less-than-lifetime exposure in Glaser et al. (1990), and a 10-fold uncertainty factor to account for variation in the human population generates a total uncertainty factor of 300. Application of the total uncertainty factor of 300 and the RDDR of 2.1576 to the BMC generated by Malsch et al. (1994) based on LDH in BALF (Glaser et al., 1990) results in an RfC of 1 E-4 mg/m^3 for inhalation of hexavalent chromium particulates.

I.B.3. Uncertainty and Modifying Factors (Inhalation RfC)

See discussion above.

(1) Chromic acid mists and dissolved Cr (VI) aerosols:
UF = 90.
MF = 1.

(2) Chromium (VI) particulates:
UF = 300.
MF = 1

I.B.4. Additional Studies/Comments (Inhalation RfC)

There is considerable uncertainty with regard to the relevance of the nasal septum atrophy endpoint observed in the chromeplating industry to exposure to hexavalent chromium in the environment. The effects were observed in chromeplaters who were exposed to chromic acid mists near the plating baths. Environmental exposures would most likely occur through contact with hexavalent chromium dusts, and exposures to chromic acid mists in the environment is considered to be unlikely. An additional uncertainty is related to the determination of dose in the Lindberg and Hedenstierna study. Nasal septum atrophy in this study was related to TWA exposures to chromic acid. The most significant effects (nasal septum perforation) were observed in workers who experienced peak excursions to levels considerably greater than the TWA. It is uncertain whether the peak excursion data or the TWAs are more appropriate for the determination of dose in this study. The RfC based on the data of Lindberg and Hedenstierna (1983) should only be used to address exposures to chromic acid and dissolved hexavalent chromium aerosols.

Nasal mucosal irritation, atrophy, and perforation have been widely reported following occupational exposures to chromic acid mists and dissolved hexavalent chromium aerosols. Glaser et al. (1990) did not report on upper respiratory effects following exposure of rats to sodium dichromate. The RfC based on the data of Glaser et al. should only be used to address inhalation of Cr(VI) particulates.

The RfCs in this IRIS Summary were added in 1998. The previous RfC section for hexavalent chromium in IRIS was empty.

For more detail on other Hazard Identification Issues, exit to [the toxicological review, Section 4.7](#) (PDF).

I.B.5. Confidence in the Inhalation RfC

(1) Chromic acid mists and dissolved Cr (VI) aerosols:

Study — Low
Database — Low
RfC -- Low

The overall confidence in this RfC assessment is low. Confidence in the chosen study is low because of uncertainties regarding the exposure characterization and the role of direct contact for the critical effect. Confidence in the database is low because the supporting studies are equally uncertain regarding the exposure characterization.

(2) Chromium (VI) particulates:

Study — Medium
RfC — Medium

The overall confidence in this RfC assessment is medium. Confidence in the chosen study is medium because of uncertainties regarding upper respiratory, reproductive, and renal effects resulting from the exposures.

For more detail on Characterization of Hazard and Dose Response, exit to [the toxicological review, Section 6](#) (PDF).

I.B.6. EPA Documentation and Review of the Inhalation RfC

Source Document — U.S. EPA, 1998

This assessment was peer reviewed by external scientists. Their comments have been evaluated carefully and incorporated in finalization of this IRIS Summary. A record of these comments is included as an appendix to the Toxicological Review of Acetonitrile in Support of Summary Information (a PDF document) on the Integrated Risk Information System (IRIS) (U.S. EPA, 1998). ***To review this appendix, exit to the toxicological review, Appendix A,***

External Peer Review -- Summary of Comments and Disposition (PDF).

Agency Consensus Date — 04/28/1998

Screening-Level Literature Review Findings — A screening-level review conducted by an EPA contractor of the more recent toxicology literature pertinent to the RfC for Chromium (VI) conducted in August 2003 did not identify any critical new studies. IRIS users who know of important new studies may provide that information to the IRIS Hotline at hotline.iris@epa.gov or 202-566-1676.

I.B.7. EPA Contacts (Inhalation RfC)

Please contact the IRIS Hotline for all questions concerning this assessment or IRIS, in general, at (202)566-1676 (phone), (202)566-1749 (fax), or hotline.iris@epa.gov (Internet address).

II. Carcinogenicity Assessment for Lifetime Exposure

Substance Name: Chromium (VI)
CASRN: 18540-29-9
Last Revised — 09/03/1998

Section II provides information on three aspects of the carcinogenic assessment for the substance in question; the weight-of-evidence judgment of the likelihood that the substance is a human carcinogen, and quantitative estimates of risk from oral exposure and from inhalation exposure. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per µg/L drinking water or risk per µg/m3 air breathed. The third form in which risk is presented is a concentration of the chemical in drinking water or air associated with cancer risks of 1 in 10,000, 1 in 100,000, or 1 in 1,000,000. The rationale and methods used to develop the carcinogenicity information in IRIS are described in The Risk Assessment Guidelines of 1986 (EPA/600/8-87/045) and in the IRIS Background Document. IRIS summaries developed since the publication of EPA's more recent Proposed Guidelines for Carcinogen Risk Assessment also utilize those Guidelines where indicated (Federal Register 61(79):17960-18011, April 23, 1996). Users are referred to Section I of this IRIS file for information on long-term toxic effects other than carcinogenicity.

II.A. Evidence for Human Carcinogenicity

II.A.1. Weight-of-Evidence Characterization

Under the current guidelines (EPA, 1986), Cr(VI) is classified as Group A - known human carcinogen by the inhalation route of exposure. Carcinogenicity by the oral route of exposure cannot be determined and is classified as Group D.

Under the proposed guidelines (EPA, 1996), Cr(VI) would be characterized as a known human carcinogen by the inhalation route of exposure on the following basis.

Hexavalent chromium is known to be carcinogenic in humans by the inhalation route of exposure. Results of occupational epidemiologic studies of chromium-exposed workers are consistent across investigators and study populations. Dose-response relationships have been established for chromium exposure and lung cancer. Chromium-exposed workers are exposed to both Cr(III) and Cr(VI) compounds. Because only Cr(VI) has been found to be carcinogenic in animal studies, however, it was concluded that only Cr(VI) should be classified as a human carcinogen.

Animal data are consistent with the human carcinogenicity data on hexavalent chromium. Hexavalent chromium compounds are carcinogenic in animal bioassays, producing the following tumor types: intramuscular injection site tumors in rats and mice, intrapleural implant site tumors for various Cr(VI) compounds in rats, intrabronchial implantation site tumors for various Cr(VI) compounds in rats, and subcutaneous injection site sarcomas in rats.

In vitro data are suggestive of a potential mode of action for hexavalent chromium carcinogenesis. Hexavalent chromium carcinogenesis may result from the formation of mutagenic oxidatitive DNA lesions following intracellular reduction to the trivalent form. Cr(VI) readily passes through cell membranes and is rapidly reduced intracellularly to generate reactive Cr(V) and Cr(IV) intermediates and reactive oxygen species. A number of potentially mutagenic DNA lesions are formed during the reduction of Cr(VI). Hexavalent chromium is mutagenic in bacterial assays, yeasts, and V79 cells, and Cr(VI) compounds decrease the fidelity of DNA synthesis in vitro and produce unscheduled DNA synthesis as a consequence of DNA damage. Chromate has been shown to transform both primary cells and cell lines.

For more detail on Characterization of Hazard and Dose Response, exit to the toxicological review, Section 6 (PDF).

For more detail on other Hazard Identification Issues, exit to the toxicological review, Section 4.7 (PDF).

II.A.2. Human Carcinogenicity Data

Occupational exposure to chromium compounds has been studied in the chromate production, chromeplating and chrome pigment, ferrochromium production, gold mining, leather tanning, and chrome alloy production industries.

Workers in the chromate industry are exposed to both trivalent and hexavalent compounds of chromium. Epidemiological studies of chromate production plants in Japan, Great Britain, West Germany, and the United States have revealed a correlation between occupational exposure to chromium and lung cancer, but the specific form of chromium responsible for the induction of cancer was not identified (Machle and Gregorius, 1948; Baejter, 1950a,b; Bidstrup, 1951; Mancuso and Hueper, 1951; Brinton et al., 1952; Bidstrup and Case, 1956; Todd, 1962; Taylor, 1966; Enterline, 1974; Mancuso, 1975; Ohsaki et al., 1978; Sano and Mitohara, 1978; Hayes et al., 1979; Hill and Ferguson, 1979; Alderson et al., 1981; Haguenor et al., 1981; Satoh et al., 1981; Korallus et al., 1982; Frentzel-Beyme, 1983; Langard and Vigander, 1983; Watanabe and Fukuchi, 1984; Davies, 1984; Mancuso, 1997).

Mancuso and Hueper (1951) conducted a proportional mortality study of a cohort of chromate workers (employed for > l year from 1931-1949 in a Painesville, OH chromate plant) in order to investigate lung cancer associated with chromate production. Of the 2,931 deaths of males in the county where the plant is located, 34 (1.2%) were due to respiratory cancer. Of the 33 deaths among the chromate workers, however, 6 (18.2%) were due to respiratory cancer. Within the limitations of the study design, this report strongly suggested an increased incidence of respiratory cancer in the chromate-production plant.

In an update of the Mancuso and Hueper (1951) study, Mancuso (1975) followed 332 of the workers employed from 1931-1951 until 1974. By 1974, > 50% of this cohort had died. Of these men, 63.6%, 62.5%, and 58.3% of the cancer deaths for men employed from 1931-1932, 1933-1934, and 1935-1937, respectively, were due to lung cancer. Lung cancer death rates increased by gradient of exposure to total chromium, and significant deposition of chromium was found in the lungs of workers long after the exposure ceased. Mancuso (1975) reported that these lung cancer deaths were related to insoluble (trivalent), soluble (hexavalent), and total chromium exposure, but the small numbers involved make identification of the specific form of chromium responsible for the lung cancer uncertain.

Mancuso (1997) recently updated this study, following the combined cohort of 332 workers until 1993. Of 283 deaths (85% of the cohort identified), 66 lung cancers were found (23.3%

of all deaths and 64.7% of all cancers). Lung cancer rates clearly increased by gradient level of exposure to total chromium. The relationship between gradient level of exposure and lung cancer rates is less clear for trivalent and hexavalent chromium. The rates of lung cancer within the cohort are consistent with those reported in Mancuso (1975), and provide further support for the cancer risk assessment based on those data.

Studies of chrome pigment workers in the United States (Hayes et al., 1989), England (Davies, 1984, 1979, 1978), Norway (Langard and Vigander, 1983; Langard and Norseth, 1975), and in the Netherlands and Germany (Frentzel-Beyme, 1983) have consistently demonstrated an association between occupational chromium exposure (predominantly to Cr [VI]) and lung cancer.

Several studies of the chromeplating industry have demonstrated a positive relationship between cancer and exposure to chromium compounds (Royle, 1975; Franchini et al., 1983; Sorahan et al., 1987).

II.A.3. Animal Carcinogenicity Data

Animal data are consistent with the findings of human epidemiological studies of hexavalent chromium. Hexavalent chromium compounds were carcinogenic in animal assays producing the following tumor types: lung tumors following inhalation of aerosols of sodium chromate and pyrolized Cr(VI)/Cr(III) oxide mixtures in rats (Glaser et al., 1986), lung tumors following intratracheal administration of sodium dichromate in rats (Steinhoff et al., 1983), intramuscular injection site tumors in Fischer 344 and Bethesda Black rats and in C57BL mice (Furst et al., 1976; Maltoni, 1974, 1976; Payne, 1960a; Hueper and Payne, 1959); intrapleural implant site tumors for various Cr(VI) compounds in Sprague-Dawley and Bethesda Black rats (Payne, 1960b; Hueper 1961; Hueper and Payne, 1962), intrabronchial implantation site tumors for various Cr(VI) compounds in Wistar rats (Levy and Martin, 1983; Laskin et al., 1970; Levy, as quoted in NIOSH, 1975), and subcutaneous injection site sarcomas in Sprague-Dawley rats (Maltoni, 1974, 1976). Inflammation is considered to be essential for the induction of most chromium respiratory effects and may influence the carcinogenicity of Cr(VI) compounds (Glaser et al., 1985).

II.A.4. Supporting Data for Carcinogenicity

Metabolism and genotoxicity. Hexavalent chromium is rapidly taken up by cells through the sulfate transport system (Sugiyama, 1992). Once inside the cell, Cr(VI) is quickly reduced to the trivalent form by cellular reductants, including ascorbic acid, glutathione and flavoenzymes (cytochrome P-450 and glutathione reductase), and riboflavin (De Flora et al., 1989; De Flora et al., 1990; Sugiyama, 1992). The intracellular reduction of Cr(VI) generates reactive Cr(V) and Cr(IV) intermediates as well as hydroxyl free radicals (OH) and singlet oxygen ($^{1}O_2$) (Kawanishi et al., 1986). A variety of DNA lesions are formed during the reduction of Cr(VI) to Cr(III), including DNA strand breaks, alkali-labile sites, DNA-protein and DNA-DNA crosslinks, and oxidative DNA damage, such as 8-oxo-deoxyguanosine (Klein et al., 1992; Klein et al., 1991; De Flora et al., 1990). The relative importance of the different chromium complexes and oxidative DNA damage in the toxicity of Cr(VI) is unknown.

A large number of chromium compounds have been assayed with in vitro genetic toxicology assays. In general, hexavalent chromium is mutagenic in bacterial assays whereas trivalent chromium is not (Lofroth, 1978; Petrilli and DeFlora, 1977, 1978). Likewise Cr(VI), but not Cr(III), was mutagenic in yeasts (Bonatti et al., 1976) and in V79 cells (Newbold et al., 1979). Cr(III) and (VI) compounds decrease the fidelity of DNA synthesis in vitro (Loeb et al., 1977), while Cr(VI) compounds inhibit replicative DNA synthesis in mammalian cells (Levis et al., 1978) and produce unscheduled DNA synthesis, presumably repair synthesis, as a consequence of DNA damage (Raffetto, 1977). Chromate has been shown to transform both primary cells and cell lines (Fradkin et al., 1975; Tsuda and Kato, 1977; Casto et al., 1979). Chromosomal effects produced by treatment with chromium compounds have been reported by a number of authors; for example, both Cr(VI) and Cr(III) salts were clastogenic for cultured human leukocytes (Nakamuro et al.,1978).

In dogs (2/group) exposed to potassium dichromate in drinking water at concentrations up to 11.2 ppm for 4 years, gross and microscopic examination of all major organs revealed no treatment-related lesions (Anwar et al., 1961). The small number of animals and the relatively short exposure duration relative to the lifespan of the dog precludes a conclusion regarding a possible carcinogenic response. There are no other long-term studies of ingested Cr(VI). Cr(VI) is readily converted to Cr(III) in vivo, but there is no evidence that Cr(III) is oxidized to Cr(VI) in vivo. Cr(III) is an essential trace element.

II.B. Quantitative Estimate of Carcinogenic Risk from Oral Exposure

The oral carcinogenicity of Cr(VI) cannot be determined. No data were located in the available literature that suggested that Cr(VI) is carcinogenic by the oral route of exposure.

II.C. Quantitative Estimate of Carcinogenic Risk from Inhalation Exposure

II.C.1. Summary of Risk Estimates

II.C.1.1. Air Unit Risk — 1.2E-2 per (μg/cu.m)

Source: Mancuso, 1975

II.C.1.2. Extrapolation Method — Multistage, extra risk

Air Concentrations at Specified Risk Levels:

Risk Level	Concentration
E-4 (1 in 10,000)	8E-3 (μg/m^3)
E-5 (1 in 100,000)	8E-4 (μg/m^3)
E-6 (1 in 1,000,000)	8E-5 (μg/m^3)

II.C.2. Dose-Response Data for Carcinogenicity, Inhalation Exposure

Tumor type -- lung cancer
Test animals — human
Route — inhalation, occupational exposure
Source -- Mancuso, 1975

Subject age (years)	Exposure Level midrange (μg/m^3)	Deaths From Lung Cancer	Person-Years
50	5.66 25.27 46.83	3 6 6	1,345 931 299
60	4.68 20.79 39.08	4 5 5	1,063 712 211
70	4.41 21.29	2 4	401 345

II.C.3. Additional Comments (Carcinogenicity, Inhalation Exposure)

Mancuso (1997) recently updated the study of Mancuso (1975), following the combined cohort of 332 workers until 1993. Of 283 deaths (85% of the cohort identified), 66 lung cancers were found (23.3% of all deaths and 64.7% of all cancers). Lung cancer rates clearly increased by gradient level of exposure to total chromium. The relationship between gradient level of exposure and lung cancer rates is less clear for trivalent and hexavalent chromium. The rates of lung cancer within the cohort are consistent with those reported in Mancuso (1975), and provide further support for the cancer risk assessment based on those data.

The cancer mortality in Mancuso (1975) was assumed to be due to Cr(VI), which was further assumed to be no less than one-seventh of total chromium. It was also assumed that the smoking habits of chromate workers were similar to those of the U.S. white male population.

Trivalent chromium compounds have not been reported as carcinogenic by any route of administration.

The unit risk should not be used if the air concentration exceeds 8E-1 µg/m3, since above this concentration the unit risk may not be appropriate.

The carcinogenicity section of this IRIS Summary was updated in 1998; however, the quantitative results have not been modified.

II.C.4. Discussion of Confidence (Carcinogenicity, Inhalation Exposure)

Results of studies of chromium exposure are consistent across investigators and countries. A dose relationship for lung tumors has been established. Theassumption that the ratio of Cr(III) to Cr(VI) is 6:1 may lead to a sevenfold underestimation of risk. The use of 1949 hygiene data (Bourne and Yee, 1950), which may underestimate worker exposure, may result in an overestimation of risk. Further overestimation of risk may be due to the implicit assumption that the smoking habits of chromate workers were similar to those of the general white male population, since it is generally accepted that the proportion of smokers is higher for industrial workers than for the general population.

II.D. EPA Documentation, Review, and Contacts (Carcinogenicity Assessment)

II.D.1. EPA Documentation

Source Document — U.S. EPA, 1998

This assessment was peer reviewed by external scientists. Their comments have been evaluated carefully and incorporated in finalization of this IRIS Summary. A record of these comments is included as an appendix to the Toxicological Review of Acetonitrile in Support of Summary Information (a PDF document) on the Integrated Risk Information System (IRIS) (U.S. EPA, 1998). ***To review this appendix, exit to the toxicological review, Appendix A, External Peer Review -- Summary of Comments and Disposition (PDF)***.

Other EPA Documentation — U.S. EPA. (1984) Health assessment document for chromium. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH. EPA/600/8-83-014F.

II.D.2. EPA Review (Carcinogenicity Assessment)

Agency consensus date -- 04/28/1998

Screening-Level Literature Review Findings — A screening-level review conducted by an EPA contractor of the more recent toxicology literature pertinent to the cancer assessment for Chromium (VI) conducted in August 2003 did not identify any critical new studies. IRIS users who know of important new studies may provide that information to the IRIS Hotline at hotline.iris@epa.gov or 202-566-1676.

II.D.3. EPA Contacts (Carcinogenicity Assessment)

Please contact the IRIS Hotline for all questions concerning this assessment or IRIS, in general, at (202)566-1676 (phone), (202)566-1749 (fax), or hotline.iris@epa.gov (Internet address).

III. [reserved]

IV. [reserved]

V. [reserved]

VI. Bibliography

Chromium (VI)
CASRN — 18540-29-9

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VII. Revision History

Chromium (VI)
CASRN —18540-29-9

Date	Section	Description
09/03/1998	I., II., VI.	Revised RfD, RfC, carcinogenicity assessment, refs.
10/28/2003	I.A.6., I.B.6., II.D.2.	Screening-Level Literature Review Findings message has been added.

VIII. Synonyms

Chromium (VI)
CASRN —18540-29-9
Last Revised — 03/31/1987

- 18540-29-9
- 7440-47-3
- Chromic ion

- Chromium
- Chromium, ion
- Chromium (VI)
- Chromium (VI) ion

EXHIBIT 15

Paramount Hexavalent Chromium Monitoring Results (ng/m^3)

Sample Date	Site #2	Site #3	Site #4	Site #5	Site #6	Site #7	Site #8	Site #9	Site #10	Site #11	Site #12	Site #13	Site #14	Site #15	Site #16	Site #17	Site #18	Site #19	Site #20	Site #21	Site #22	Site #23	Site #24	Site #25	Site #26	Site #27	Site #28	Site #29	Site #30	Site #31	Site #32	Site #33	Site #34	Site #35	Site #36
Sat, Oct 15, 2016	0.27	0.13	0.24	0.06	1	7.9	N/A	N/A	N/A	N/A	0.06	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tue, Oct 18, 2016	0.53	—	0.43	1.20	0.46	Invalid	N/A	N/A	N/A	N/A	0.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Fri, Oct 21, 2016	0.14	0.11	0.41	0.68	0.9	1.1	N/A	N/A	N/A	N/A	0.34	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Mon, Oct 24, 2016	1.56	—	0.34	0.59	0.89	4.2	N/A	N/A	N/A	N/A	0.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Oct 27, 2016	1.10	0.2	0.21	0.28	0.98	5	29	2.7	1.4	17	0.30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, Oct 30, 2016	0.46	—	0.08	0.23	0.29	4.8	25	1.1	0.31	0.15	Invalid	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Nov 2, 2016	0.33	0.12	0.2	0.42	0.53	2.7	12	2.4	1.3	11	0.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sat, Nov 5, 2016	0.25	—	N/A	N/A	N/A	3.6	14	1.2	0.79	8.8	N/A	2.3	12	26	0.51	0.61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tue, Nov 8, 2016	0.43	0.16	N/A	N/A	N/A	2.4	15	1.5	0.97	5.4	N/A	8.8	16	13	0.28	0.71	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Fri, Nov 11, 2016	0.3	—	N/A	N/A	N/A	2.6	17	2.4	1.8	3.3	N/A	8.4	15	16	0.64	0.44	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Mon, Nov 14, 2016	0.29	0.21	N/A	N/A	N/A	2.7	12	0.67	0.43	8.5	N/A	Invalid	12	14	Invalid	0.79	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Nov 17, 2016	0.25	—	N/A	N/A	N/A	1.1	17	2.6	1.2	3.4	N/A	4.0	7.0	2.3	0.27	0.32	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, Nov 20, 2016	0.18	0.11	N/A	N/A	N/A	0.42	4.7	0.79	N/A	2.1	N/A	0.94	3.6	10	0.67	0.14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Nov 24, 2016	0.06	0.04	N/A	N/A	N/A	0.06	7.6	6.3	N/A	0.08	N/A	0.11	0.1	0.11	0.06	0.05	0.06	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sat, Nov 26, 2016	0.06	0.06	N/A	N/A	N/A	NSD	NSD	NSD	N/A	NSD	N/A	NSD	NSD	NSD	NSD	NSD	NSD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tue, Nov 29, 2016	0.10	—	N/A	N/A	N/A	1.8	12	1.5	N/A	Invalid	N/A	1.8	4.4	5.3	0.35	0.42	Invalid	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Fri, Dec 2, 2016	0.28	0.07	N/A	N/A	N/A	0.64	4.9	1.7	N/A	2	N/A	1.3	1.6	7.6	0.51	0.14	3.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Mon, Dec 5, 2016	0.70	—	N/A	N/A	N/A	0.44	0.15	0.17	N/A	0.2	N/A	0.27	0.18	0.67	0.27	0.11	0.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Dec 8, 2016	0.43	0.38	N/A	N/A	N/A	3.75	1.30	0.47	N/A	4.50	N/A	0.93	5.70	10.00	0.21	8.30	1.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, Dec 11, 2016	0.25	—	N/A	N/A	N/A	0.23	2.30	0.32	N/A	0.35	N/A	0.16	0.13	0.27	0.11	0.16	2.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Dec 14, 2016	0.31	0.25	N/A	N/A	N/A	2.60	12.10	1.40	N/A	5.80	N/A	4.40	10.00	3.10	0.44	0.77	1.60	1.40	0.46	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sat, Dec 17, 2016	0.61	—	N/A	N/A	N/A	0.16	0.27	0.25	N/A	Invalid	N/A	0.99	0.57	0.37	0.08	0.16	0.28	1.00	Invalid	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tue, Dec 20, 2016	0.18	0.15	N/A	N/A	N/A	1.01	3.01	1.07	N/A	0.55	N/A	1.80	2.10	2.20	0.23	0.18	0.31	0.26	0.31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, Dec 25, 2016	0.04	0.05	N/A	N/A	N/A	0.05	0.08	0.06	N/A	0.05	N/A	0.06	0.05	0.05	0.05	0.04	0.06	0.06	Invalid	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Dec 29, 2016	0.35	—	N/A	N/A	N/A	0.23	Invalid	0.23	N/A	0.82	N/A	2.50	2.00	1.50	0.15	0.22	0.41	0.28	0.27	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, Jan 1, 2017	0.19	0.34	N/A	N/A	N/A	0.19	0.28	0.27	N/A	0.26	N/A	0.28	0.25	0.24	0.25	0.20	0.21	0.24	NS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Jan 4, 2017	0.33	—	N/A	N/A	N/A	Invalid	0.40	Invalid	N/A	0.60	N/A	0.76	0.95	1.04	0.22	0.39	0.24	0.16	0.15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sat, Jan 7, 2017	0.04	0.06	N/A	N/A	N/A	0.14	0.39	0.86	N/A	0.45	N/A	0.79	0.94	3.00	0.07	0.07	0.45	0.07	Invalid	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tue, Jan 10, 2017	0.74	—	N/A	N/A	N/A	1.16	2.21	0.75	N/A	0.31	N/A	0.40	0.36	0.31	0.35	0.43	0.78	0.78	0.41	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Fri, Jan 13, 2017	0.64	0.13	N/A	N/A	N/A	0.76	2.40	0.49	N/A	0.50	N/A	0.33	0.39	0.52	0.23	0.25	0.68	0.43	Invalid	0.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Mon, Jan 16, 2017	0.73	—	N/A	N/A	N/A	0.54	4.00	0.74	N/A	0.65	N/A	1.54	0.76	0.68	0.33	0.14	0.23	0.61	Invalid	0.23	Invalid	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Jan 19, 2017	0.41	0.23	N/A	N/A	N/A	0.19	0.30	0.17	N/A	0.68	N/A	0.91	1.17	1.26	0.30	0.20	0.32	1.41	0.62	0.81	0.18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, Jan 22, 2017	0.13	—	N/A	N/A	N/A	Invalid	0.11	0.21	N/A	0.10	N/A	0.10	0.12	0.09	0.08	0.13	0.17	Invalid	Invalid	0.77	0.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Jan 25, 2017	0.51	0.14	N/A	N/A	N/A	0.28	0.43	0.42	N/A	0.86	N/A	2.30	1.19	1.25	0.15	0.22	0.62	0.37	0.26	0.23	0.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Jan 26, 2017	N/A	N/A	N/A	N/A	N/A	N/A	0.15	N/A	N/A	N/A	N/A	N/A	N/A	1.51	N/A	N/A	N/A	0.29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sat, Jan 28, 2017	0.07	—	N/A	N/A	N/A	0.19	0.24	0.21	N/A	0.46	N/A	0.36	0.44	0.38	0.13	0.10	0.18	0.24	NS	0.21	NS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tue, Jan 31, 2017	0.15	0.10	N/A	N/A	N/A	0.62	0.83	0.38	N/A	1.02	N/A	0.81	2.74	15.17	0.22	0.21	0.90	0.25	0.15	0.53	0.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Fri, Feb 3, 2017	0.08	—	N/A	N/A	N/A	0.15	0.40	0.22	N/A	0.37	N/A	0.41	0.36	0.87	Invalid	0.13	1.09	0.20	NS	0.32	NS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Mon, Feb 6, 2017	0.09	0.07	N/A	N/A	N/A	0.22	0.17	0.19	N/A	0.27	N/A	Invalid	0.28	0.26	0.36	0.34	0.11	0.30	N/A	2.68	0.98	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tue, Feb 7, 2017	N/A	N/A	N/A	N/A	N/A	N/A	2.01	N/A	N/A	N/A	N/A	N/A	N/A	0.49	N/A	N/A	N/A	1.16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Feb 9, 2017	0.90	—	N/A	N/A	N/A	0.38	0.57	0.72	N/A	0.38	N/A	0.32	0.35	0.30	0.22	0.27	0.31	2.38	N/A	0.47	0.21	2.98	0.89	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, Feb 12, 2017	0.12	0.17	N/A	N/A	N/A	0.41	3.11	0.12	N/A	0.21	N/A	0.25	0.19	0.23	0.20	0.21	0.42	Invalid	N/A	0.33	0.28	0.41	0.39	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Feb 15, 2017	0.92	—	N/A	N/A	N/A	0.46	0.45	0.38	N/A	1.05	N/A	0.35	1.31	0.97	Invalid	0.50	1.15	0.47	N/A	0.30	1.22	0.62	0.72	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sat, Feb 18, 2017	0.02	0.56	N/A	N/A	N/A	0.79	0.36	0.14	N/A	0.20	N/A	0.19	0.32	0.22	Invalid	N/A	N/A	0.13	N/A	0.54	N/A	0.57	1.22	0.19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tue, Feb 21, 2017	1.47	—	N/A	N/A	N/A	1.09	0.81	0.56	N/A	0.63	N/A	0.31	0.50	0.62	0.25	N/A	N/A	2.16	N/A	0.38	NS	0.78	NS	0.69	Invalid	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Fri, Feb 24, 2017	0.25	0.14	N/A	N/A	N/A	0.33	0.48	0.61	N/A	0.66	N/A	0.42	0.58	0.75	0.14	N/A	N/A	0.91	N/A	0.29	NS	1.05	0.56	0.21	NS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Mon, Feb 27, 2017	0.57	—	N/A	N/A	N/A	1.60	2.75	0.35	N/A	0.39	N/A	0.33	0.29	0.38	0.31	N/A	N/A	2.26	N/A	0.81	0.25	2.03	N/A	0.40	3.64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Mar 1, 2017	N/A	N/A	N/A	N/A	N/A	N/A	1.04	N/A	N/A	N/A	N/A	N/A	N/A	0.79	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Mar 2, 2017	0.29	0.13	N/A	N/A	N/A	0.75	1.13	1.02	N/A	0.86	N/A	1.74	1.83	1.73	0.23	N/A	N/A	0.76	N/A	0.64	0.29	0.76	N/A	0.28	0.65	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, Mar 5, 2017	0.15	—	N/A	N/A	N/A	0.16	0.15	0.15	N/A	0.09	N/A	0.11	Invalid	0.09	0.09	N/A	N/A	1.60	N/A	0.36	0.06	0.76	N/A	0.16	0.29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Mar 8, 2017	0.26	0.18	N/A	N/A	N/A	0.57	0.93	0.54	N/A	0.45	N/A	0.33	0.29	0.37	0.16	N/A	N/A	0.58	N/A	0.32	0.24	0.56	N/A	0.27	0.37	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sat, Mar 11, 2017	Invalid	—	N/A	N/A	N/A	1.66	4.09[a]	1.17	N/A	1.55	N/A	1.12	0.38	0.31	0.93	N/A	N/A	0.37	N/A	0.34	NS	0.56	N/A	0.67	0.33	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tue, Mar 14, 2017	0.48	NS	N/A	N/A	N/A	1.59	0.67	1.47	N/A	0.65	N/A	1.31	1.21	0.65	0.76	N/A	N/A	1.17	N/A	0.69	NS	2.03	N/A	1.00	0.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Fri, Mar 17, 2017	0.22	—	N/A	N/A	N/A	0.71	0.44	1.05	N/A	0.61	N/A	1.34	0.91	0.87	0.66	N/A	N/A	0.79	N/A	0.79	NS	1.30	N/A	0.88	1.29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Mon, Mar 20, 2017	0.64	0.27	N/A	N/A	N/A	0.94	0.14	0.16	N/A	1.20	N/A	0.13	0.16	0.56	0.09	N/A	N/A	2.04	N/A	1.14	0.07	3.05	N/A	0.68	0.98	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Mar 23, 2017	0.84	—	N/A	N/A	N/A	0.13	0.90	0.16	N/A	0.15	N/A	1.11	1.27	0.19	0.98	N/A	N/A	1.69	N/A	0.75	1.09	1.23	N/A	0.40	0.45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, Mar 26, 2017	0.49	0.11	N/A	N/A	N/A	0.07	0.14	0.08	N/A	0.08	N/A	0.09	0.09	0.09	0.09	N/A	N/A	0.32	N/A	0.12	0.04	0.32	N/A	0.20	0.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Mar 29, 2017	0.21	—	N/A	N/A	N/A	0.40	0.54	0.30	N/A	0.32	N/A	0.22	0.32	0.40	0.19	N/A	N/A	1.02	N/A	0.24	0.44	1.06	N/A	0.45	0.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sat, Apr 1, 2017	0.02	0.04	N/A	N/A	N/A	0.06	0.47	0.09	N/A	0.25	N/A	0.14	0.21	0.36	0.11	N/A	N/A	0.70	N/A	0.14	N/A	0.56	N/A	0.06	0.09	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Tue, Apr 4, 2017	0.20	—	N/A	N/A	N/A	0.19	0.16	0.14	N/A	0.50	N/A	0.11	0.47	0.19	0.12	N/A	N/A	0.67	N/A	0.51	N/A	1.55	N/A	0.21	0.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Fri, Apr 7, 2017	0.26	0.11	N/A	N/A	N/A	0.14	0.32	0.11	N/A	0.18	N/A	0.08	1.36	0.17	0.14	N/A	N/A	1.09	N/A	1.32	N/A	1.33	0.92	0.19	0.22	2.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Mon, Apr 10, 2017	0.27	—	N/A	N/A	N/A	NS	NS	NS	N/A	NS	N/A	NS	NS	NS	NS	N/A	N/A	NS	N/A	NS	N/A	NS	NS	NS	NS	NS	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Apr 12, 2017	N/A	N/A	N/A	N/A	N/A	N/A	0.49	N/A	N/A	N/A	N/A	N/A	N/A	1.65	N/A	N/A	N/A	4.48	N/A	N/A	N/A	2.56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, Apr 13, 2017	0.35	0.14	N/A	N/A	N/A	0.54	0.91	0.12	N/A	0.19	N/A	0.32	0.19	0.36	0.28	N/A	N/A	NS	N/A	1.46	N/A	3.38	0.99	0.18	0.57	1.21	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, Apr 16, 2017	Invalid	—	N/A	N/A	N/A	0.16	0.27	0.16	N/A	0.05	N/A	0.43	0.05	0.07	0.10	N/A	N/A	0.18	N/A	0.14	N/A	0.80	0.34	0.49	0.35	0.22	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Apr 19, 2017	0.48	0.09	N/A	N/A	N/A	0.32	1.22	Invalid	N/A	0.28	N/A	0.14	0.40	0.64	1.79	N/A	N/A	2.37	N/A	1.83	N/A	2.24	0.78	0.40	Invalid	1.89	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Sat, Apr 22, 2017[AA]	0.03	—	N/A	N/A	N/A	0.13	0.73	0.64	N/A	0.09	N/A	0.10	0.24	0.14	0.09	N/A	N/A	0.65	N/A	0.26	N/A	0.68	0.62	0.18	0.12	0.54	0.13	N/A	N/A	N/A	N/A	N/A	N/A		

Paramount Hexavalent Chromium Monitoring Results (ng/m^3)

Sample Date	Site #2	Site #3	Site #4	Site #5	Site #6	Site #7	Site #8	Site #9	Site #10	Site #11	Site #12	Site #13	Site #14	Site #15	Site #16	Site #17	Site #18	Site #19	Site #20	Site #21	Site #22	Site #23	Site #24	Site #25	Site #26	Site #27	Site #28	Site #29	Site #30	Site #31	Site #32	Site #33	Site #34	Site #35	Site #36
Tue, Apr 25, 2017	0.96	0.16	N/A	N/A	N/A	0.22	0.42	1.27	N/A	Invalid	N/A	1.80	0.20	0.28	0.68	N/A	N/A	3.71	N/A	2.17	N/A	1.29	1.23	0.42	0.75	1.33	0.69	N/A	N/A	N/A	N/A	N/A	N/A		
Fri, Apr 28, 2017	0.44	—	N/A	N/A	N/A	0.66	0.69	0.40	N/A	0.18	N/A	0.16	0.21	0.16	0.12	N/A	N/A	0.80	N/A	0.75	N/A	0.72	1.14	0.23	0.82	0.85	0.59	N/A	N/A	N/A	N/A	N/A	N/A		
Mon, May 1, 2017	0.38	0.09	N/A	N/A	N/A	0.35	0.30	0.13	N/A	0.14	N/A	0.13	0.20	0.22	0.15	N/A	N/A	NS	N/A	0.41	N/A	0.59	0.93	0.80	0.34	0.62	0.92	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, May 3, 2017	N/A	N/A	N/A	N/A	N/A	N/A	0.29	N/A	N/A	N/A	N/A	N/A	N/A	0.29	N/A	N/A	N/A	1.09	N/A	N/A	N/A	1.36	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Thu, May 4, 2017	0.36	—	N/A	N/A	N/A	1.21	2.79	0.12	N/A	0.21	N/A	0.17	0.27	0.90	0.18	N/A	N/A	NS	N/A	0.19	N/A	2.64	1.70	0.34	0.15	0.38	0.93	N/A	N/A	N/A	N/A	N/A	N/A		
Sun, May 7, 2017	0.07	1.65	N/A	N/A	N/A	0.09	0.11	0.12	N/A	0.94	N/A	0.10	0.12	Invalid	0.78	N/A	N/A	0.96	N/A	0.23	N/A	0.22	0.97	0.07	0.79	1.27	0.85	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, May 10, 2017	0.12	—	N/A	N/A	N/A	0.58	0.42	0.13	N/A	0.32	N/A	0.23	0.22	0.37	0.14	N/A	N/A	0.31	N/A	0.49	N/A	0.64	0.68	2.60	0.93	Invalid	1.87	N/A	N/A	N/A	N/A	N/A	N/A		
Sat, May 13, 2017	0.03	0.56	N/A	N/A	N/A	0.07	0.53*	0.14	N/A	0.12	N/A	0.06	0.51	0.24	0.43	N/A	N/A	0.53	N/A	Invalid	N/A	1.03	0.21	0.43	0.11	0.27	0.18	0.20	0.22	N/A	N/A	N/A	N/A		
Tue, May 16, 2017	0.18	—	N/A	N/A	N/A	Invalid	0.46	Invalid	N/A	Invalid	N/A	0.16	0.67	0.53	Invalid	N/A	N/A	0.55	N/A	Invalid	N/A	Invalid	Invalid	0.16	Invalid	Invalid	Invalid	Invalid	Invalid	N/A	N/A	N/A	N/A		
Fri, May 19, 2017	0.32	0.17	N/A	N/A	N/A	0.22	0.36	0.22	N/A	0.20	N/A	Invalid	0.30	0.24	0.16	N/A	N/A	0.47	N/A	0.18	N/A	0.77	1.12	0.53	0.21	0.52	0.62	0.93	0.30	N/A	N/A	N/A	N/A		
Mon, May 22, 2017	0.32	—	N/A	N/A	N/A	0.18	1.12	0.21	N/A	1.16^	N/A	0.48	0.28^	0.87	Invalid	N/A	N/A	1.31	N/A	0.26	N/A	1.44	Invalid	0.34	0.24	1.23	0.76	1.95	1.18	N/A	N/A	N/A	N/A		
Thu, May 25, 2017	0.05	NS	N/A	N/A	N/A	0.14	0.29	0.15	N/A	0.13	N/A	0.11	0.15	0.43	0.31	N/A	N/A	0.90	N/A	0.66^	N/A	1.09	1.76	0.10^	0.62	0.78	0.69	0.41	0.27	N/A	N/A	N/A	N/A		
Sun, May 28, 2017	0.02	—	N/A	N/A	N/A	0.11^	0.69	0.25	N/A	0.88	N/A	1.50	0.08	0.72	0.72	N/A	N/A	0.08	N/A	0.32	N/A	0.10	0.10	0.08	0.39	2.31	0.45	0.45	0.07	N/A	N/A	N/A	N/A		
Wed, May 31, 2017	0.18	NS	N/A	N/A	N/A	1.23	0.69	1.90^	N/A	0.36	N/A	1.77	0.27	1.48	0.14	N/A	N/A	0.29	N/A	0.70	N/A	1.43	0.87	0.16	0.36	1.09	0.85	1.19	0.58	N/A	N/A	N/A	N/A		
Sat, Jun 3, 2017	0.03	—	N/A	N/A	N/A	0.11	0.12	0.19	N/A	0.14	N/A	0.12	0.15	0.24	0.14	N/A	N/A	0.02	N/A	0.22	N/A	0.01	0.24	1.46	0.74	0.40	0.40	0.09	0.11	N/A	N/A	N/A	N/A		
Tue, Jun 6, 2017	0.04	0.07	N/A	N/A	N/A	N/A	0.74	N/A	N/A	N/A	N/A	0.16	1.30	0.18	N/A	N/A	0.69	N/A	N/A	N/A	N/A	0.37	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Wed, Jun 7, 2017	N/A	N/A	N/A	N/A	N/A	0.19	0.69	N/A	N/A	0.75	N/A	N/A	N/A	N/A	0.13	N/A	N/A	0.28	N/A	0.91	N/A	0.76^	1.28	2.55	0.56*	1.37	1.63	1.58	0.60	N/A	N/A	N/A	N/A		
Fri, Jun 9, 2017	0.56	—	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Mon, Jun 12, 2017	0.23	0.18	N/A	N/A	N/A	0.78	0.17	N/A	N/A	0.12	N/A	0.08	0.14^	0.71	0.18	N/A	0.70	0.71	N/A	0.73	N/A	2.20	1.46	0.17	0.57	1.26	1.27	0.46	0.25^	N/A	N/A	N/A	N/A		
Thu, Jun 15, 2017	0.19	—	N/A	N/A	N/A	0.67	0.26	N/A	N/A	0.32	N/A	0.18	0.66	0.64^	0.14	N/A	0.36	0.95	N/A	0.72	N/A	1.02	1.02	0.23	0.23	0.64	0.87	2.64	2.44	N/A	N/A	N/A	N/A		
Sun, Jun 18, 2017	0.20	0.82	N/A	N/A	N/A	1.31^	0.21	N/A	N/A	0.10	N/A	0.72	0.11	0.66	0.09	N/A	0.25	0.82	N/A	0.20	N/A	0.77	0.18	0.11	N/A	3.19	0.15	0.10^	0.14	0.67	N/A	N/A	N/A	N/A	N/A
Wed, Jun 21, 2017	0.14	—	N/A	N/A	N/A	2.12	0.30	N/A	N/A	0.92	N/A	0.12	0.19	0.64	1.39	N/A	1.29	0.37	N/A	0.23	N/A	0.72	0.91	0.17	N/A	1.97	0.46*	2.39	0.90	0.33	0.25	N/A	N/A	N/A	N/A
Sat, Jun 24, 2017	0.30	0.09	N/A	N/A	N/A	1.23	0.34	N/A	N/A	1.08	N/A	0.68^	4.54	0.26	0.09	N/A	0.81	0.28	N/A	0.83	N/A	0.47	0.38	1.01	N/A	0.17	0.40	2.55	0.18^	0.31	0.12	N/A	N/A	N/A	N/A
Tue, Jun 27, 2017	0.29	—	N/A	N/A	N/A	0.45	0.37	N/A	N/A	0.21	N/A	0.45	0.80	1.16	0.14	N/A	0.43^	Invalid	N/A	0.65	N/A	1.08^	2.40	0.16	N/A	0.36	1.06	1.19	0.89	Invalid	0.60	N/A	N/A	N/A	N/A
Fri, Jun 30, 2017	0.24	0.59	N/A	N/A	N/A	0.30	1.46	N/A	N/A	2.58^	N/A	1.78	0.16	0.19	0.11	N/A	2.45	0.41	N/A	0.34	N/A	2.44	0.85	0.80	N/A	0.42	0.94	0.13	1.12	0.33	2.31	N/A	N/A	N/A	N/A
Mon, Jul 3, 2017	0.29	—	N/A	N/A	N/A	0.15	0.29	N/A	N/A	1.46	N/A	0.96	0.18	0.17	0.13	N/A	1.27	0.14	N/A	0.14	N/A	2.90	0.43	0.23*	N/A	0.14	1.40	1.16	0.75	2.07	0.21*	N/A	N/A	N/A	N/A
Thu, Jul 6, 2017	0.31	0.37	N/A	N/A	N/A	0.95	0.36	N/A	N/A	0.19^	N/A	0.22	Invalid	1.02	0.19	N/A	0.31	0.94	N/A	0.36	N/A	0.84	1.54	0.25	N/A	0.73^	0.80	0.26	0.34	0.41	0.68	0.77	N/A	N/A	N/A
Sun, Jul 9, 2017	0.04	—	N/A	N/A	N/A	0.14	0.24	N/A	N/A	1.04	N/A	0.10	3.09	0.11	0.62	N/A	0.74	1.25	N/A	1.87	N/A	0.22	1.75	0.62	N/A	3.64	0.29	1.44	0.12	3.44	3.21	0.09	N/A	N/A	N/A
Wed, Jul 12, 2017	0.70	0.12	N/A	N/A	N/A	1.07	0.35	N/A	N/A	0.13	N/A	0.19	2.19	0.31	2.77^	N/A	0.20	2.87	N/A	1.26	N/A	0.86	2.90	4.27	N/A	7.66	0.72	0.28	0.22	1.41^	2.99	4.79	N/A	N/A	N/A
Sat, Jul 15, 2017	0.17	—	N/A	N/A	N/A	3.70	0.10	N/A	N/A	6.26	N/A	Invalid	5.95^	5.51^	Invalid	N/A	4.66	5.19^	N/A	Invalid	N/A	Invalid	1.46	0.13	N/A	2.32	2.00^	0.34	0.09	Invalid	0.51	0.10	N/A	N/A	N/A
Tue, Jul 18, 2017	0.72	0.41	N/A	N/A	N/A	3.65	0.20	N/A	N/A	8.90	N/A	2.37	2.81^	7.49	0.13	N/A	4.03	4.68	N/A	4.50	N/A	0.96	7.69	1.32	N/A	4.31	7.40	5.86	4.46^	3.71	5.82	4.02	N/A	N/A	N/A
Fri, Jul 21, 2017	0.36	—	N/A	N/A	N/A	2.99	0.20	N/A	N/A	1.63	N/A	0.15	1.97	1.17	0.17	N/A	0.28	0.72	N/A	0.91	N/A	1.15	2.77	0.26	N/A	1.25	0.60^	0.15	0.84	0.76	Invalid^	Invalid	2.65	N/A	N/A
Mon, Jul 24, 2017	0.61	0.44	N/A	N/A	N/A	0.21	0.32	N/A	N/A	0.79	N/A	1.02	0.18	1.80	1.11	N/A	0.34^	0.49	N/A	2.64	N/A	0.96	1.88	0.25	N/A	0.37	0.46	2.15	1.59	0.81	0.45^	2.26	0.14	N/A	N/A
Thu, Jul 27, 2017	0.71	—	N/A	N/A	N/A	0.51	0.10	N/A	N/A	0.16	N/A	2.38	1.97	2.06	3.26^	N/A	0.22	3.20	N/A	Invalid	N/A	0.82	0.70	1.91	N/A	0.35	2.75	15.44	2.62	1.62^	0.63	1.42	1.75	N/A	N/A
Sun, Jul 30, 2017	0.44	0.26	N/A	N/A	N/A	2.58	0.58	N/A	N/A	0.17	N/A	1.60	0.07	0.13^	0.10^	N/A	0.21	0.14	N/A	0.40	N/A	2.50	0.08	0.20	N/A	0.09	0.10	3.00	0.17	0.34	0.70	0.09	1.44	N/A	N/A
Wed, Aug 2, 2017	0.31	—	N/A	N/A	N/A	0.29	0.20	N/A	N/A	0.70	N/A	0.30	0.16	0.27	0.13	N/A	0.61	0.39	N/A	Invalid	N/A	1.06	0.99	0.19^	N/A	0.56	0.41	0.48	0.18	0.39	1.04	0.20	1.71	N/A	N/A
Sat, Aug 5, 2017	0.07	0.07	N/A	N/A	N/A	0.24	0.46	N/A	N/A	0.26	N/A	0.10	0.27	0.21	0.19	N/A	0.49	0.21^	N/A	0.37	N/A	0.37	0.47	0.25	N/A	1.18	Invalid	0.20	0.19	0.33	0.34	0.19	0.21	N/A	N/A
Tue, Aug 8, 2017	0.29	—	N/A	N/A	N/A	0.32	0.20	N/A	N/A	0.31	N/A	0.34	0.11^	0.27^	0.23	N/A	0.25	0.68	N/A	0.28	N/A	0.62	0.76	0.36	N/A	0.38	0.33	0.29	0.24	0.39	0.63	0.15	0.16	N/A	N/A
Fri, Aug 11, 2017	0.86	0.16	N/A	N/A	N/A	0.46	0.76	N/A	N/A	0.19	N/A	0.24	0.25	0.26	0.20	N/A	0.33	0.44	N/A	0.21	N/A	0.71	0.53^	0.38	N/A	0.31	0.53	0.26	N/A	0.39	0.78	N/A	0.26	0.26	0.24^

Notes:

N/A Means no monitor at this location to collect sample and --- means no monitoring scheduled to be collected on this date.

Invalid means sample collected was invalid due to a variety of reasons such as loss of power, equipment malfunction, etc.

NS Means samplers were not operating due to a variety of reasons such as limited access, weather, samplers under repair, etc.

Site #1 was discontinued in 2013.

Sites #29 and 30 are located in northern Long Beach.

Additional monitoring data available for Sites #2 and #3 at: http://www.aqmd.gov/home/regulations/compliance/air-monitoring-activities

^ Sample does not count towards a three day sample average per conditions in the Stipulated Order of Abatement. See below for additional information

^^Samplers owned by the City of Paramount were deployed with SCAQMD monitors. SCAQMD samplers and those owned by City of Paramount are rotated between sample locations for each sampling date.

^ Sampler owned by the City of Paramount.

*Collocated sampler result, data from primary sampler was invalid.

Date	Site #	Note
03/11/17	8	Neighborhood power outage which affected air pollution control devices. SCAQMD confirmed power outage with Southern California Edison. Aerocraft to provide backup power remediation
07/15/17	14 & 15	Site #16 results did not meet the criteria for a reportable number; however, a winds analysis and the result at Site #16, which is partially upwind of Sites #14 and #15 for this date, is likely higher than those for Site #14 and #15 and therefore the results at Sites #14 and #15 do not trigger the curtailment action under the Stipulated Order of Abatement

Paramount Hexavalent Chromium Monitoring Results (ng/m^3)

Sample Date	Site #2	Site #3	Site #4	Site #5	Site #6	Site #7	Site #8	Site #9	Site #10	Site #11	Site #12	Site #13	Site #14	Site #15	Site #16	Site #17	Site #18	Site #19	Site #20	Site #21	Site #22	Site #23	Site #24	Site #25	Site #26	Site #27	Site #28	Site #29	Site #30	Site #31	Site #32	Site #33	Site #34	Site #35	Site #36

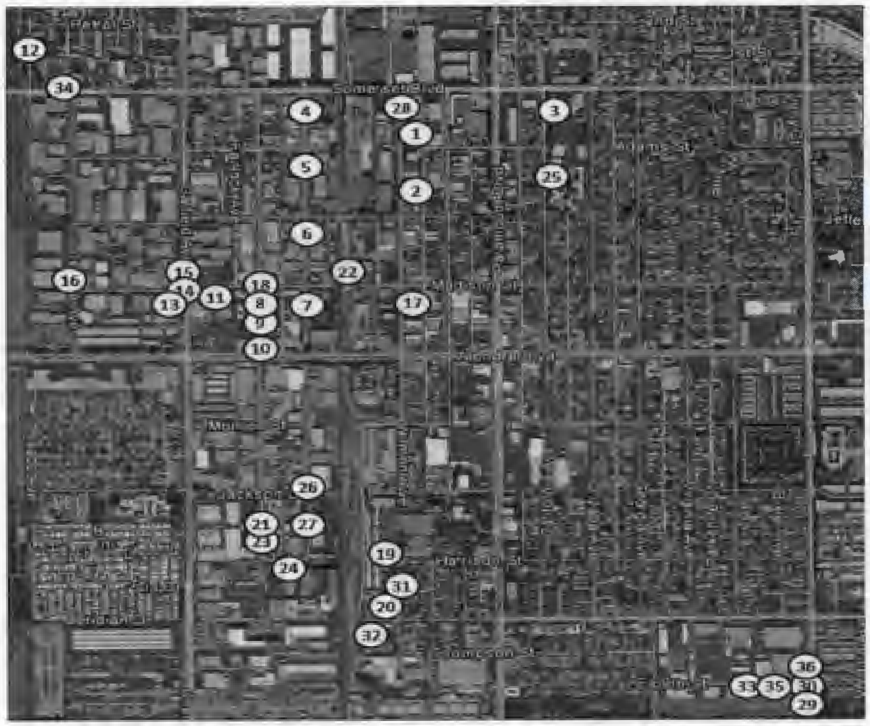

EXHIBIT 16

BEFORE THE HEARING BOARD OF THE

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

In the Matter of SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT, Petitioner, v. LUBECO INC., [Facility ID No. 41229] , Respondents.	**Case No. 6089-1** **[PROPOSED] FINDINGS AND DECISION FOR A STIPULATED ORDER FOR ABATEMENT** Health & Safety Code § 41700, District Rule 402 Hearing Date: August 17, 2017 Time: 9:00 a.m. Place: 21865 Copley Drive Diamond Bar, CA 91765

<u>FINDINGS AND DECISION OF THE HEARING BOARD</u>

This Petition for an Order for Abatement was heard on August 17, 2017, pursuant to notice and in accordance with the provisions of California Health and Safety Code §40823 and District Rule 812. The following members of the Hearing Board were present: Julie Prussack, Chair; Patricia Byrd, Vice Chair; Edward Camarena; Roger L. Lerner, M.D.; and Hon. Nate Holden. Petitioner South Coast Air Quality Management District, Executive Officer, ("SCAQMD") was represented by Teresa R. Barrera, Senior Deputy District Counsel and Stacey Pruitt, Senior Deputy District Counsel. Respondent Lubeco Inc. ("Respondent" or "Lubeco") was represented by Christopher Foster, Esq. of Clark Hill. The public was given the opportunity to testify. The matter was submitted and evidence received.

The Hearing Board finds that GOOD CAUSE exists to issue the stipulated Order for Abatement. This finding of good cause is based on the following:

1. The District has established a prima facie case that Lubeco, Inc. is violating California Health and Safety Code section 41700 and District Rule 402. The District's prima facie case is based on the following allegations and evidence:

a. Petitioner is a body corporate and politic established and existing pursuant to Health and Safety Code §40000 *et seq*. and §40400 *et seq*., and is the sole and exclusive local agency with the responsibility for comprehensive air pollution control in the South Coast Basin.

b. Respondent Lubeco is a business subject to the jurisdiction of the District. It is located at 6859 Downey Avenue, Long Beach, CA 90805 (Facility ID No. 41229) ("Facility'), which is within the District's jurisdiction and is subject to the District's regulations.

c. Lubeco is a metal finishing facility that serves the aerospace industry. Its operations primarily involve surface preparation, anodizing, and coating aspects of metal finishing operations. These processes utilize material that result in emissions of hexavalent chromium.

d. Directly across the street from Lubeco, in the prevailing downwind direction, is a residential neighborhood. Within 300 feet of the facility, in the prevailing downwind direction, the District has identified approximately seven residential duplexes that are home to a considerable number of persons. Additional residences, including a large apartment building, as well as an elementary school are located within 1000 feet of the facility.

e. On April 27, 2017, the District conducted a source test of the heated sodium dichromate seal tank [Tank 14 of the anodizing line operating under Permit No. G29366] and determined that the average emissions rate of hexavalent chromium from the tank was 244,000 ng/dscm in concentration units and 1.71 x

10^{-4} lb/hr in mass emission units. The District alleges that these source test results indicate a significant source of hexavalent chromium within the facility, which, without appropriate air pollution controls, likely contribute substantially to the elevated levels measured at the monitor near the facility, as well as the elevated risk levels detected in the modeling.

f. **California Health & Safety Code §41700** and **District Rule 402** prohibit any person from discharging from any source whatsoever such quantities of air contaminants that will endanger the health or safety of any considerable number of persons or to the public.

g. The term "endanger" as used in §41700 and District Rule 402 includes the creation of a significant risk of harm.

h. The District alleges that Lubeco is violating **California Health & Safety Code §41700** and **District Rule 402** because its emissions of hexavalent chromium into the ambient air are creating a significant risk of harm that endangers the health or safety of a considerable number of persons or the public.

i. District Rule 1402 was adopted to reduce the health risk associated with emissions of toxic air contaminants from existing sources by specifying limits for maximum individual cancer risk (MICR), cancer burden, and non-cancer acute and chronic hazard index (HI) applicable to total facility emissions. According to District Rule 1402 (c)(19), a "significant" risk level is defined as a cancer risk of 100 in a million.

j. District staff has estimated the cancer risk at the nearest residential receptor by modeling the emissions from Lubeco, including the emissions of the sodium dichromate seal tank, and is alleging that Lubeco is creating a significant risk of harm to a considerable number of persons/nearby residents. The District alleges that the modeled cancer risk exceeds 100 in a million.

k. The District's risk calculations, which are the basis for the alleged nuisance, are consistent with elevated readings of hexavalent chromium measured at Monitor

No. 29 located directly in front of LUBECO.

2. Respondent LUBECO, Inc. denies the allegations. Respondent further denies that it is violating California Health & Safety Code §41700 and District Rule 402. Nonetheless, Respondent has agreed to stipulate to issuance of this Order for Abatement pursuant to California Health & Safety Code §42451; and

3. There are benefits to the community of issuing a prompt enforceable order in lieu of a prolonged hearing that will involve litigation of complex issues and numerous potential defenses.

CONCLUSIONS

1. The issuance of this Order for Abatement will not constitute a taking of property without due process of law.

2. If the issuance of this Order for Abatement results in the closing or elimination of an otherwise lawful business, such closing would not be without a corresponding benefit in reducing air contaminants.

3. This Order for Abatement is not intended to be nor does it act as a variance.

4. The issuance of this Order for Abatement upon a fully noticed hearing will not constitute a taking of property without due process of law.

ORDER

THEREFORE, subject to the aforesaid statements and good cause appearing, the Hearing Board hereby orders Respondent to immediately cease and desist from violating California Health & Safety Code §41700 and District Rule 402, or in the alternative comply with the following conditions and increments of progress:

1. LUBECO shall provide space and access to the District to install and operate up to 4 ambient air monitors and a meteorological ("met") station on its property. These monitors are intended to supplement the information generated by nearby off-site ambient air monitors also operated by the District.

2. LUBECO shall not operate any process or piece of equipment identified in Attachment 1 if the air monitoring results measured at the LUBECO downwind ambient air monitor(s) exceed 1.0 ng/m^3 of hexavalent chromium, based on an average of the most recent 3

samples. If a valid sample is not collected on any monitoring day, the most recent previous valid samples available shall be used to determine the average. Prior to averaging, the level at the downwind ambient air monitor shall reflect a subtraction for a. or b.:

a. Any result obtained from an upwind ambient air monitor. The upwind and downwind ambient air monitors, including those on-site and off-site, shall be determined solely by the District based on the met data generated for a particular sampling day or, if that data is not available, based on the met data generated by the next nearest met station.

b. Sub-regional background levels of Cr VI as determined by either:

- The value from the lowest monitor in the Paramount area on that sampling day; or
- The average level found from the nearest MATES-IV site (Compton) (0.11ng/m3) if a sub-regional background cannot be determined from the monitors in the Paramount area (due to meteorological conditions, data from other monitors, or the influence of Paramount sources)

3. Prior to averaging, the level at the LUBECO downwind monitor may reflect a subtraction for known or suspected contributions from other known sources. Consideration of other sources may include analysis of meteorological data from the days each sample was collected. Specific sources should be identified as contributors before subtracting any potential contribution. Emissions from unidentified or unverified 'other sources' cannot be considered as contributors to a source-specific monitor.

4. Notwithstanding the foregoing, the District may authorize LUBECO to operate some or all of the processes or pieces identified in Attachment 1 upon (i) a showing by LUBECO, to the satisfaction of the District, that the cause or causes of the exceedance have been identified and remediated, or (ii) if the LUBECO downwind monitoring results are determined by the District to not have been caused by LUBECO. For example, the District may subtract for, or decide to not impose curtailment, based on consideration of other pertinent information including, but not limited to specific operational data from the facility on the days included in the average, modeling analysis

from the facility, monitoring data from the facility, etc. LUBECO may submit operational data that shows that key Cr VI emitting devices/processes were not operational on a specific day and there are no other contributing factors such as housekeeping activities or maintenance activities.

5. In addition, the District may, by written notification, remove specific processes or pieces of equipment from the list of equipment required to be shut down under this condition if emissions from the equipment are tested under conditions representing normal and expected operation and it is shown to the satisfaction of the District that the processes or pieces of equipment do not or would not materially contribute to an exceedance of the 1.0 ng/ m^3 hexavalent chromium action level at the LUBECO monitor.

6. If the District determines that the most recent 3-sample average, as calculated above, has exceeded 1.0 ng/m^3, then the District shall send written notice by 1:00 p.m. to LUBECO via email (lubecoinc@gmail.com) of the monitoring results and the need to curtail operations pursuant to Paragraph 2. On the same day that the curtailment notice is provided, the District shall initiate a telephone call (Tel. No. 562-602-1791) at 3:00 p.m. with Steve Rossi, President of LUBECO or any other responsible corporate official available at the time of the telephone call to advise LUBECO of the monitoring results and the need to curtail operations. LUBECO shall have until 4:30 p.m. of the day when the curtailment notice is received to wrap up operations.

7. LUBECO may resume operation of any processes and equipment shut down as the result of a hexavalent chromium action level exceedance when it receives notice from the District that the most recent 3-sample average, as calculated above, measured at the LUBECO monitor is less than or equal to 1.0 ng/m^3.

8. LUBECO may, at its discretion, maintain and operate ambient hexavalent chromium monitor(s) consistent with a District approved Sampling and Analysis Plan. The District will review LUBECO's Sampling and Analysis Plan within 7 District working days of submittal and either approve, conditionally approve, or reject the Plan. Prior to the District's decision on LUBECO's Sampling and Analysis Plan, LUBECO will operate consistent with its proposed Plan. LUBECO may present evidence to the District consisting of data from ambient monitors operated consistent with the Sampling and Analysis Plan, LUBECO's meteorological station, and other credible sources

justifying the reduction of any particular day's monitoring result to better reflect LUBECO's contribution to ambient concentrations in the community. The District shall consider LUBECO's evidence but is not required to use that evidence in concluding whether the 1.0 ng/m^3 action level has been exceeded and its determination may be appealed.

9. LUBECO shall immediately disconnect and cease operating Tank Nos. 23, 24, and 35. These tanks shall be removed from the premises within 60 days. Within 15 days, LUBECO shall file a permit application to remove these tanks from its permit.

10. LUBECO shall cover with plastic and shall turn off the tank heaters for any tank not in use.

11. Within 30 days, LUBECO shall install plastic strip curtains along the western edge of the canopy associated with the overhead door on the west side of the building. In addition, within 30 days, LUBECO shall install an industrial curtain along portions of the southern and eastern end of the open process tank area consistent with the diagram and specifications set forth in Attachment 2.

12. Starting immediately, LUBECO shall conduct all de-masking operations involving chrome-sprayed parts inside a spray booth vented to air pollution control equipment. All materials from de-masking that are laden with chrome-sprayed materials must be place in a bag or container with a lid prior to removing them from the spray booth.

13. Starting immediately, LUBECO shall store all paint trays used during the painting of parts with chromated coatings in an enclosed container when not in use.

14. Starting immediately, LUBECO shall conduct general maintenance using a vacuum device that is vented to High Efficiency Particle Arrestor (HEPA) filters. The HEPA filters used shall be individually DOP tested with 0.3 micron particles and certified to have an efficiency of not less than 99.997%. LUBECO shall cease using brooms to sweep the premises.

15. Starting immediately, LUBECO shall conduct and document weekly inspections of the roof. The inspections are intended to identify staining or material accumulations. If staining or material accumulations are noted, LUBECO shall immediately clean the areas with a vacuum device that is vented to High Efficiency Particle Arrestor (HEPA) filters. The HEPA filters used shall be

individually DOP tested with 0.3 micron particles and certified to have an efficiency of not less than 99.997%.

16. Within 15 days, LUBECO shall prepare and file a housekeeping and maintenance plan and implementation schedule with the District. SCAQMD will either approve, partially approve, conditionally approve, or reject the plan. LUBECO shall not clean the roof or do housekeeping until the plan or plan elements are approved. LUBECO shall comply with the approved elements of the plan. If the plan is rejected by SCAQMD, the parties will return to the Hearing Board at the next earliest available hearing date after any appropriate notice if applicable. This condition is intended to supplement the requirements of District Rules 1469 and 1469.1. LUBECO is not relieved from its obligation to comply with those rules.

17. Within 45 days, LUBECO shall submit a plan to the District (Attn: Laki Tisopulos) identifying all feasible measures by which it can reduce its emissions of hexavalent chromium. Within 30 days of District approval of that plan, LUBECO shall submit any required permit applications on an expedited basis. LUBECO shall complete installation of all upgrades as soon as possible and in no event later than 150 days after issuance of the permits.

18. The Hearing Board may modify this Order for Abatement without the stipulation of the parties upon a showing a good cause therefore, and upon making the findings requirement by Health and Safety Code Section 42451(c) and District Rule 806(a). Any modification of the Order shall be made only at a public hearing held upon 10 days published notice and appropriate written notice to Respondent.

19. Unless terminated earlier, the Hearing Board shall retain jurisdiction over this matter until ______________ at which time this Order for Abatement, if it has not been properly extended, shall expire.

20. This Order for Abatement does not act as a variance, and Respondent is subject to all rules and regulations of the District, and with all applicable provisions of California law. Nothing herein shall be deemed or construed to limit authority of the District to issue Notices of Violation,

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or to seek civil penalties, or injunctive relief, or to seek further orders for abatement, or other administrative or legal relief.

FOR THE BOARD: ______________________________

DATE SIGNED: ______________________________

SO STIPULATED:

DATE: August __, 2017

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
OFFICE OF THE GENERAL COUNSEL
Teresa R. Barrera, Senior Deputy District Counsel

By: ______________________________
Teresa R. Barrera
Attorney for Petitioner

DATE: August __, 2017

LUBECO, INC.

By: ______________________________

ATTACHMENT 1

ANODIZE LINE (PERMIT NO. G29366)

TANK NO. 14 – DICHROMATE SEAL

TANK NO. 16 – CHROMIC ACID ANODIZE

TANK NO. 23 – DEOXIDIZER (TO BE REMOVED)

TANK NO. 24 – POTASSIUM DICHROMATE (TO BE REMOVED)

TANK NO. 25 – CHEM FILM

PASSIVATION LINE (PERMIT NO. G29360)

TANK NO. 33 – CHROMIC RINSE

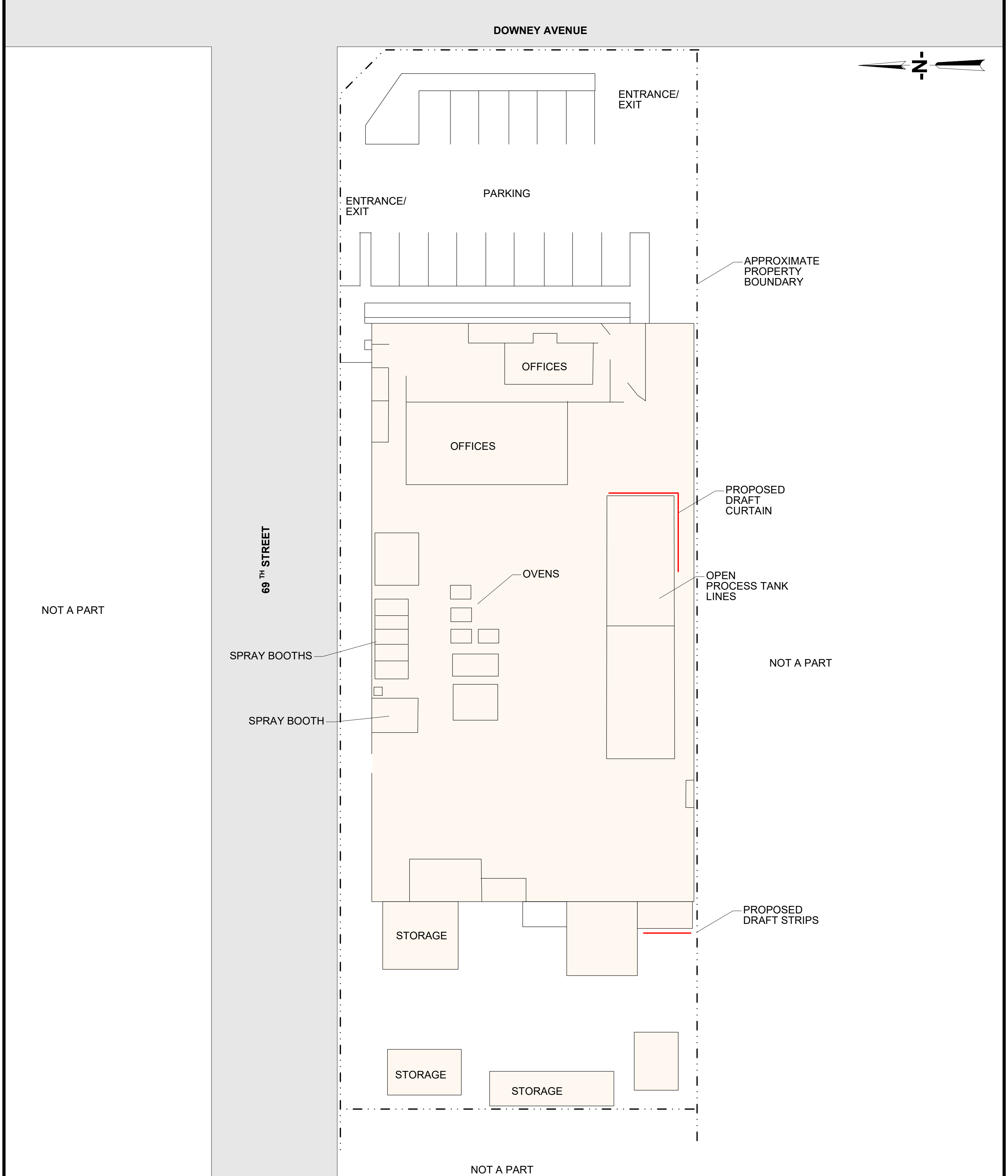
TANK NO. 35 – DOW 7 (TO BE REMOVED)

TANK NO. 37 – TICERMET A

TANK NO. 39 – PASSIVATE TY II

TANK NO. 41 – DICHROMATE RINSE

ATTACHMENT 2



Lubeco, Inc. **6859 Downey Avenue** **Long Beach, California**	**Site Map**	
	DWG-0900191S	
JE Compliance Services	**Figure 1**	**Page**