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REPORT FOR TOTAL CHROMIUM EMISSION TESTING

52nd Paint Central Plant

SV-Scrubber Outlet

Lacks Enterprises, Inc.
525 West Allegan Street
Lansing, Michigan 48933
Client Reference No. 23-PC-1163206

CleanAir Project No. 14473-3
A2LA ISO 17025 Certificate No. 4342.01
A2LA / STAC Certificate No. 4342.02
Revision 0, Final Report
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COMMITMENT TO QUALITY

To the best of our knowledge, the data presented in this report are accurate, complete, error free and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies.

Report Submittal:

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I hereby certify that the information contained within the final test report has been reviewed and, to the best of my ability, verified as accurate.

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REPORT REVISION HISTORY

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PROJECT PERSONNEL

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS & ABBREVIATIONS

AAS (atomic absorption spectrometry)
acfm (actual cubic feet per minute)
ACI (activated carbon injection)
ADL (above detection limit)
AIG (ammonia injection grid)
APC (air pollution control)
AQCS (air quality control system(s))
ASME (American Society of Mechanical Engineers)
ASTM (American Society for Testing and Materials)
BDL (below detection limit)
Btu (British thermal units)
CAM (compliance assurance monitoring)
CARB (California Air Resources Board)
CCM (Controlled Condensation Method)
CE (capture efficiency)
°C (degrees Celsius)
CEMS (continuous emissions monitoring system(s))
CFB (circulating fluidized bed)
CFR (Code of Federal Regulations)
cm (centimeter(s))
COMS (continuous opacity monitoring system(s))
CT (combustion turbine)
CTI (Cooling Technology Institute)
CTM (Conditional Test Method)
CVAAS (cold vapor atomic absorption spectroscopy)
CVAFS (cold vapor atomic fluorescence spectrometry)
DI H_2O (de-ionized water)
%dv (percent, dry volume)
DLL (detection level limited)
DE (destruction efficiency)
DCI (dry carbon injection)
DGM (dry gas meter)
dscf (dry standard cubic feet)
dscfm (dry standard cubic feet per minute)
dscm (dry standard cubic meter)
ESP (electrostatic precipitator)
FAMS (flue gas adsorbent mercury speciation)
°F (degrees Fahrenheit)
FB (field blank)
FCC (fluidized catalytic cracking)
FCCU (fluidized catalytic cracking unit)
FEGT (furnace exit gas temperatures)
FF (fabric filter)
FGD (flue gas desulfurization)
FIA (flame ionization analyzer)
FID (flame ionization detector)
FPD (flame photometric detection)
FRB (field reagent blank)
FSTM (flue gas sorbent total mercury)
ft (feet or foot)
ft^2 (square feet)
ft^3 (cubic feet)
ft/sec (feet per second)
FTIR (Fourier Transform Infrared Spectroscopy)
FTRB (field train reagent blank)
g (gram(s))
GC (gas chromatography)
GFAAS (graphite furnace atomic absorption spectroscopy)
GFC (gas filter correlation)
gr/dscf (grains per dry standard cubic feet)
> (greater than)/ ≥ (greater than or equal to)
g/s (grams per second)
H_2O (water)
HAP(s) (hazardous air pollutant(s))
HI (heat input)
hr (hour(s))
HR GC/MS (high-resolution gas chromatography and mass spectrometry)
HRVOC (highly reactive volatile organic compounds)
HSRG(s) (heat recovery steam generator(s))
HVT (high velocity thermocouple)
IC (ion chromatography)
IC/PCR (ion chromatography with post column reactor)
ICP/MS (inductively coupled argon plasma mass spectroscopy)
ID (induced draft)
in. (inch(es))
in. H_2O (inches water)
in. Hg (inches mercury)
IPA (isopropyl alcohol)
ISE (ion-specific electrode)
kg (kilogram(s))
kg/hr (kilogram(s) per hour)
< (less than)/ ≤ (less than or equal to)
L (liter(s))
lb (pound(s))
lb/hr (pound per hour)
lb/MMBtu (pound per million British thermal units)
lb/TBtu (pound per trillion British thermal units)
lb/lb-mole (pound per pound mole)
LR GC/MS (low-resolution gas chromatography and mass spectrometry)
m (meter)
m^3 (cubic meter)
MACT (maximum achievable control technology)
MASS® (Multi-Point Automated Sampling System)
MATS (Mercury and Air Toxics Standards)
MDL (method detection limit)
µg (microgram(s))
min. (minute(s))
mg (milligram(s))
ml (milliliter(s))
MMBtu (million British thermal units)
MW (megawatt(s))
NCASI (National Council for Air and Stream Improvement)
ND (non-detect)
NDIR (non-dispersive infrared)
NDO (natural draft opening)
NESHAP (National Emission Standards for Hazardous Air Pollutants)
ng (nanogram(s))
Nm^3 (Normal cubic meter)
% (percent)
PEMS (predictive emissions monitoring systems)
PFGC (pneumatic focusing gas chromatography)
pg (picogram(s))
PJFF (pulse jet fabric filter)
ppb (parts per billion)
PPE (personal protective equipment)
ppm (parts per million)
ppmdv (parts per million, dry volume)
ppmwv (parts per million, wet volume)
PSD (particle size distribution)
psi (pound(s) per square inch)
PTE (permanent total enclosure)
PTFE (polytetrafluoroethylene)
QA/QC (quality assurance/quality control)
QI (qualified individual)
QSTI (qualified source testing individual)
QSTO (qualified source testing observer)
RA (relative accuracy)
RATA (relative accuracy test audit)
RB (reagent blank)
RE (removal or reduction efficiency)
RM (reference method)
scf (standard cubic feet)
scfm (standard cubic feet per minute)
SCR (selective catalytic reduction)
SDA (spray dryer absorber)
SNCR (selective non-catalytic reduction)
STD (standard)
STMS (sorbent trap monitoring system)
TBtu (trillion British thermal units)
TEOM (Tapered Element Oscillating Microbalance)
TEQ (toxic equivalency quotient)
ton/hr (ton per hour)
ton/yr (ton per year)
TSS (third stage separator)
USEPA or EPA (United States Environmental Protection Agency)
UVA (ultraviolet absorption)
WFGD (wet flue gas desulfurization)
%wv (percent, wet volume)

1. PROJECT OVERVIEW

TEST PROGRAM SUMMARY

Lacks Enterprises, Inc. contracted CleanAir Engineering (CleanAir) to complete testing on the SV-Scrubber Outlet at the 52nd Paint Central Plant located in Kentwood, Michigan.

The objective of the test program was to perform testing to demonstrate compliance with applicable limits outlined in the Michigan Permit to Install 110-18A.

A summary of the test program results is presented below. Section 2 Results provides a more detailed account of the test conditions and data analysis.

Table 1-1:
Summary of Results / Permit Limits

Source Constituent	Sampling Method	Average Emission	Permit Limit[1]
SV-Scrubber Outlet			
Total Cr (lb/hr)	EPA 306	6.33E-05	1.06E-04

[1] Permit limits obtained from Michigan Permit to Install 110-18A.

TEST PROGRAM DETAILS

PARAMETERS

The test program included the following measurements:

- total chromium (Cr)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas temperature
- flue gas flow rate

SCHEDULE

Testing was performed on October 21, 2021. Table 1-2 outlines the on-site schedule followed during the test program.

Table 1-2:
Test Schedule

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	SV-Scrubber Outlet	EPA Method 306	Total Chromium	10/21/21	07:42	09:54
2	SV-Scrubber Outlet	EPA Method 306	Total Chromium	10/21/21	10:06	12:11
3	SV-Scrubber Outlet	EPA Method 306	Total Chromium	10/21/21	12:24	14:28

DISCUSSION

Three 120-minute isokinetic test runs were performed at the SV-Scrubber Outlet using EPA Method 306 for the determination of total chromium. The source was ambient, therefore 20.9% dv for O_2 and 0.0% dv for CO_2 were used.

The Method 306 chromium sampling train included the following equipment:

- borosilicate-glass nozzle
- unheated borosilicate glass probe liner
- set of four Greenburg-Smith (GS) impingers:
  - first modified GS impinger contained 100 mL of 0.1N sodium hydroxide (NaOH)
  - second standard GS impinger contained 100 mL of 0.1N NaOH
  - third modified GS impinger was dry
  - fourth modified GS impinger contained a known quantity of silica gel

At the conclusion of the sample runs after the final leak check of the sample system, the interior of the nozzle, probe liner, and all glassware up to the fourth impinger was rinsed with 0.1N NaOH.

The 0.1N NaOH rinses were collected in a pre-cleaned sample container. Prior to recovering the impingers, gravimetric analyses (post-test weights) were obtained for the determination of moisture content of the stack gases. The contents of the impinger were then collected in the sample container. The samples were shipped to Element One, Inc., located in Wilmington, North Carolina, for analysis using inductively coupled plasma mass spectroscopy (ICP/MS) in accordance with USEPA Method 306.

Verification of the Absence of Cyclonic Flow

A cyclonic flow check was performed in accordance with EPA Method 1, Section 11.4. This procedure is referred to as the "nulling" technique. An S-type pitot tube connected to an inclined manometer was used in this method. This is the same apparatus as referenced in EPA Method 2.

The pitot tube was positioned at each of the EPA Method 1 traverse point locations so that the face openings of the pitot tube are orientated perpendicular to the stack or duct cross-sectional plane. This position was referenced as the "0° reference." The velocity pressure (ΔP) measurement at this position was recorded. If the ΔP reading was zero, a cyclonic angle of 0° is recorded. If the ΔP reading was not zero, the pitot tube was rotated clockwise (positive) or counterclockwise (negative) as required to obtain a zero ΔP reading. The angle required to obtain the zero reading was measured using a digital protractor (±0.1°) attached to the pitot tube.

After all the traverse points had been checked, the average of the absolute values of each angle was calculated. If this resultant angle is ≤ 20°, the flow condition at the location is considered acceptable. Measured resultant angle was 5.9°. The field data is in Appendix E.

End of Section

2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices.

Table 2-1:
SV-Scrubber Outlet Stack – Chromium Results

Run No.		1	2	3	Average
Date (2021)		Oct 21	Oct 21	Oct 21	
Start Time (approx.)		07:42	10:06	12:24	
Stop Time (approx.)		09:54	12:11	14:28	
Gas Conditions					
O_2	Oxygen (dry volume %)	20.9	20.9	20.9	**20.9**
CO_2	Carbon dioxide (dry volume %)	0.0	0.0	0.0	**0.0**
T_s	Stack temperature (°F)	65	63	61	**63**
B_w	Actual water vapor in gas (% by volume)	2.15	2.00	1.85	**2.00**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	13,500	13,900	13,700	**13,700**
Q_s	Volumetric flow rate, standard (scfm)	13,100	13,600	13,400	**13,400**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	12,900	13,300	13,200	**13,100**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	63.72	65.57	65.13	**64.81**
%I	Isokinetic sampling (%)	100.8	100.2	100.5	**100.5**
Laboratory Data					
m_n	Total matter corrected for allowable blanks (µg)	2.12	1.67	3.29	
Chromium Results - Total					
C_{sd}	Concentration (lb/dscf)	7.35E-11	5.63E-11	1.11E-10	**8.04E-11**
C_{sd}	Concentration (mg/dscm)	1.18E-03	9.01E-04	1.79E-03	**1.29E-03**
$E_{lb/hr}$	Rate (lb/hr)	5.67E-05	4.50E-05	8.83E-05	**6.33E-05**

End of Section

3. DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

Lacks Enterprise Inc. is a privately owned company based in Grand Rapids, Michigan, which produces molded, painted, or plated plastic products. The SV-Scrubber Outlet has a Composite Mesh Pad (CMP) Scrubber control device as part of the 52nd Paint Central Plant.

The testing reported in this document was performed at the SV-Scrubber Outlet Stack located on the roof.

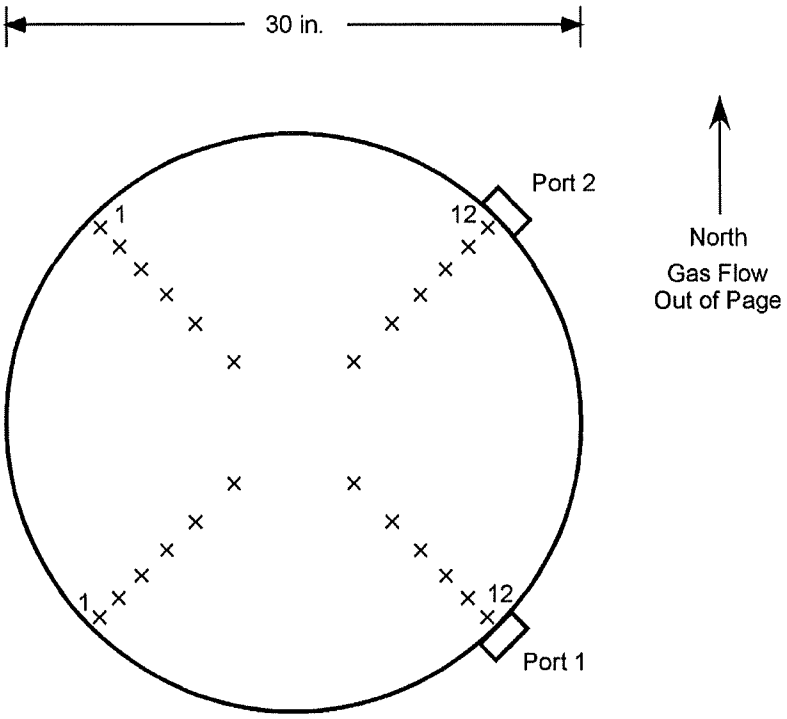
TEST LOCATION

The sample point placement was determined by EPA Method 1 specifications. The first and twelfth and sampling points were relocated to the minimum distance of 1-inch from the stack wall (stacks greater than 24 inches in diameter) per EPA Method 1 Section 11.3.2.1. Table 3-1 presents the sampling information for the test location. The figure represents the layout of the test location.

Table 3-1:
Sampling Information

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
SV-Scrubber Outlet							
Total Cr	EPA 306	1-3	2	12	5	120	3-1

Figure 3-1:
SV-Scrubber Outlet Sample Point Layout (EPA Method 1)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	97.9	29.0
2	93.3	28.0
3	88.2	26.5
4	82.3	24.7
5	75.0	22.5
6	64.4	19.3
7	35.6	10.7
8	25.0	7.5
9	17.7	5.3
10	11.8	3.5
11	6.7	2.0
12	2.1	1.0

Duct diameters upstream from flow disturbance (A): 1.0 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 2.1 Limit: 2.0

End of Section

4. METHODOLOGY

PROCEDURES AND REGULATIONS

The test program sampling measurements followed procedures and regulations outlined by the USEPA and Michigan Department of Environment, Great Lakes, and Energy (EGLE). These methods appear in detail in Title 40 of the CFR and at https://www.epa.gov/emc.

Appendix A includes diagrams of the sampling apparatus, as well as specifications for sampling, recovery, and analytical procedures. Any modifications to standard test methods are explicitly indicated in this appendix. In accordance with ASTM D7036 requirements, CleanAir included a description of any such modifications along with the full context of the objectives and requirements of the test program in the test protocol submitted prior to the measurement portion of this project. Modifications to standard methods are not covered by the ISO 17025 and TNI portions of CleanAir's A2LA accreditation.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods," EPA/600/R-94/038C. Appendix D contains additional QA/QC measures, as outlined in CleanAir's internal Quality Manual.

TITLE 40 CFR PART 60, APPENDIX A

Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
Method 3	"Gas Analysis for the Determination of Dry Molecular Weight"
Method 4	"Determination of Moisture Content in Stack Gases"
Method 306	"Determination of Chromium Emission from Decorative and Hard Chromium Electroplating and Chromium Anodizing Operations – Isokinetic Method"

End of Section

5. APPENDIX

Appendix A: Test Method Specifications

Appendix B: Sample Calculations

Appendix C: Parameters

Appendix D: QA/QC Data

Appendix E: Field Data

Appendix F: Field Data Printouts

Appendix G: Laboratory Data

Appendix H: Facility Operating Data

Appendix I: CleanAir Resumes and Certifications

APPENDIX B: SAMPLE CALCULATIONS

EPA Method 306 (Total Chromium)
Sampling, Velocity and Moisture Sample Calculations

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Volume of water collected (wscf)

$$V_{wstd} = (0.04706)(V_{lc})$$

Where:

V_{lc}	= total volume of liquid collected in impingers and silica gel (ml)	=	31.4	ml
0.04706	= ideal gas conversion factor (ft^3 water vapor/ml or gm)	=	0.04706	ft^3/ml
V_{wstd}	= volume of water vapor collected at standard conditions (ft^3)	=	1.48	ft^3

2. Volume of gas metered, standard conditions (dscf)

$$V_{mstd} = \frac{(17.64)(V_m)\left(P_{bar} + \frac{\Delta H}{13.6}\right)(Y_d)}{(460 + T_m)}$$

Where:

P_{bar}	= barometric pressure (in. Hg)	=	28.90	in. Hg
T_m	= average dry gas meter temperature (°F)	=	65.27	°F
V_m	= volume of gas sample through the dry gas meter at meter conditions (dcf)	=	65.28	dcf
Y_d	= gas meter correction factor (dimensionless)	=	1.0036	
ΔH	= average pressure drop across meter box orifice (in. H_2O)	=	0.86	in. H_2O
17.64	= standard temperature to pressure ratio (°R/in. Hg)	=	17.64	°R/in. Hg
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in.H_2O/in. Hg
460	= °F to °R conversion constant	=	460	
V_{mstd}	= volume of gas sampled through the dry gas meter at standard conditions (dscf)	=	63.724	dscf

3. Stack gas pressure (in. Hg)

$$P_s = P_{bar} + \left(\frac{P_g}{13.6}\right)$$

Where:

P_{bar}	= barometric pressure (in. Hg)	=	28.90	in. Hg
P_g	= sample gas static pressure (in. H_2O)	=	0.20	in. H_2O
13.6	= conversion factor (in. H_2O/in. Hg)	=	13.6	in. H_2O/in. Hg
P_s	= absolute stack gas pressure (in. Hg)	=	28.91	in. Hg

8. Actual water vapor in gas (% by volume)

$$B_w = MINIMUM \left[B_{wo}, B_{ws} \right]$$

Where:

B_{ws}	= proportion of water vapor in the gas stream by volume at saturated conditions	=	0.0215	
B_{wo}	= proportion of water measured in the gas stream by volume	=	0.0227	
B_w	= actual water vapor in gas	=	0.0215	
		=	2.15	%

9. Nitrogen (plus carbon monoxide) in gas stream (% by volume, dry)

$$N_2 + CO = 100 - CO_2 - O_2$$

Where:

CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	0.0	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	20.9	%
100	= conversion factor (%)	=	100	%
N_2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=	79.10	%

10. Molecular weight of dry gas stream (lb/lb·mole)

$$M_d = (M_{CO_2})\frac{(CO_2)}{(100)} + (M_{O_2})\frac{(O_2)}{(100)} + (M_{N_2+CO})\frac{(N_2+CO)}{(100)}$$

Where:

M_{CO2}	= molecular weight of carbon dioxide (lb/lb·mole)	=	44.00	lb/lb·mole
M_{O2}	= molecular weight of oxygen (lb/lb·mole)	=	32.00	lb/lb·mole
M_{N2+CO}	= molecular weight of nitrogen and carbon monoxide (lb/lb·mole)	=	28.00	lb/lb·mole
CO_2	= proportion of carbon dioxide in the gas stream by volume (%)	=	0.0	%
O_2	= proportion of oxygen in the gas stream by volume (%)	=	20.9	%
N_2+CO	= proportion of nitrogen and CO in the gas stream by volume (%)	=	79.1	%
100	= conversion factor (%)	=	100	%
M_d	= dry molecular weight of sample gas (lb/lb·mole)	=	28.84	lb/lb·mole

11. Molecular weight of stack gas (lb/lb·mole)

$$M_s = (M_d)(1 - B_w) + (M_{H_2O})(B_w)$$

Where:

B_w	= proportion of water vapor in the gas stream by volume	=	0.0215	
M_d	= dry molecular weight of stack gas (lb/lb·mole)	=	28.84	lb/lb·mole
M_{H2O}	= molecular weight of water (lb/lb·mole)	=	18.00	lb/lb·mole
M_s	= molecular weight of stack gas, wet basis (lb/lb·mole)	=	28.60	lb/lb·mole

16. Dry flow of stack gas corrected to 7%O_2 (dscfm)

$$Q_{std\,7} = (Q_{std})\left(\frac{20.9 - O_2}{20.9 - 7}\right)$$

Where:

Q_{std}	= volumetric flow rate at standard conditions, dry basis (dscfm)	=	12,865	dscfm
O_2	= proportion of oxygen in the gas stream by volume (%)	=	20.9	%
20.9	= oxygen content of ambient air (%)	=	20.9	%
7	= oxygen content of corrected gas (%)	=	7.0	%
Q_{std7}	= volumetric flow rate at STP and 7%O_2, dry basis (dscfm)	=	0	dscfm

17. Hourly time basis conversion of volumetric flow rate (Q_{std} example)

$$Q_{std-hr} = (Q_{std-min})(60)$$

Where

$Q_{std-min}$	= volumetric flow rate, english units (ft^3/min)	=	12,865	dscfm
60	= conversion factor (min/hr)	=	60	min/hr
Q_{std-hr}	= volumetric flow rate, hourly basis (dscf/hr)	=	771,889	dscf/hr

18. Metric Conversion of Gas Volumes (Q_{std} example)

$$Q_{std-metric} = (Q_{std-english})\left(\frac{60}{35.31}\right)$$

Where:

$Q_{std-english}$	= volumetric flow rate, english units (ft^3/min)	=	12,865	dscfm
35.31	= conversion factor (ft^3/m^3)	=	35.31	ft^3/m^3
60	= conversion factor (min/hr)	=	60	min/hr
$Q_{std-metric}$	= volumetric flow rate, metric units (m^3/hr)	=	21,860	dry std m^3/hr

19. Standard to Normal Conversion of Gas Volumes (Q_{std} example)

$$Q_{Normal} = (Q_{std-metric})\left(\frac{32 + 460}{68 + 460}\right)$$

Where:

$Q_{std-metric}$	= volumetric flow rate, metric units (dry std m^3/hr)	=	21,860	dry std m^3/hr
32	= normal temperature (°F)	=	32	°F
68	standard temperature (°F)	=	68	°F
460	= standard temperature in Rankine (68°F)	=	460	
Q_{Normal}	= volumetric flow rate, metric units (dry Nm^3/hr)	=	20,370	dry Nm^3/hr

LOGIC FOR TREATING DETECTION LIMITS

(all metals except mercury)

1. Logic for Determining Maximum Allowable Front-Half Blank Correction ($m_{FB\text{-}allow}$)

	CASE 1	CASE 2
	m_{FB} = D	m_{FB} = ND
Rule		
ND = 0	$m_{FB\text{-}allow}$ = M29 Rule	$m_{FB\text{-}allow}$ = 0
ND=1x	$m_{FB\text{-}allow}$ = M29 Rule	$m_{FB\text{-}allow}$ = 0
ND=0.5x	$m_{FB\text{-}allow}$ = M29 Rule	$m_{FB\text{-}allow}$ = 0

2. Logic for Determining Blank-Corrected Front-Half Sample Amount (m_F)

	CASE 1	CASE 2
	$m_{FS} - m_{FB\text{-}allow} \geq$ MDL	$m_{FS} - m_{FB\text{-}allow} <$ MDL
Rule		
ND = 0	$m_F = m_{FS} - m_{FB\text{-}allow}$	$m_F =$ < MDL
ND=1x	$m_F = m_{FS} - m_{FB\text{-}allow}$	$m_F =$ < MDL
ND=0.5x	$m_F = m_{FS} - m_{FB\text{-}allow}$	$m_F =$ < MDL

3. Logic for Determining Maximum Allowable Back-Half Blank Correction ($m_{BB\text{-}allow}$)

	CASE 1	CASE 2
	m_{BB} = D	m_{BB} = ND
Rule		
ND = 0	$m_{BB\text{-}allow}$ = M29 Rule	$m_{BB\text{-}allow}$ = 0
ND=1x	$m_{BB\text{-}allow}$ = M29 Rule	$m_{BB\text{-}allow}$ = 0
ND=0.5x	$m_{BB\text{-}allow}$ = M29 Rule	$m_{BB\text{-}allow}$ = 0

4. Logic for Determining Blank-Corrected Back-Half Sample Amount (m_B)

	CASE 1	CASE 2
	$m_{BS} - m_{BB\text{-}allow} \geq$ MDL	$m_{BS} - m_{BB\text{-}allow} <$ MDL
Rule		
ND = 0	$m_B = m_{BS} - m_{BB\text{-}allow}$	$m_B =$ < MDL
ND=1x	$m_B = m_{BS} - m_{BB\text{-}allow}$	$m_B =$ < MDL
ND=0.5x	$m_B = m_{BS} - m_{BB\text{-}allow}$	$m_B =$ < MDL

5. Logic for Adding Front and Back-Half Corrected Samples (m_n)

	CASE 1 Both are D	CASE 2 One is D, other is ND	CASE 3 Both are ND
Rule			
ND = 0	$m_n = m_F + m_B$	m_n = D	$m_n =$ < Sum ND
ND=1x	$m_n = m_F + m_B$	$m_n =$ < [D + ND]	$m_n =$ < Sum ND
ND=0.5x	$m_n = m_F + m_B$	$m_n =$ <[D + 0.5ND]	$m_n =$ < 0.5 Sum ND

Definitions and Notes

The term "Rule" refers to the rule being implemented for handling non-detectable quantities in summations.
MDL = minimum detection limit.
D = Detectable quantity reported as D.
ND = Non-Detectable quantity reported at a value of ND.
If Front and Back-Half fractions are combined, then only Items 1 and 2 are used.

Prepared by Clean Air Engineering Proprietary Software
SS Metals-1 Version 2006-12c

EPA Method 306 (Total Chromium)
Chromium Sample Calculations

Sample data taken from Run 1

Note: The tables presenting the results are generated electronically from raw data. It may not be possible to exactly duplicate these results using a calculator. The reference method data, results, and all calculations are carried to sixteen decimal places throughout. The final table is formatted to an appropriate number of significant figures.

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1. Chromium concentration (lb/dscf)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{2.205\times10^{-3}}{10^{6}}\right)$$

Where:

m_n	= chromium collected in sample (total µg)	=	2.1230	µg
V_{mstd}	= volume metered, standard (dscf)	=	63.7242	dscf
2.205×10^{-3}	= conversion factor (lb/g)	=	2.205E-03	lb/g
10^6	= conversion factor (µg/g)	=	1.0E+06	µg/g
C_{sd}	= chromium concentration (lb/dscf)	=	7.3461E-11	lb/dscf

2. Chromium concentration (µg/dscm)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)(35.31)$$

Where:

m_n	= chromium collected in sample (total µg)	=	2.1230	µg
V_{mstd}	= volume metered, standard (dscf)	=	63.7242	dscf
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
C_{sd}	= chromium concentration (µg/dscm)	=	1.1764	µg/dscm

3. Chromium concentration (mg/dscm)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)\left(\frac{35.31}{1000}\right)$$

Where:

m_n	= chromium collected in sample (total µg)	=	2.1230	µg
V_{mstd}	= volume metered, standard (dscf)	=	63.7242	dscf
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
1000	= conversion factor (µg/mg)	=	1000	µg/mg
C_{sd}	= chromium concentration (mg/dscm)	=	1.1764E-03	mg/dscm

4. Chromium concentration (µg/Nm3 dry)

$$C_{sd} = \left(\frac{m_n}{V_{mstd}}\right)(35.31)\left(\frac{68 + 460}{32 + 460}\right)$$

Where:

m_n	= chromium collected in sample (total µg)	=	2.1230	µg
V_{mstd}	= volume metered, standard (dscf)	=	63.7242	dscf
35.31	= conversion factor (dscf/dscm)	=	35.31	dscf/dscm
68	= standard temperature (°F)	=	68	°F
32	= normal temperature (°F)	=	32	°F
460	= °F to °R conversion constant	=	460	
C_{sd}	= chromium concentration (µg/Nm3 dry)	=	1.2624	µg/Nm^3 dry

End of Appendix Section