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REPORT FOR TOTAL CHROMIUM EMISSION TESTING

Plastic Plate Kraft Plant

Chrome Etch Scrubber Outlet Stack (SVK2)

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

CleanAir Project No. 14473-2
A2LA ISO 17025 Certificate No. 4342.01
A2LA / STAC Certificate No. 4342.02
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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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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 Chrome Etch Scrubber (SVK2) Outlet Stack at the Plastic Plate Kraft (PPK) 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 Renewable Operating Permit MI-ROP-N7374-2020.

CleanAir performed testing under two test conditions:

- Without HEPA Filter (Runs 1, 2, and 3)
- With HEPA Filter (Runs 4, 5, and 6)

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]
Chrome Etch Scrubber Outlet (SVK2)			
Total Cr (lb/hr) Without HEPA Filter	EPA 306	0.0117	0.0032
Total Cr (lb/hr) With HEPA Filter	EPA 306	0.0019	0.0032

[1] Permit limits obtained from Michigan Renewable Operating Permit MI-ROP-N7374-2020.

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 19 and 20, 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	Chrome Etch Scrubber Outlet (SVK2) - Without HEPA Filter	EPA Method 306	Total Chromium	10/19/21	07:48	09:59
2	Chrome Etch Scrubber Outlet (SVK2) - Without HEPA Filter	EPA Method 306	Total Chromium	10/19/21	10:27	12:36
3	Chrome Etch Scrubber Outlet (SVK2) - Without HEPA Filter	EPA Method 306	Total Chromium	10/19/21	12:59	15:08
4	Chrome Etch Scrubber Outlet (SVK2) - With HEPA Filter	EPA Method 306	Total Chromium	10/20/21	07:08	09:15
5	Chrome Etch Scrubber Outlet (SVK2) - With HEPA Filter	EPA Method 306	Total Chromium	10/20/21	09:30	11:37
6	Chrome Etch Scrubber Outlet (SVK2) - With HEPA Filter	EPA Method 306	Total Chromium	10/20/21	11:58	14:03

DISCUSSION

Three 120-minute isokinetic test runs were performed at the Chrome Etch Scrubber Outlet using EPA Method 306 for the determination of total chromium. Testing was performed at two conditions: with and without HEPA filters. 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 ($\pm 0.1°$) 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 $\leq 20°$, the flow condition at the location is considered acceptable. Measured resultant angle was 2.6°. 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:
Chrome Etch Scrubber Outlet Stack (SVK2) – Chromium Results (Without HEPA Filters)

Run No.		1	2	3	Average
Date (2021)		Oct 19	Oct 19	Oct 19	
Start Time (approx.)		07:48	10:27	12:59	
Stop Time (approx.)		09:59	12:36	15:08	
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)	80	84	84	**82**
B_w	Actual water vapor in gas (% by volume)	1.59	1.64	2.26	**1.83**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	54,400	54,000	54,400	**54,200**
Q_s	Volumetric flow rate, standard (scfm)	51,800	51,100	51,500	**51,500**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	51,000	50,300	50,300	**50,500**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	66.59	64.52	63.78	**64.96**
%I	Isokinetic sampling (%)	99.0	97.3	96.1	**97.5**
Laboratory Data					
m_n	Total matter corrected for allowable blanks (µg)	158.71	111.71	71.41	
Chromium Results - Total					
C_{sd}	Concentration (lb/dscf)	5.26E-09	3.82E-09	2.47E-09	**3.85E-09**
C_{sd}	Concentration (mg/dscm)	0.0842	0.0611	0.0395	**0.0616**
$E_{lb/hr}$	Rate (lb/hr)	0.0161	0.0115	0.00745	**0.0117**

Table 2-2:
Chrome Etch Scrubber Outlet Stack (SVK2) – Chromium Results (With HEPA Filters)

Run No.		4	5	6	Average
Date (2021)		Oct 20	Oct 20	Oct 20	
Start Time (approx.)		07:08	09:30	11:58	
Stop Time (approx.)		09:15	11:37	14:03	
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)	81	83	85	**83**
B_w	Actual water vapor in gas (% by volume)	1.48	1.88	1.93	**1.76**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	52,200	50,900	52,900	**52,000**
Q_s	Volumetric flow rate, standard (scfm)	49,700	48,300	50,000	**49,300**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	49,000	47,300	49,100	**48,500**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	63.89	60.82	61.60	**62.11**
%I	Isokinetic sampling (%)	98.9	97.4	95.2	**97.1**
Laboratory Data					
m_n	Total matter corrected for allowable blanks (µg)	23.71	17.41	15.31	
Chromium Results - Total					
C_{sd}	Concentration (lb/dscf)	8.18E-10	6.31E-10	5.48E-10	**6.66E-10**
C_{sd}	Concentration (mg/dscm)	0.0131	0.0101	0.00878	**0.0107**
$E_{lb/hr}$	Rate (lb/hr)	0.00241	0.00179	0.00161	**0.00194**

End of Section

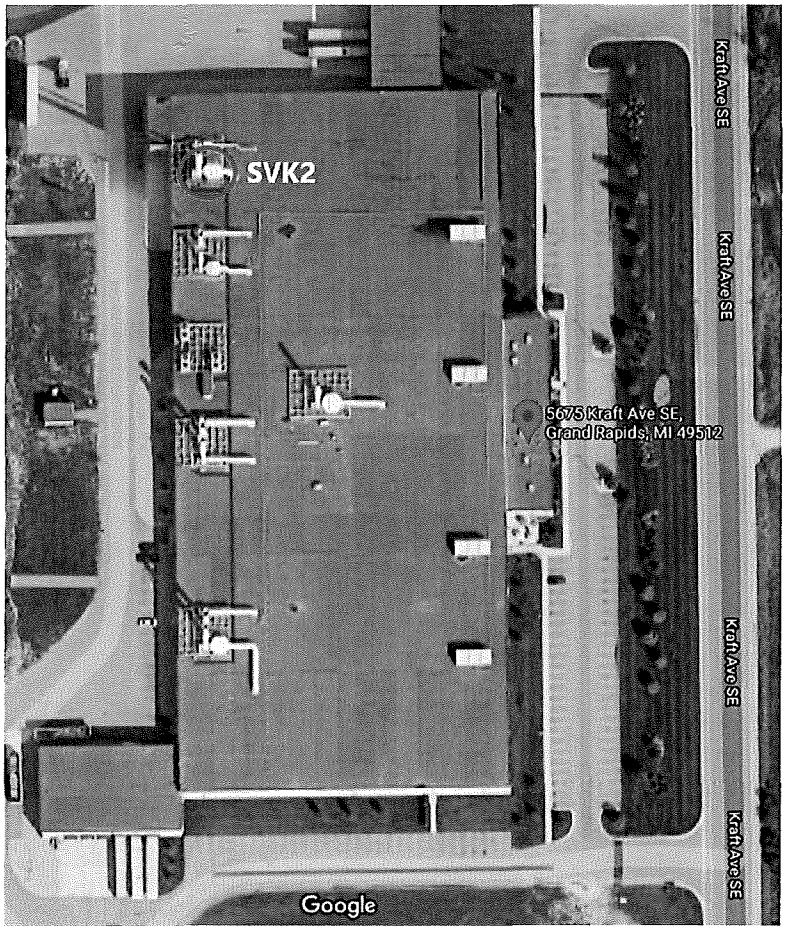
3. DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

Lacks Enterprise Inc. is a privately owned company based in Grand Rapids, Michigan, which produces molded, painted, or plated plastic products. The Chrome Etch SVK2 has a Composite Mesh Pad (CMP) Scrubber control device as part of the Plastic Plate Kraft (PPK) Plant. The Chrome Etch SVK2 unit consists of three (3) hexavalent chromic acid etch tanks controlled by one common composite mesh pad scrubber system. Each tank has a fume suppressant applied to control surface tension. The tanks contain chromic acid and sulfuric acid.

The testing reported in this document was performed at the Chrome Etch Scrubber SVK2 Outlet Stack located on the roof. Figure 3-1 presents a photograph of the locations.

Figure 3-1:
Location Photograph



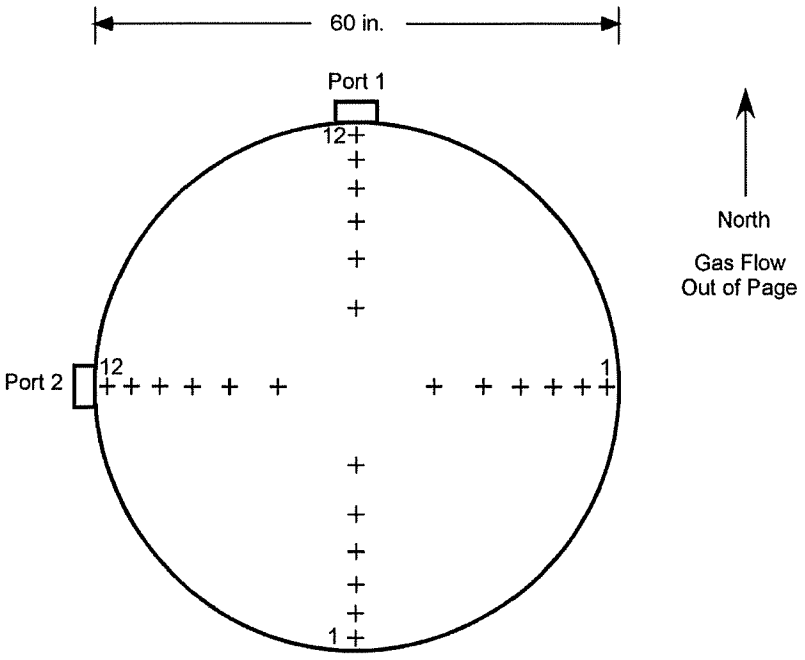
TEST LOCATIONS

The sample point placement was determined by EPA Method 1 specifications. Table 3-1 presents the sampling information for the test locations. The figures represent 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
Chrome Etch Scrubber (SVK2)							
Total Cr (Outlet Stack)	EPA 306	1-6	2	12	5	120	3-2

Figure 3-2:
Chrome Etch Scrubber Outlet Stack (SVK2) (EPA Method 1)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	97.9	58.7
2	93.3	56.0
3	88.2	52.9
4	82.3	49.4
5	75.0	45.0
6	64.4	38.6
7	35.6	21.4
8	25.0	15.0
9	17.7	10.6
10	11.8	7.1
11	6.7	4.0
12	2.1	1.3

Duct diameters upstream from flow disturbance (A): 1.1 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 5.8 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"

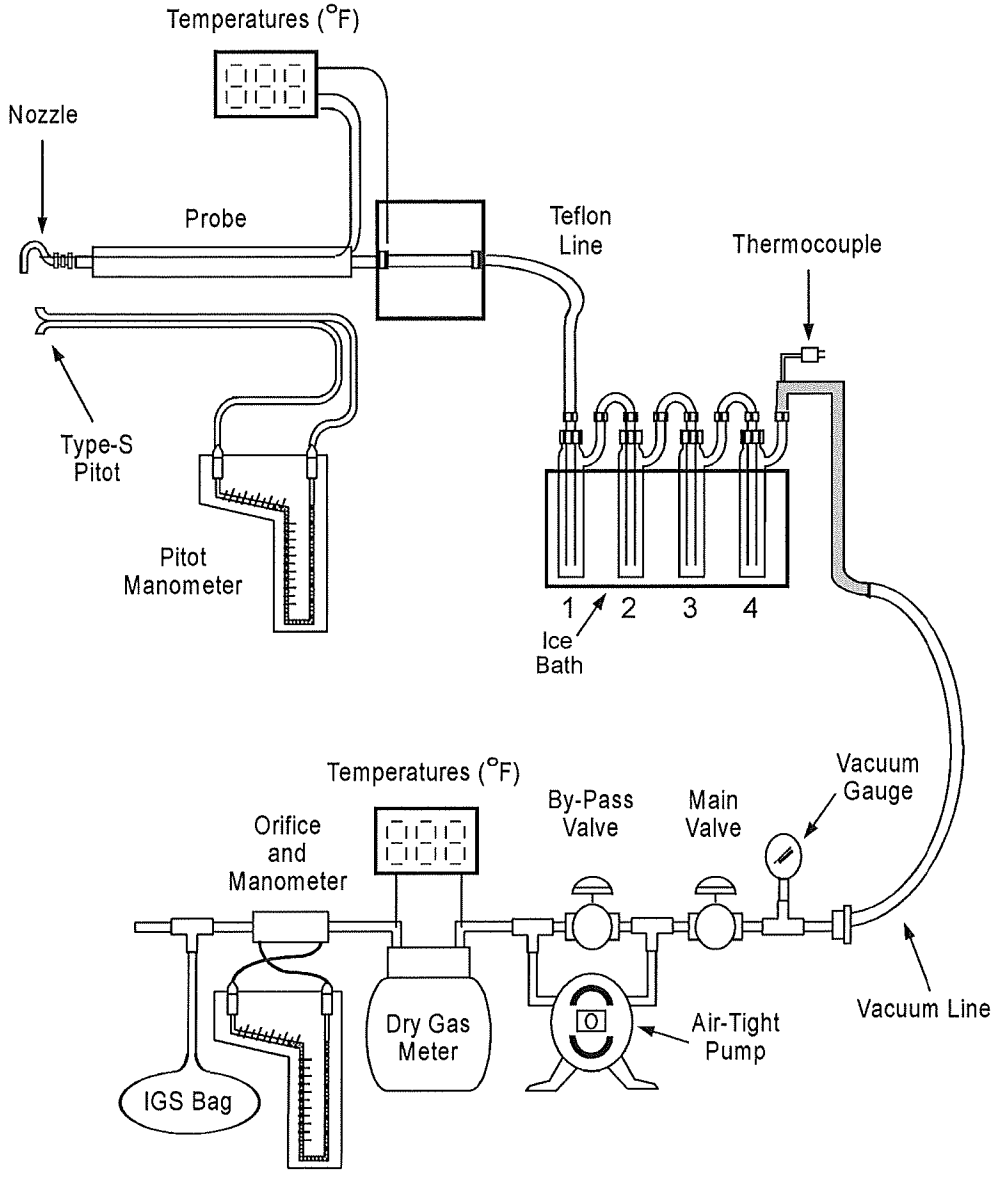
End of Section

Specification Sheet for EPA Method 306

Source Location Name(s)	Chrome Etch Scrubber Outlet Stack (SVK2)
Pollutant(s) to be Determined	Total Chromium (Cr)
Other Parameters to be Determined from Train	Gas Density, Moisture, Flow Rate

	Standard Method Specification	Actual Specification Used
Pollutant Sampling Information		
Duration of Run	N/A	120 minutes
No. of Sample Traverse Points	N/A	24
Sample Time per Point	N/A	5 minutes
Sampling Rate	Isokinetic (90-110%)	Isokinetic (90-110%)
Sampling Probe		
Nozzle Material	Stainless Steel or Glass	Borosilicate Glass
Nozzle Design	Button-Hook or Elbow	Button-Hook
Probe Liner Material	Borosilicate or Quartz Glass	Borosilicate Glass
Effective Probe Length	N/A	6 feet
Probe Temperature Set-Point	248˚F±25˚F	None
Velocity Measuring Equipment		
Pitot Tube Design	Type S	Type S
Pitot Tube Coefficient	N/A	0.84
Pitot Tube Calibration by	Geometric or Wind Tunnel	Geometric
Pitot Tube Attachment	Attached to Probe	Attached to Probe
Metering System Console		
Meter Type	Dry Gas Meter	Dry Gas Meter
Meter Accuracy	±2%	±1%
Meter Resolution	N/A	0.01 cubic feet
Meter Size	N/A	0.1 dcf/revolution
Meter Calibrated Against	Wet Test Meter or Standard DGM	Wet Test Meter
Pump Type	N/A	Rotary Vane
Temperature Measurements	N/A	Type K Thermocouple/Pyrometer
Temperature Resolution	5.4˚F	1.0˚F
ΔP Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
ΔH Differential Pressure Gauge	Inclined Manometer or Equivalent	Inclined Manometer
Barometer	Mercury or Aneroid	Digital Barometer calibrated w/Mercury Aneroid
Filter Description		
Filter Location	After Probe	None
Filter Holder Material	Quartz	N/A
Filter Support Material	Glass Frit	N/A
Cyclone Material	N/A	None
Filter Heater Set-Point	248˚F±25˚F	N/A
Filter Material	Glass Fiber	N/A
Other Components		
Description	N/A	N/A
Location	N/A	N/A
Operating Temperature	N/A	N/A

EPA Method 306
Sampling Train Configuration

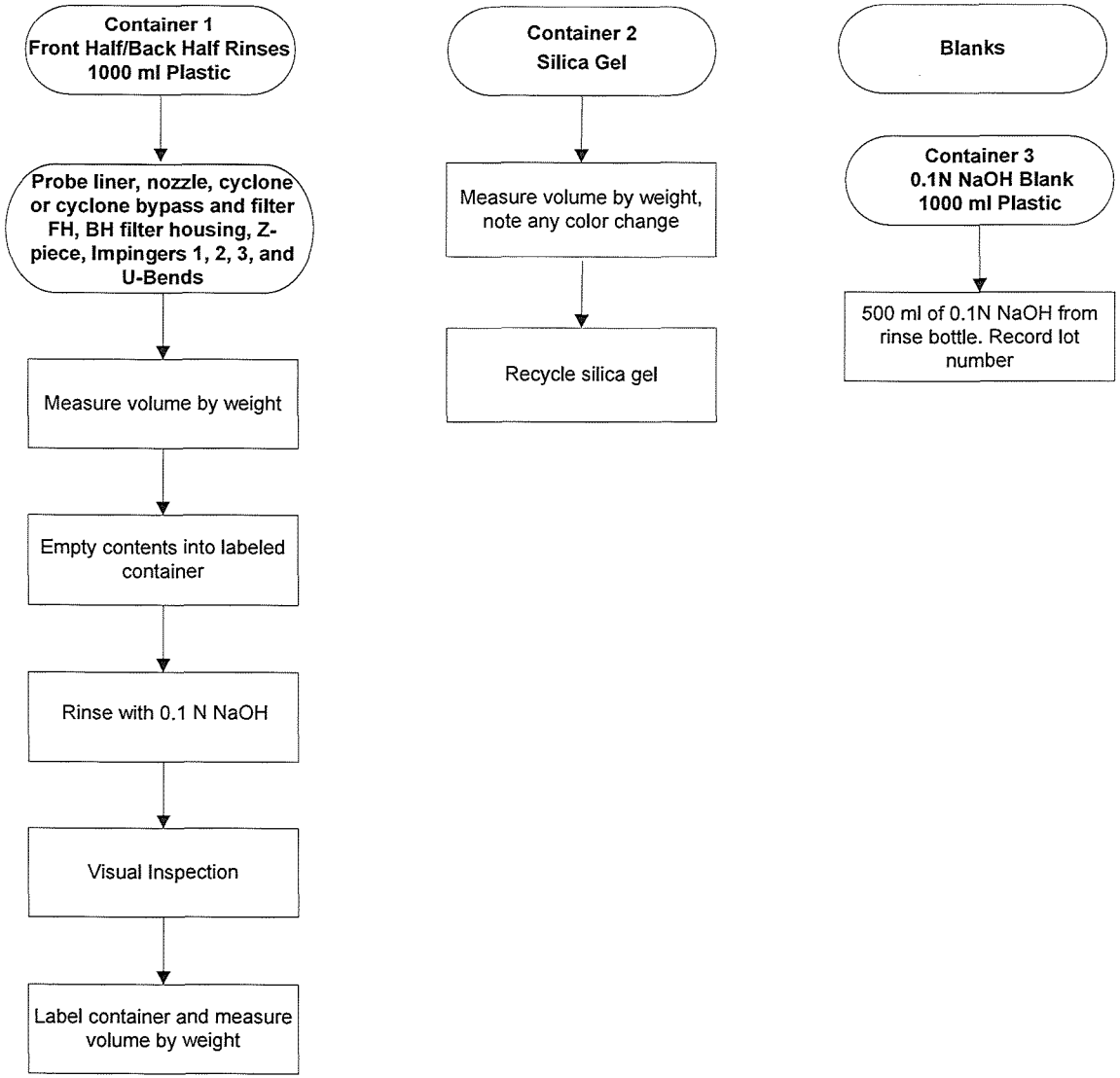


Impinger Contents

Impinger 1	0.1N NaOH
Impinger 2	0.1N NaOH
Impinger 3	Empty
Impinger 4	Silica gel

EPA Method 306
Sample Recovery Flowchart

- Tare all sample containers before sample collection
- Mark all liquid levels and final weights on the outside of each sample container
- Seal all sample containers with Teflon tape
- If recycling, bake silica gel for two hours at 350 degrees F (175 degrees C)



End of Appendix Section