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 AIR QUALITY DIVISION

1. PROJECT OVERVIEW

TEST PROGRAM SUMMARY

Lacks Enterprises, Inc. contracted CleanAir Engineering (CleanAir) to complete testing on the inlet and outlet of the Chrome Etch (SVK-2) and Chrome Plate (SVK-8) Composite Mesh Pad (CPM) Scrubber Units at the Barden Plater Plant located in Kentwood, Michigan.

The objective of the test program was to demonstrate compliance with applicable limits outlined in the Michigan Renewable Operating Permit MI-ROP-N2079-2017. In addition, diagnostic inlet testing was performed for informational purposes and is presented in this test report.

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**

| <u>Source</u> | <u>Sampling</u> | <u>Average Emission</u> | <u>Permit Limit¹</u> |
|-----------------------------|-----------------|-------------------------|---------------------------------|
| Constituent | Method | | |
| <u>Chrome Etch (SVK-2)</u> | | | |
| Inlet Total Cr (lb/hr) | EPA 306 | 1.4 | NA |
| Outlet Total Cr (lb/hr) | EPA 306 | 0.00046 | 0.0025 |
| <u>Chrome Plate (SVK-8)</u> | | | |
| Inlet Total Cr (lb/hr) | EPA 306 | 0.002 | NA |
| Outlet Total Cr (lb/hr) | EPA 306 | 0.00007 | 0.0006 |

¹ Permit limits obtained from Michigan Renewable Operating Permit MI-ROP-N2079-2017.

TEST PROGRAM DETAILS

PARAMETERS

The test program included the following measurements:

- total chromium (Cr)
- flue gas composition (e.g., O₂, CO₂, H₂O)
- flue gas temperature
- flue gas flow rate

SCHEDULE

Testing was performed on July 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 | SVK-2 Inlet | EPA Method 306 | Total Chromium | 07/20/21 | 08:06 | 10:14 |
| 2 | SVK-2 Inlet | EPA Method 306 | Total Chromium | 07/20/21 | 10:34 | 12:41 |
| 3 | SVK-2 Inlet | EPA Method 306 | Total Chromium | 07/20/21 | 13:28 | 15:40 |
| 1 | SVK-2 Outlet | EPA Method 306 | Total Chromium | 07/20/21 | 08:06 | 10:13 |
| 2 | SVK-2 Outlet | EPA Method 306 | Total Chromium | 07/20/21 | 10:34 | 12:41 |
| 3 | SVK-2 Outlet | EPA Method 306 | Total Chromium | 07/20/21 | 13:28 | 15:40 |
| 1 | SVK-8 Inlet | EPA Method 306 | Total Chromium | 07/20/21 | 08:30 | 10:47 |
| 2 | SVK-8 Inlet | EPA Method 306 | Total Chromium | 07/20/21 | 11:19 | 13:24 |
| 3 | SVK-8 Inlet | EPA Method 306 | Total Chromium | 07/20/21 | 14:18 | 16:31 |
| 1 | SVK-8 Outlet | EPA Method 306 | Total Chromium | 07/20/21 | 08:30 | 10:47 |
| 2 | SVK-8 Outlet | EPA Method 306 | Total Chromium | 07/20/21 | 11:19 | 13:24 |
| 3 | SVK-8 Outlet | EPA Method 306 | Total Chromium | 07/20/21 | 14:18 | 16:31 |

DISCUSSION

Three 120-minute tests were performed on the inlet and outlet of the SVK-2 and SVK-8 Scrubber Units using EPA Method 306 for the determination of total chromium.

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.

During the field testing, the upstream and downstream disturbances were measured on-site by CleanAir. Based on the field measurements of the outlet locations, the location of the sample test port did not meet the EPA Method 1 requirement of being at least two diameters downstream from the nearest disturbance. All historical testing has been performed at these same test ports. For future testing, the sample ports on the outlet locations should be moved to meet the EPA Method 1 requirement.

End of Section

2. RESULTS

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

**Table 2-1:
 SVK-2 Inlet – Total Chromium**

| Run No. | | 1 | 2 | 3 | Average |
|---------------------------------|--|----------|----------|----------|-----------------|
| Date (2021) | | Jul 20 | Jul 20 | Jul 20 | |
| Start Time (approx.) | | 08:06 | 10:34 | 13:28 | |
| Stop Time (approx.) | | 10:14 | 12:41 | 15:40 | |
| 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) | 84 | 87 | 89 | 87 |
| B _w | Actual water vapor in gas (% by volume) | 2.46 | 2.69 | 2.33 | 2.49 |
| Gas Flow Rate | | | | | |
| Q _a | Volumetric flow rate, actual (acfm) | 57,300 | 57,300 | 56,800 | 57,100 |
| Q _s | Volumetric flow rate, standard (scfm) | 53,800 | 53,400 | 52,700 | 53,300 |
| Q _{std} | Volumetric flow rate, dry standard (dscfm) | 52,400 | 52,000 | 51,500 | 52,000 |
| Sampling Data | | | | | |
| V _{mstd} | Volume metered, standard (dscf) | 64.27 | 63.22 | 63.04 | 63.51 |
| %I | Isokinetic sampling (%) | 98.8 | 98.0 | 98.6 | 98.5 |
| Laboratory Data | | | | | |
| m _n | Total matter corrected for allowable blanks (µg) | 12,604 | 11,759 | 13,738 | |
| Chromium Results - Total | | | | | |
| C _{sd} | Concentration (lb/dscf) | 4.32E-07 | 4.10E-07 | 4.81E-07 | 4.41E-07 |
| C _{sd} | Concentration (mg/dscm) | 6.92 | 6.57 | 7.70 | 7.06 |
| E _{lb/hr} | Rate (lb/hr) | 1.36 | 1.28 | 1.48 | 1.37 |

**Table 2-2:
 SVK-2 Outlet – Total Chromium**

| Run No. | 1 | 2 | 3 | Average |
|---|----------|----------|----------|-----------------|
| Date (2021) | Jul 20 | Jul 20 | Jul 20 | |
| Start Time (approx.) | 08:06 | 10:34 | 13:28 | |
| Stop Time (approx.) | 10:13 | 12:41 | 15:40 | |
| 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) | 88 | 92 | 95 | 92 |
| B _w Actual water vapor in gas (% by volume) | 2.35 | 2.91 | 2.59 | 2.61 |
| Gas Flow Rate | | | | |
| Q _a Volumetric flow rate, actual (acfm) | 56,200 | 56,500 | 56,700 | 56,500 |
| Q _s Volumetric flow rate, standard (scfm) | 52,900 | 52,700 | 52,700 | 52,800 |
| Q _{std} Volumetric flow rate, dry standard (dscfm) | 51,700 | 51,200 | 51,300 | 51,400 |
| Sampling Data | | | | |
| V _{mstd} Volume metered, standard (dscf) | 63.83 | 63.55 | 63.82 | 63.73 |
| %I Isokinetic sampling (%) | 101.4 | 102.0 | 102.1 | 101.8 |
| Laboratory Data | | | | |
| m _n Total matter corrected for allowable blanks (µg) | 7.79 | 1.70 | 3.54 | |
| Chromium Results - Total | | | | |
| C _{sd} Concentration (lb/dscf) | 2.69E-10 | 5.90E-11 | 1.22E-10 | 1.50E-10 |
| C _{sd} Concentration (mg/dscm) | 4.31E-03 | 9.45E-04 | 1.96E-03 | 2.40E-03 |
| E _{lb/hr} Rate (lb/hr) | 8.35E-04 | 1.81E-04 | 3.77E-04 | 4.64E-04 |

**Table 2-3:
 SVK-8 Inlet – Total Chromium**

| Run No. | 1 | 2 | 3 | Average |
|---|----------|----------|----------|-----------------|
| Date (2021) | Jul 20 | Jul 20 | Jul 20 | |
| Start Time (approx.) | 08:30 | 11:19 | 14:18 | |
| Stop Time (approx.) | 10:47 | 13:24 | 16:31 | |
| 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 | 82 | 84 | 82 |
| B _w Actual water vapor in gas (% by volume) | 2.61 | 2.64 | 2.98 | 2.74 |
| Gas Flow Rate | | | | |
| Q _a Volumetric flow rate, actual (acfm) | 45,100 | 45,000 | 43,400 | 44,500 |
| Q _s Volumetric flow rate, standard (scfm) | 42,700 | 42,500 | 40,800 | 42,000 |
| Q _{std} Volumetric flow rate, dry standard (dscfm) | 41,600 | 41,400 | 39,600 | 40,900 |
| Sampling Data | | | | |
| V _{mstd} Volume metered, standard (dscf) | 63.15 | 62.90 | 59.19 | 61.75 |
| %I Isokinetic sampling (%) | 103.4 | 103.4 | 101.7 | 102.8 |
| Laboratory Data | | | | |
| m _n Total matter corrected for allowable blanks (µg) | 25.7 | 23.4 | 21.9 | |
| Chromium Results - Total | | | | |
| C _{sd} Concentration (lb/dscf) | 8.97E-10 | 8.20E-10 | 8.16E-10 | 8.44E-10 |
| C _{sd} Concentration (mg/dscm) | 0.0144 | 0.0131 | 0.0131 | 0.0135 |
| E _{lb/hr} Rate (lb/hr) | 2.24E-03 | 2.04E-03 | 1.94E-03 | 2.07E-03 |

**Table 2-4:
 SVK-8 Outlet – Total Chromium**

| Run No. | | 1 | 2 | 3 | Average |
|---------------------------------|--|----------|----------|----------|-----------------|
| Date (2021) | | Jul 20 | Jul 20 | Jul 20 | |
| Start Time (approx.) | | 08:30 | 11:19 | 14:18 | |
| Stop Time (approx.) | | 10:47 | 13:24 | 16:31 | |
| 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) | 83 | 85 | 87 | 85 |
| B _w | Actual water vapor in gas (% by volume) | 2.98 | 2.91 | 2.71 | 2.87 |
| Gas Flow Rate | | | | | |
| Q _a | Volumetric flow rate, actual (acfm) | 34,200 | 34,700 | 33,100 | 34,000 |
| Q _s | Volumetric flow rate, standard (scfm) | 32,500 | 32,800 | 31,200 | 32,200 |
| Q _{std} | Volumetric flow rate, dry standard (dscfm) | 31,600 | 31,900 | 30,400 | 31,300 |
| Sampling Data | | | | | |
| V _{mstd} | Volume metered, standard (dscf) | 55.39 | 56.87 | 50.68 | 54.32 |
| %I | Isokinetic sampling (%) | 103.0 | 104.7 | 97.9 | 101.9 |
| Laboratory Data | | | | | |
| m _n | Total matter corrected for allowable blanks (µg) | 0.655 | 0.850 | 1.20 | |
| Chromium Results - Total | | | | | |
| C _{sd} | Concentration (lb/dscf) | 2.61E-11 | 3.30E-11 | 5.22E-11 | 3.71E-11 |
| C _{sd} | Concentration (mg/dscm) | 4.18E-04 | 5.28E-04 | 8.36E-04 | 5.94E-04 |
| E _{lb/hr} | Rate (lb/hr) | 4.94E-05 | 6.30E-05 | 9.52E-05 | 6.92E-05 |

End of Section

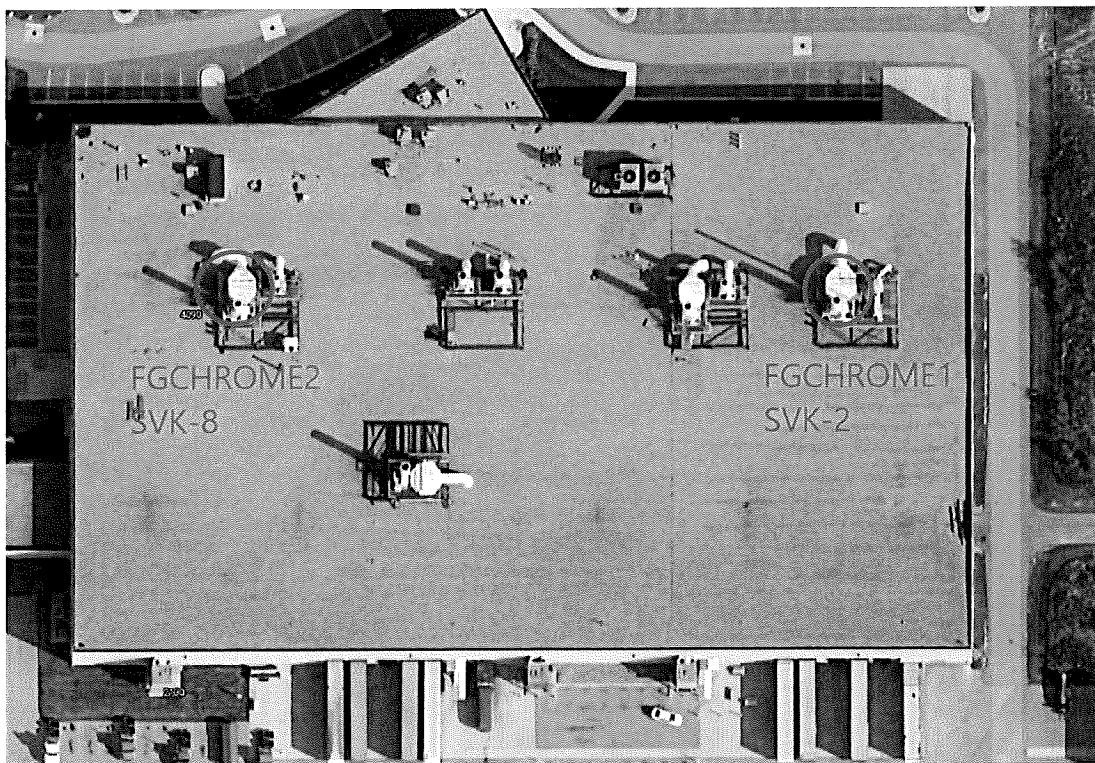
3. DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

Lacks Enterprise Inc. is a privately owned company based in Grand Rapids, Michigan, which produces molded, painted, or plated plastic products. The Chrome Etch SVK-2 and Chrome Plate SVK-8 have a Composite Mesh Pad (CMP) Scrubber control device as part of the Barden Plater Plant. The Chrome Etch SVK-2 consists of three chromic acid etch tanks, a chrome conversion unit, and a chrome recovery unit. The Chrome Plate SVK-8 consists of three decorative chrome plating tanks and a chrome recovery unit.

The testing reported in this document was performed at the inlet and stack of the SVK-2 and SVK-8 ICMP Scrubber. SVK-2 and SVK-8 are located on the roof of the building. Figure 3-1 presents a photograph of the locations.

Figure 3-1:
Location Photograph



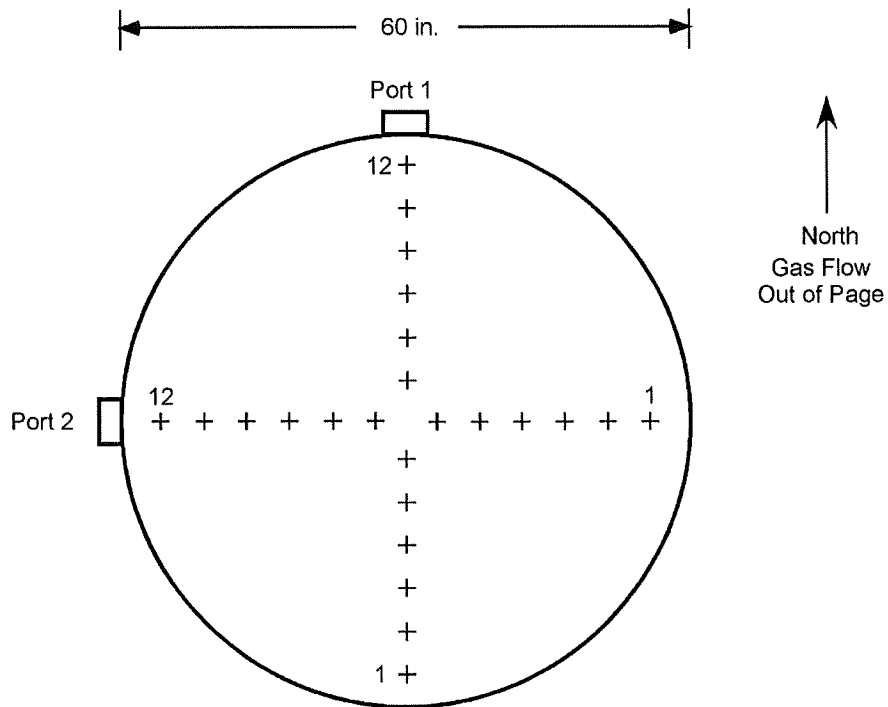
TEST LOCATIONS

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 locations.

**Table 3-1:
 Sampling Information**

| <u>Source</u> Constituent | Method | Run No. | Ports | Points per Port | Minutes per Point | Total Minutes | Figure |
|------------------------------|---------|------------|-------|--------------------|----------------------|------------------|--------|
| <u>Chrome Etch (SVK-2)</u> | | | | | | | |
| Total Cr (Inlet) | EPA 306 | 1-3 | 2 | 12 | 5 | 120 | 3-2 |
| Total Cr (Outlet) | EPA 306 | 1-3 | 2 | 12 | 5 | 120 | 3-3 |
| <u>Chrome Plate (SVK-8)</u> | | | | | | | |
| Total Cr (Inlet) | EPA 306 | 1-3 | 2 | 12 | 5 | 120 | 3-4 |
| Total Cr (Outlet) | EPA 306 | 1-3 | 2 | 12 | 5 | 120 | 3-5 |

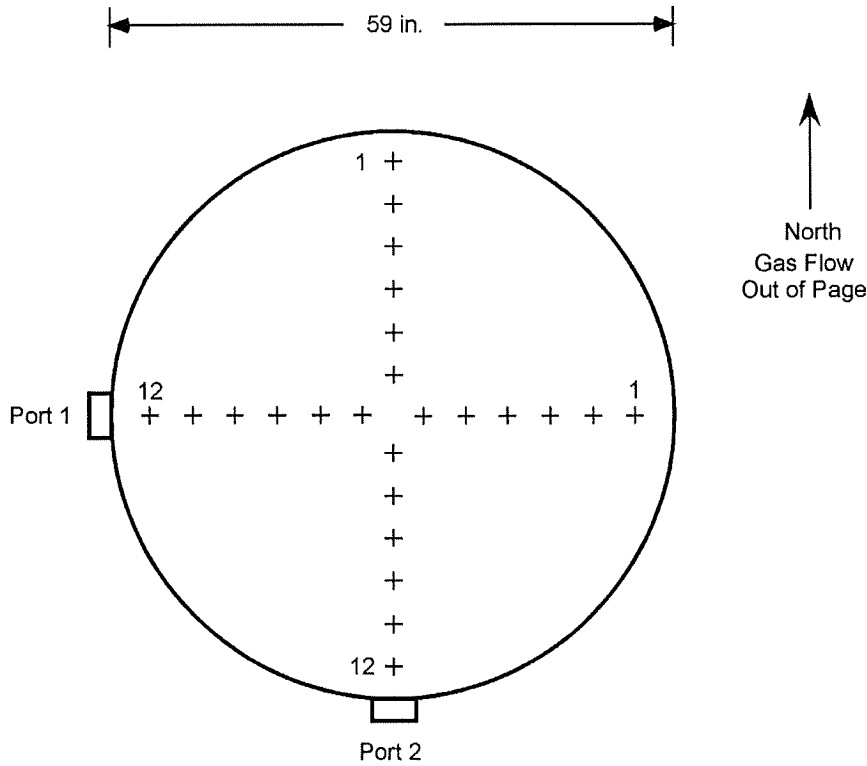
**Figure 3-2:
 SVK-2 Inlet Sample Point Layout (EPA Method 1)**



| 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): 0.65 Limit: 0.5
 Duct diameters downstream from flow disturbance (B): 0.5 Limit: 2.0

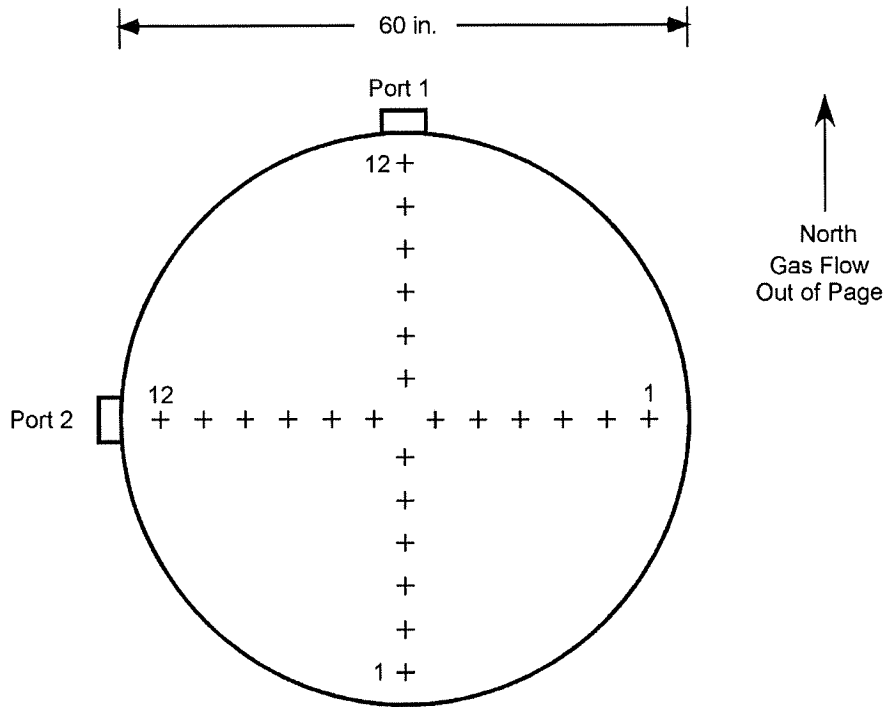
**Figure 3-3:
 SVK-2 Outlet Sample Point Layout (EPA Method 1)**



| Sampling Point | % of Stack Diameter | Port to Point Distance (inches) |
|----------------|---------------------|---------------------------------|
| 1 | 97.9 | 57.8 |
| 2 | 93.3 | 55.0 |
| 3 | 88.2 | 52.0 |
| 4 | 82.3 | 48.6 |
| 5 | 75.0 | 44.3 |
| 6 | 64.4 | 38.0 |
| 7 | 35.6 | 21.0 |
| 8 | 25.0 | 14.8 |
| 9 | 17.7 | 10.4 |
| 10 | 11.8 | 7.0 |
| 11 | 6.7 | 4.0 |
| 12 | 2.1 | 1.2 |

Duct diameters upstream from flow disturbance (A): 2.25 Limit: 0.5
 Duct diameters downstream from flow disturbance (B): 1.0 Limit: 2.0

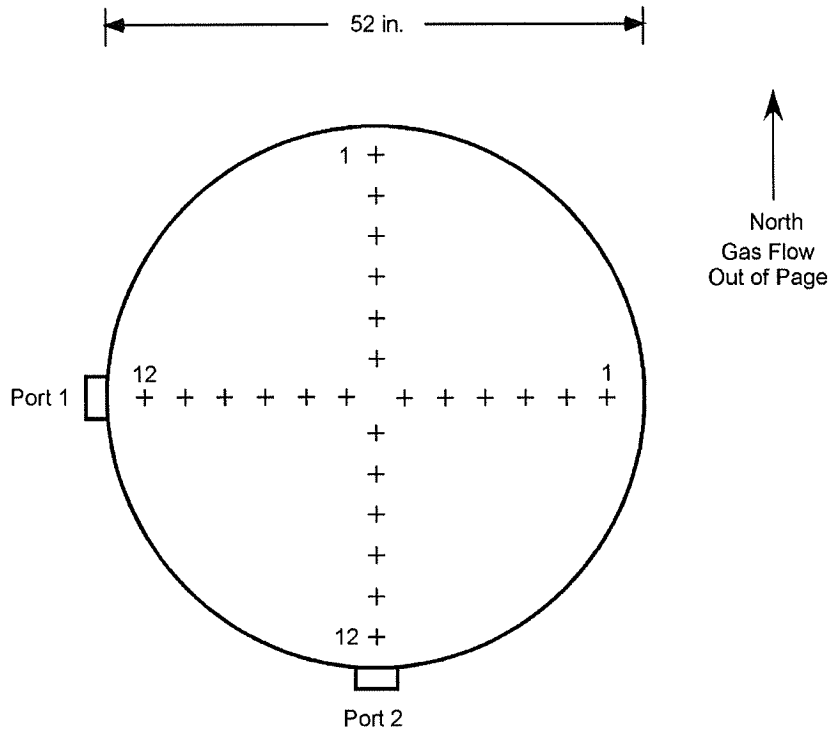
**Figure 3-4:
 SVK-8 Inlet Sample Point Layout (EPA Method 1)**



| 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): 0.33 Limit: 0.5
 Duct diameters downstream from flow disturbance (B): 0.70 Limit: 2.0

**Figure 3-5:
 SVK-8 Outlet Sample Point Layout (EPA Method 1)**



| Sampling Point | % of Stack Diameter | Port to Point Distance (inches) |
|----------------|---------------------|---------------------------------|
| 1 | 97.9 | 50.9 |
| 2 | 93.3 | 48.5 |
| 3 | 88.2 | 45.9 |
| 4 | 82.3 | 42.8 |
| 5 | 75.0 | 39.0 |
| 6 | 64.4 | 33.5 |
| 7 | 35.6 | 18.5 |
| 8 | 25.0 | 13.0 |
| 9 | 17.7 | 9.2 |
| 10 | 11.8 | 6.1 |
| 11 | 6.7 | 3.5 |
| 12 | 2.1 | 1.1 |

Duct diameters upstream from flow disturbance (A): 2.25 Limit: 0.5
 Duct diameters downstream from flow disturbance (B): 0.58 Limit: 2.0

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 3A | "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)" |
| 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" |

METHODOLOGY DISCUSSION

Volumetric Flow Determination – USEPA Methods 1-4

EPA Methods 1 through 4 of 40 CFR 60, Appendix A, were used to measure the flue gas volumetric flow. These methods determined several characteristics of the flue gas stream: velocity, moisture, flow rate and the concentrations of oxygen (O₂) and carbon dioxide (CO₂).

As part of the test program, CleanAir collected an integrated gas sample in a flexible bag for the first test run. It was determined that ambient conditions were present (O₂ = 20.9% and CO₂ = 0%). Due to the ambient nature of each source, no other gas samples were collected.

TOTAL CHROMIUM – USEPA METHOD 306

Isokinetic sampling was conducted using a glass-lined Method 5 probe (unheated) that extracted flue gas into a glass impinger-train (to eliminate contamination), and housed an alkaline solution containing 0.1 N NaOH. Samples were recovered using an alkaline solution and transported to a laboratory for analysis using ICP-MS.

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